

Annexure-I

(21 Pages)

Present Activities undertaken by the Institute

As per the mandate of the Institution the programs and activities are divided into the following major areas:

- Faculty and Staff Development
 - Short Term Programs
 - PG Programs
 - Doctoral Programs (Ph.D.)
- Curriculum Development
- Instructional Material Development
- Research and Development
- Extension Services and Consultancy

Brief account of the activities undertaken by the Institute during the last five years is given below:

Faculty and Staff Development : Faculty and staff development programs are

Short Term Programs : Training Programs in pedagogy and engineering and management areas.

PG Programs : Master of Engineering Programs in Engineering Education, Mechanical Engineering, (Manufacturing Technology), Civil Engineering (Construction Technology and Management), Computer Science and Engineering, Electrical Engineering (Instrumentation and Control) and Electronics and Communication Engineering . For all these programs the Institute is affiliated to Punjab University Chandigarh).

Doctoral Programs (Ph.D.) : Institute is Research Centre of Punjab University Chandigarh and Punjab Technical University Jalandhar for Doctoral Research.

Institute is QIP Centre of AICTE for Master of Engineering Programs and Ph.D. programs for Polytechnic and Engineering College faculty.

(A) Short Term Courses

The Institute undertakes approx. 250-300 Short Term Courses (need based and customized)per year pertaining training to Approx. 15000 faculty from Technical Institutes as well as Industry professionals. Following is the assessment of online/contact mode short term courses since 2010.

1. Assessment of online/contact mode short term courses since 2010

The data for the courses and participants since 2010 -11 is hereby given below.

| Year | No. of Short term courses for polytechnics | No. of Polytechnic faculty trained | No. of Short term courses for Engineering Colleges | No. of Engineering faculty trained | No. of ICT courses | No. of participants trained in ICT courses |
|---------|--|------------------------------------|--|------------------------------------|--------------------|--|
| 2010-11 | 140 | 1697 | 93 | 1474 | -- | -- |
| 2011-12 | 150 | 2105 | 93 | 1612 | -- | -- |
| 2012-13 | 133 | 4724 | 92 | 1344 | 107 | 4611 |
| 2013-14 | 183 | 2751 | 120 | 1731 | 65 | 9283 |
| 2014-15 | 202 (Poly+Engg) | 3136 | --- | --- | 66 | 10910 |
| 2015-16 | 200 (Poly+Engg) | 3566 | | | 68 | 14453 |
| 2016-17 | 200 (Poly+Engg) | 3297 | | | 53 | 13707 |
| 2017-18 | 187 | 2670 | --- | --- | 55 | 11266 |
| 2018-19 | 238 | 4456 | | | 85 | 13658 *** |
| 2019-20 | 241 | 4437 | | | 62 | 7463 *** |

*** MOOCs courses:

- **In 2018-19, Institute launched 4 SWAYAM MOOC Courses in Graphics and Animation Development, Self Learning Material Development, Curriculum Implementation and Evaluation, Research in Technical Education. Also The institute is one of the 75 NRCs declared by MHRD, New Delhi and conducted one ARPIT Course on Real Time Power System Analysis and Smart Grid**

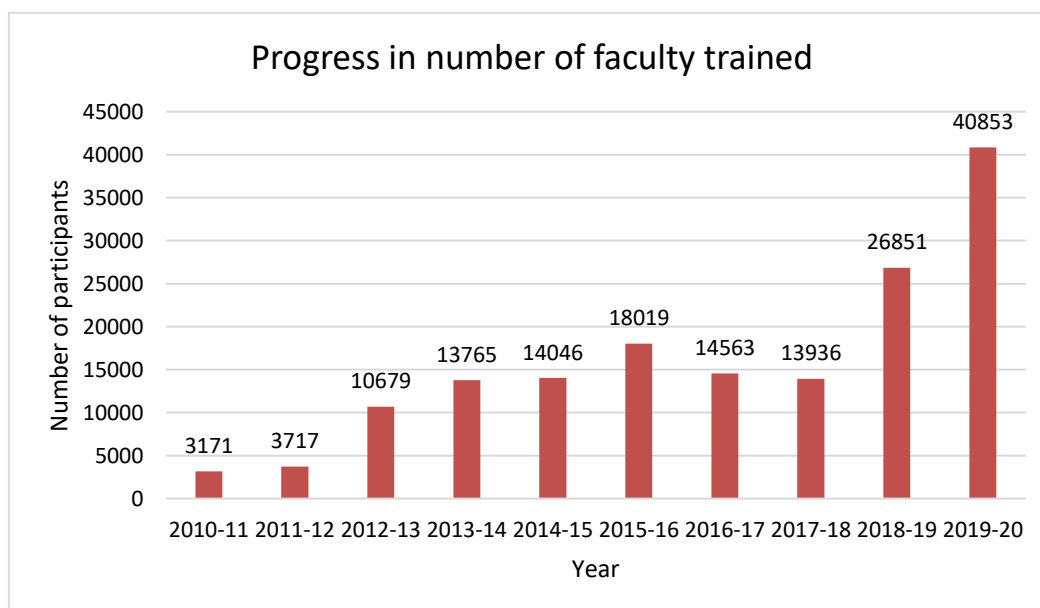
In 2018-19: No. of participants in MOOCs Swayam + ARPIT (2367+1278+748+901+3443) = 8737

- Institute developed and launched 3 AICTE-NITTT Modules in 2019-20:
 - Creative problem solving
 - Innovation, and Meaningful R & D
 - Institutional Management and Administrative Procedure and Communication Skills
 - Modes and Knowledge Dissemination

In 2019-20: 8342 (ARPIT Course)+ AICTE NITTT(9499+3763+2760) + SWAYAM Rerun Courses(1203+ 1897+1489)= 28953

Summary of the courses

| Year | No. of Short term courses | No. of faculty trained |
|---------|---------------------------|------------------------|
| 2010-11 | 233 | 3171 |
| 2011-12 | 243 | 3717 |
| 2012-13 | 332 | 10679 |
| 2013-14 | 368 | 13765 |
| 2014-15 | 268 | 14046 |
| 2015-16 | 268 | 18019 |
| 2016-17 | 253 | 17004 |
| 2017-18 | 242 | 13936 |
| 2018-19 | 223 | 26851 |
| 2019-20 | 303 | 40853 |



Analysis of online Short term courses from April-June, 2020 (Covid-19 Period)

The entire world is facing tough situation right after the identification of Coronavirus in Wuhan, China. With the wide-spread cases throughout the world, Covid-19 was announced as a pandemic by WHO in the month of March, 2020. Several countries announced lockdown for varied time to control the spread of this virus.

Considering its impact on Indian society, people were forced to stay indoors. At one side where it hampered business operations, the education sector was also affected to a considerable level. The teaching learning practices got disturbed and interrupted at all levels. In order to address the concerns, NITTTR Chandigarh took an initiative to help enthusiasts in the technical education sector to uplift their knowledge and skills amid pandemic effect. As it was not feasible to organize contact mode courses, NITTTR, Chandigarh took immediate action to organize online training programmes during lockdown period.

108 courses were conducted during April to June, 2020 and 27769 technical teachers participated in those programs from different corners of the country.

Few relevant details of these courses along with the stats are given in the following table:

Table 1: Department-wise courses conducted in the month of April, May and June 2020

| Department | April | May | June | Total |
|---|--------------|------------|-------------|--------------|
| Applied Science | 3 | 5 | 4 | 12 |
| Civil Engineering | 1 | 3 | 3 | 7 |
| Computer Science and Engineering | 7 | 9 | 5 | 21 |
| Curriculum Development Centre | 4 | 5 | 2 | 11 |
| Education and Educational Management | 1 | 4 | 1 | 6 |
| Electrical Engineering | 2 | 3 | 4 | 9 |
| Electronics and Communication Engineering | 3 | 4 | 2 | 9 |
| Entrepreneurship Development and | 3 | 4 | 4 | 11 |

| | | | | |
|-------------------------|----|----|----|-----|
| Industrial Coordination | | | | |
| Mechanical Engineering | 3 | 6 | 5 | 14 |
| Media Engineering | -- | 1 | -- | 1 |
| Rural Development | 2 | 2 | 1 | 5 |
| Total | 29 | 46 | 33 | 108 |

The stats about number of participants who attended these courses from polytechnic and engineering colleges are given in the following table:

Table 2: Number of participants trained from Polytechnic Colleges

| Departments | April | May | June | Total |
|--|--------------|------------|-------------|--------------|
| Applied Science | 140 | 246 | 187 | 617 |
| Civil Engineering | 40 | 244 | 116 | 517 |
| Computer Science and Engineering | 330 | 416 | 353 | 1208 |
| Curriculum Development Centre | 113 | 411 | 495 | 1019 |
| Education and Educational Management | 169 | 803 | 249 | 1461 |
| Electrical Engineering | 149 | 221 | 287 | 657 |
| Electronics and Communication Engineering | 293 | 934 | 207 | 1627 |
| Entrepreneurship Development and Industrial Coordination | 87 | 212 | 417 | 891 |

| | | | | |
|------------------------|-------------|-------------|-------------|--------------|
| Mechanical Engineering | 273 | 619 | 2190 | 1846 |
| Media Engineering | 0 | 98 | 0 | 106 |
| Rural Development | 93 | 102 | 0 | 290 |
| Total | 1687 | 4306 | 3256 | 10583 |

Table 3: Number of participants trained from Engineering colleges

| Departments | April | May | June | Total |
|--------------------|--------------|-------------|-------------|--------------|
| App Sc | 408 | 505 | 222 | 1222 |
| CDC | 465 | 829 | 386 | 1680 |
| Civil Engineering | 76 | 320 | 81 | 533 |
| Comp Sc | 2026 | 1650 | 451 | 5197 |
| E & CE | 827 | 2231 | 274 | 3477 |
| EDIC | 116 | 244 | 131 | 583 |
| Elect Engg | 378 | 420 | 300 | 1098 |
| EMGT | 241 | 685 | 56 | 1040 |
| Mech Engg | 341 | 1703 | 374 | 2891 |
| Media Engg | 0 | 50 | 0 | 56 |
| Rural Dev | 165 | 122 | 0 | 322 |
| Total | 5043 | 8759 | 2275 | 17186 |

During these three months, we had participants from different states. Stats about those participants are provided below:

Table 4: State-wise Participation of Polytechnic Colleges

| States | April | May | June | Total |
|------------------|-------------|-------------|-------------|--------------|
| Chandigarh | 1 | 2 | 2 | 5 |
| Delhi | 35 | 82 | 87 | 204 |
| Haryana | 28 | 60 | 370 | 458 |
| Himachal Pradesh | 14 | 16 | 4 | 34 |
| Jammu & Kashmir | 3 | 6 | 3 | 12 |
| Punjab | 78 | 53 | 33 | 164 |
| Rajasthan | 163 | 350 | 111 | 624 |
| Uttarakhand | 5 | 2 | 3 | 10 |
| Uttar Pradesh | 254 | 417 | 225 | 895 |
| Others | 1106 | 3318 | 2418 | 8176 |
| Total | 1687 | 4306 | 3256 | 10583 |

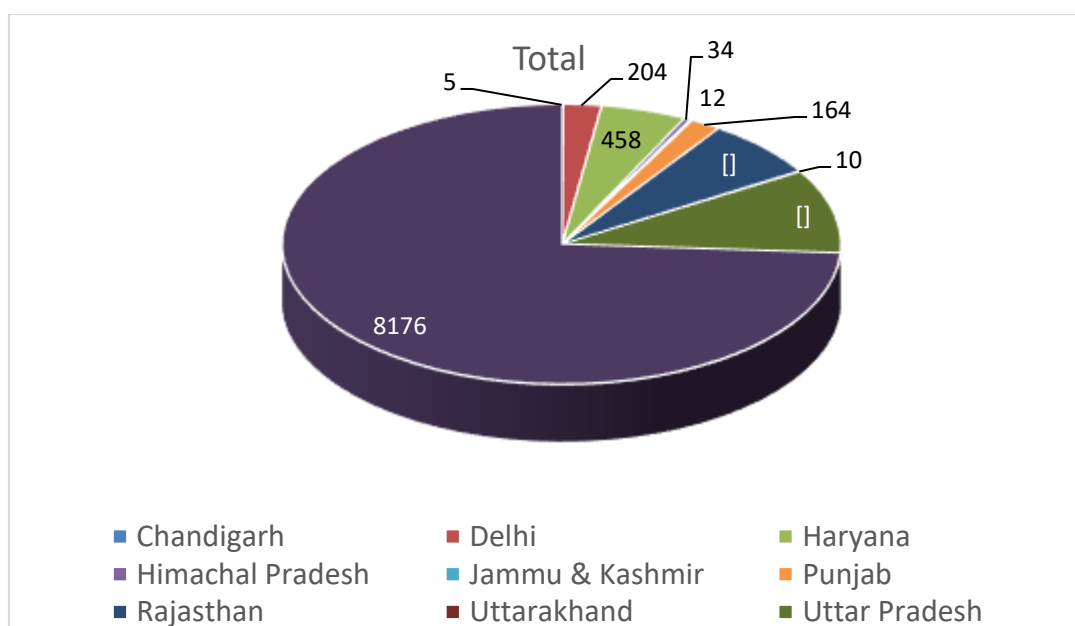


Figure 1: Pi-Chart representing participants from different states for Polytechnic Colleges in ICT

Table 5: State-wise Participation of Engineering Colleges

| States | April | May | June | Total |
|------------------|-------------|-------------|-------------|--------------|
| Chandigarh | 29 | 45 | 14 | 86 |
| Delhi | 78 | 126 | 70 | 280 |
| Haryana | 269 | 455 | 149 | 912 |
| Himachal Pradesh | 32 | 30 | 18 | 86 |
| Jammu & Kashmir | 33 | 57 | 8 | 103 |
| Panjab | 792 | 1040 | 232 | 2112 |
| Rajasthan | 144 | 434 | 83 | 686 |
| Uttarakhand | 55 | 85 | 24 | 180 |
| Uttar Pradesh | 341 | 841 | 228 | 1485 |
| Others | 3270 | 5646 | 1449 | 11256 |
| Total | 5043 | 8759 | 2275 | 17186 |

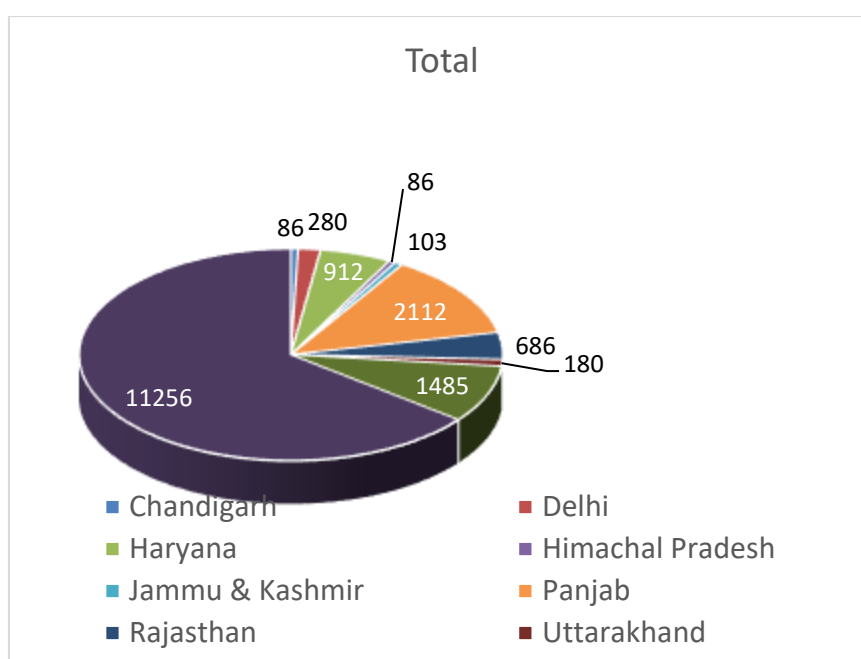


Figure 2: Pi-Chart representing participants from different states for Engg. Colleges in ICT

We have collected feedback from all course participants during these three months. Responses collected from participants are shown in the below Figure:

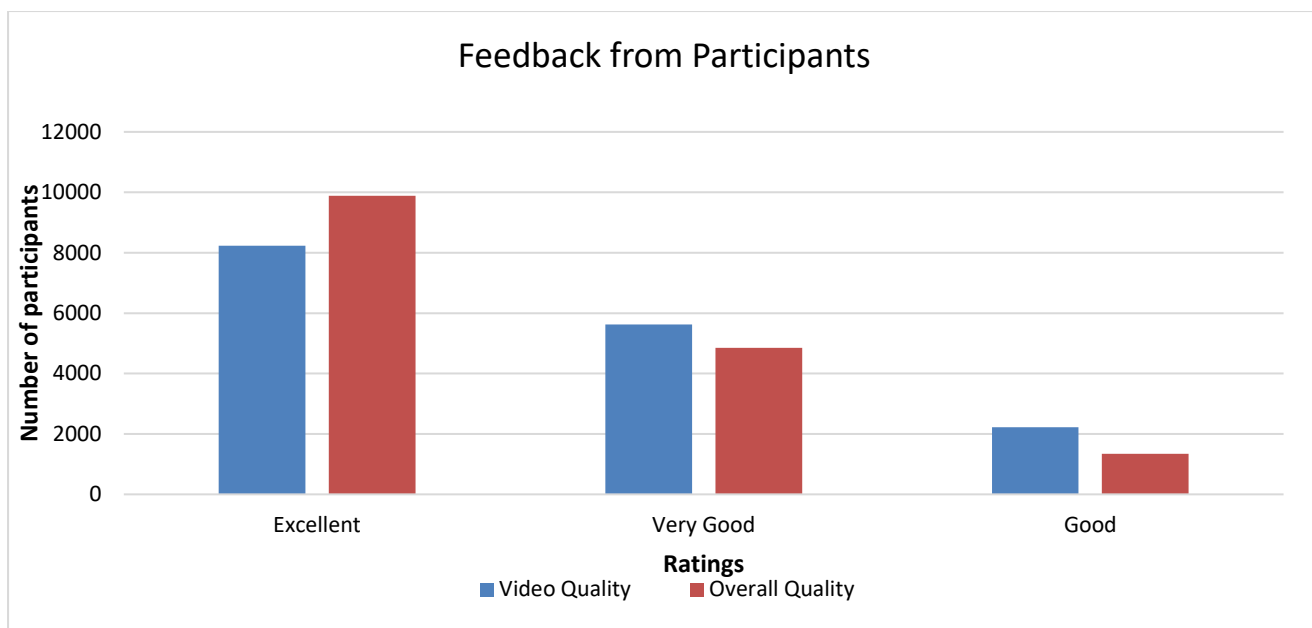


Figure 3: Bar graph representing feedback from participants

(B) Long Term Courses

The Institute already is offering PG Programmes in five Engineering disciplines:

1. Master of Engineering in Mechanical Engineering (Manufacturing Technology)
2. Master of Engineering in Civil Engineering (Construction Technology and Management)
3. Master of Engineering in Computer Science and Engineering
4. Master of Engineering in Electrical Engineering (Instrumentation and Control)
5. Master of Engineering in Electronics and Communication Engineering

No. of students Year wise (In Regular and Modular)

| Year | ME Mechanical Engg (Manufacturing Technology) | ME in Civil Engg(Construction Technology and Management) | ME in Computer Science and Engg | ME in Electrical Engineering(Instrumentation and Control) | ME in Electronics and Comm. Engg |
|---------|---|--|---------------------------------|---|----------------------------------|
| 2015-16 | 54 | 57 | 49 | 44 | 38 |
| 2016-17 | 34 | 64 | 30 | 35 | 30 |
| 2017-18 | 46 | 60 | 31 | 19 | 27 |
| 2018-19 | 17 | 41 | 14 | 19 | 12 |
| 2019-20 | 16 | 51 | 13 | 19 | 13 |

(C) Ph.D. Programs

The institute is Research Centre of Panjab University, Chandigarh and I K Gujral Punjab Technical University for Doctoral Research in Engineering and Technology.

NITTTTR Chandigarh is QIP Centre of AICTE for Master of Engineering Programs and PhD programs for Polytechnic and Engineering College faculty. Institute is the coordinator for QIP Polytechnic.

| Year | Ph.D Awarded |
|-------------|--|
| 2015-16 | <ol style="list-style-type: none">1. Seismic Efficiency of Interlinked Block Masonry System with Visco-Elastic Energy Dissipater Link.2. Investigations of Parameters for Surface Modification of Dies Using Edm Process.3. Studies on Metal Forming for Improved Surface Finish.4. An Experimental Study of Non-Traditional Machining of Al/SiC MMC's.5. Development of Optimal Controller for Maximum Power Point Tracking in Solar Photo - Voltaic System.6. Modelling, Multi Objective Optimization and Analysis of a Virtual Power Plant.7. Techno-Economic Analysis and Modelling of Stand-alone versus Grid connected Small Hydropower Systems for optimization of System performance and Cost Effectiveness.8. Design and Development of a Microcontroller Based Moisture Content Measuring Device for Cereal Grains Using their Electrical Properties. |
| 2016-17 | <ol style="list-style-type: none">1. Design and Development of a Microcontroller Based Moisture Content Measuring Device for Cereal Grains Using their Electrical Properties.2. Design and Development of a Temperature Compensated pH Monitoring/Control system for Process Industries. |
| 2017-18 | <ol style="list-style-type: none">1. Performance of Multiple-Axial-Groove Journal Bearings.2. Development of Geo-polymer Based Ferro-cement Panels under Flexural Loading.3. Performance Optimization of Cutting Tools with Multiple Nano Coatings.4. Performance Enhancement of Carbide Cutting Tools in Milling of Titanium Alloy. |
| 2018-19 | <ol style="list-style-type: none">1. Two-level Security Architecture for Virtual Machine Migration in Cloud Computing.2. Security Issues in Cloud Computing, Challenges and Solutions |
| 2019-20 | <ol style="list-style-type: none">1. Parametric Study of Metal Flow in Closed Die Forging2. Development of Proactive Non-Contact Condition Monitoring System for Rotating Machine-Elements.3. "Structural Performance of Densified Small Particles Based RC Joints"4. Hybrid Approach for privacy-preserving Multi-Keyword Ranked Search on Encrypted Cloud Data5. Development of Artificial Intelligence Based Real-Time Maximum Power Point Tracking Controller for a Hybrid Renewable Energy System6. Performance Analysis of a Surface EMG Based Control Scheme of an Exoskeleton Robot |

| |
|--|
| 7. Hybrid Control OF A Robotic Arm Using EEG And EMG Signals |
|--|

Curriculum Development: Institute caters to the curriculum development and revision needs of the technical Institutions/Boards of the northern region. Institute has expertise in developing curriculum for Outcome Based Education. The Curriculum developed/ revised by the Institute is aligned to NSQF.

| Year | No. of Curricula Designed | No. of Curricula Revised |
|---------|---------------------------|--------------------------|
| 2015-16 | 4 | 10 |
| 2016-17 | 17 | 3 |
| 2017-18 | 5 | 16 |
| 2018-19 | 11 | --- |
| 2019-20 | 02 | 02 |

Instructional Material Development : Institute develops “Print and Non-Print” Instructional Material in the form of Books, Laboratory Manuals, Educational Video Films, CAL packages. Institute Faculty works on development of MOOCs in their area of expertise.

| Year | Print Material | Non Print Material |
|---------|--|--|
| 2015-16 | <ul style="list-style-type: none"> • Text Books : 02 • Laboratory Manuals : 19 • Modules : 05 • Booklets/Readers : 03 • Course Material for Training Programmes : 200 | <ul style="list-style-type: none"> • Educational Video Films : 08 • Lecture based Video Films : 21 • E-content in Hindi for Electronics Subjects : 275 for Diploma Students of UP State • E-content in Hindi for Applied Mathematics : 96 for Diploma Students of UP State • Video Lectures uploaded on You Tube : 1038 |
| 2016-17 | <ul style="list-style-type: none"> • Text Books : 01 • Laboratory Manuals : 21 • Modules : 03 • Booklets/Readers : 12 • Course Material for Training Programmes : 200 | <ul style="list-style-type: none"> • Educational Video Films : 51 • Lecture based Video Films : 217 • CAI Packages : 02 • Video Lectures uploaded on You Tube : 1237 |
| 2017-18 | <ul style="list-style-type: none"> • Text Books: 03 • Laboratory Manuals: 05 • Modules: 04 • Readers: 04 • Course Material for Training Programs: 12 | <ul style="list-style-type: none"> • Educational Video Films : 16 • Lecture based Video Films/(NCTEL) : 73 • CAI Packages: 02 • Video Lectures uploaded on You Tube :73 |

| | | |
|---------|--|--|
| | <ul style="list-style-type: none"> Worksheets for Experiments: 25 | <ul style="list-style-type: none"> Video Films – MOOCs : 76 |
| 2018-19 | <ul style="list-style-type: none"> Text Books: 02 Laboratory Manuals: 05 Modules: 12 Readers : 01 Course Material for Training Programs: 05 | <ul style="list-style-type: none"> Educational Video Films : 120 Lecture based Video Films/(NCTEL): 122 Video Lectures uploaded on You Tube: 76 Video Films – MOOCs: 286 |
| 2019-20 | <ul style="list-style-type: none"> Text Books: 03 Laboratory Manuals: 02 Modules: 22 Course Materials: 36 | <ul style="list-style-type: none"> Educational Video Films: 31 Lecture based Video Films/(NCTEL): 47 Video Lectures uploaded on You Tube: 74 Video Films – MOOCs: 51 |

Research and Development: Research and development activities in technology and technical education form an important aspect of the NITTTR's programmes. During the last five years institute faculty has published a handsome number of publications in international/national journals and conferences.

| Year | Research Publications in International Journals | Research Publications in National Journals | Publications in National/International Conferences |
|---------|---|--|--|
| 2015-16 | 134 | 18 | 73 |
| 2016-17 | 139 | 20 | 119 |
| 2017-18 | 125 | 37 | 119 |
| 2018-19 | 191 | 3 | 55 |
| 2019-20 | 232 | --- | 44 |

Last Five-Year publications data, citations, h-index is shown in the following graphics:

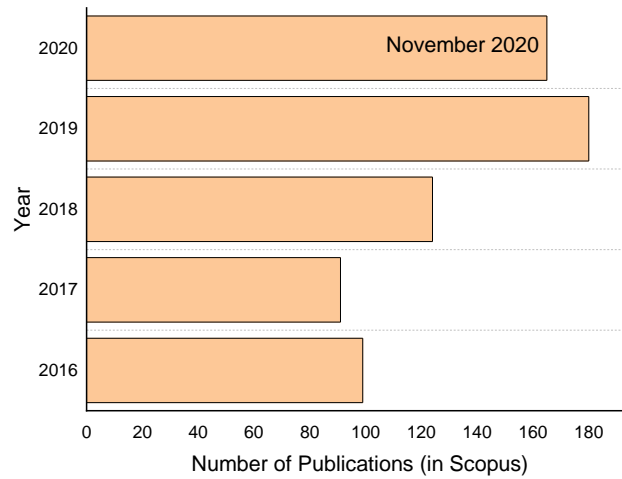


Figure 4: Number of publications (in Scopus)

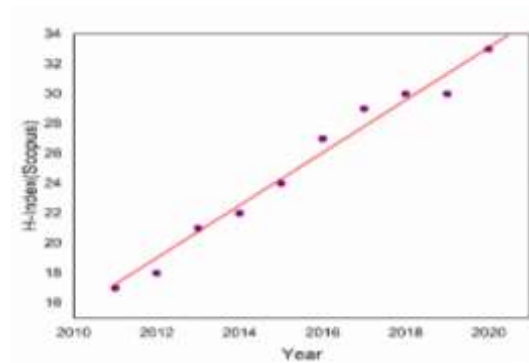


Figure 5: Graph of H Index

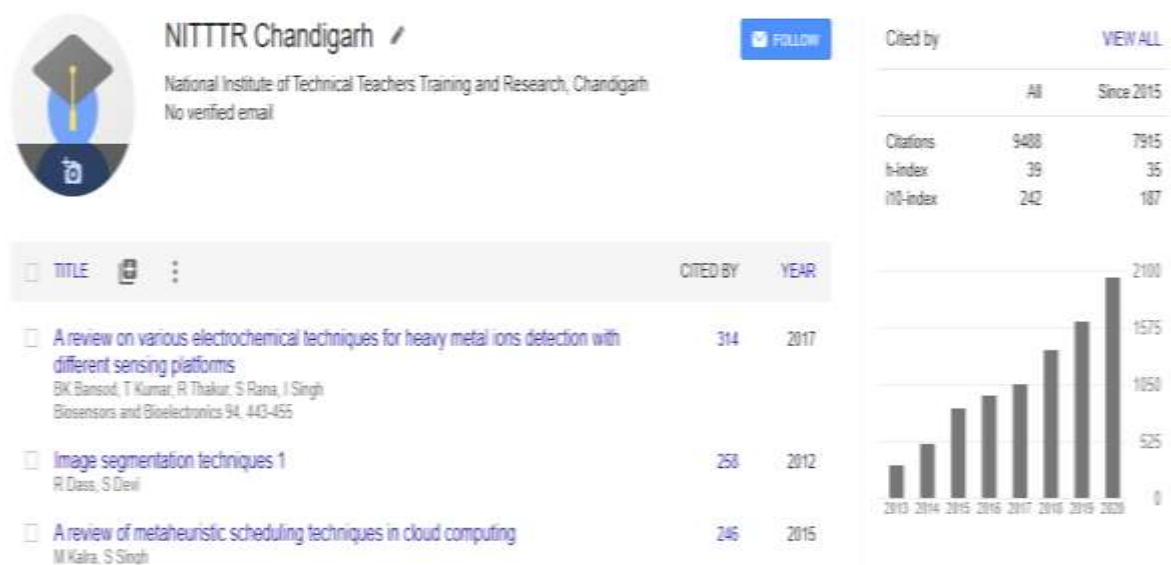


Figure 7: Google Scholar Index

Extension Services and Consultancy:

The Institute has a vibrant consultancy culture. In line with its mandate as a leading resource Institute for offering support to the technical education sector in the country various departments are offering their service to the clientele system.

Among the Engineering Departments, Civil Engineering is offering testing and consultancy services to a large number of clients ranging from government sector, private sector including builders, industry etc, in the areas of concrete mix designs, testing of materials, geotechnical investigations, structural design and testing, water testing , design, testing and quality control of roads etc. Besides Civil Engineering, other engineering departments also have a fledgling engineering design and testing consultancy. All of them are also offering consultancy in terms of training and guidance to teachers as well as students, contributing substantially to the IRG.

Non Engineering departments also have a good consultancy and outreach program. While curriculum design department, with the support of engineering departments, has been a pioneer in design and modification of curriculum of polytechnics in various states as well as in design of NSQF aligned curriculum. The rural development department also has outreach programs through which they aim to make a difference in life of rural areas.

The Institute has also developed a competence in conduct of recruitment for various agencies including government sector, semi government organizations and autonomous systems.

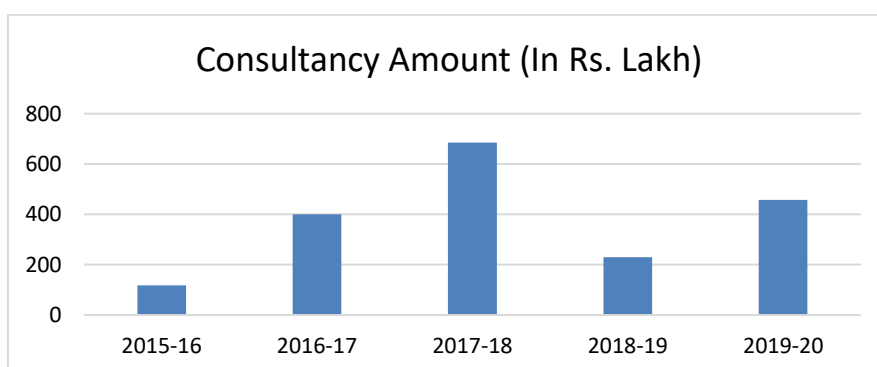


Figure 8: Consultancy earnings over the last five years.

The faculty of the Institute provides extension services to MoE, AICTE, NBA and other Government organizations. The technical Institutions are guided to setup laboratories, Preparing for Accreditation etc.

| Year | Extension and Consultancy Projects |
|---------|--|
| 2015-16 | <ol style="list-style-type: none">1. Policy Planning and Service to Industry and Community2. Implementation of Government of India Schemes such as Community Development through Polytechnics and Integrating Persons with Disabilities (PWDs) in the Mainstream of Technical and Vocational Education3. Design and Testing Services to Industry in various areas of Civil Engineering4. Testing Services to Industry in the area of Electrical Engineering5. Smart Training Centre for Vocational Training of PWDs with collaboration of Sarthak Educational Trust, New Delhi and Tech Mahindra Foundation. |

| | |
|---------|--|
| | <ol style="list-style-type: none"> 6. Training the Trainers of Technical School in Nigeria in Electrical Installation and Maintenance Work. 7. Development of Materials on Energy Conservation for its incorporation in the ITI and Diploma Engineering Curriculum for the State of Punjab (PEDA). 8. Revising the Curriculum of Certificate Programme in Electrical Installation and Maintenance Works for Skipper Electrical India Ltd., Gurgaon (HRY). 9. Training Programme on Developing Soft Skills for Effective Work Environment for the officials of Airport Authority of India (Chandigarh). 10. Seven recruitment projects for the state of Haryana, Punjab and Chandigarh |
| 2016-17 | <ol style="list-style-type: none"> 1. Design and Testing Services to Industry in various areas of Civil Engineering 2. Testing Services to Industry in the area of Electrical Engineering 3. Testing Services to Industry in the area of Electronics and Communication Engineering 4. Development of study material in Electrical Installation and Maintenance Works for Skipper Electrical India Ltd., Gurgaon (HRY). 5. 04 Training Programme were conducted by EMGT Department namely Personal Development, Effective Teaching, Induction Training Programme for Newly Recruited Teachers and Instructional Delivery. 6. Analysed the existing model curricula of 08 diploma programmes. 7. Bio-gas plant project was made operational during the year by Rural Development Department |
| 2017-18 | <ol style="list-style-type: none"> 1. Design and Testing Services to Industry in various areas of Civil Engineering 2. Testing Services to Industry in the area of Electrical Engineering 3. Testing Services to Industry in the area of Electronics and Communication Engineering 4. 03 Training Programs were conducted by EMGT Department namely Induction Training Program, Research Methodology and Training for Newly Recruited Junior Engineers. 5. Analysed the Existing Model Curricula for Diploma Programs (NSQF aligned). |
| 2018-19 | <ol style="list-style-type: none"> 1. Evaluation of Learning Materials (English, Physics, Chemistry and Mathematics) 2. Testing of Materials, Design, Quality Control 3. Training Need Analysis (TNA) for teachers of State Council of Odisha 4. Developing of Curriculum for Polytechnics and Engineering College for the State of HP 5. Energy Efficient Solar PV Shade for e-benches in Parks 6. Documentary Film on Haryana Directorate 7. Conduct of recruitment tests for Punjab government on 08-04-2018 8. Punjab Government Recruitment Test on 14-10-2018 9. Recruitment Test for PUDA, Mohali 10. Recruitment Test for MILKFED, Punjab 11. Recruitment Test of JBT Teachers for Chandigarh Administration on 27-01-2019 12. Entrance examination for Sri Mata Vaishno Devi University Jammu 13. Recruitment Test for JBT under Samagra Shiksha Abhiyan, Chd. Adm |

| | |
|---------|---|
| | 14. Third Party Audit Inspection and Stability of Buildings |
| 2019-20 | 1. Recruitment Project from Various Organizations |

Extension Services:

The Institute has continued to play a proactive role to influence the planning and development of technical education and also collaborated with institutions and organisations at national and international levels having similar objectives. The institute also provided extension services to government, public sector and other national and state level organisations, technical education system and industry in the area of engineering and technology, educational management, curriculum development, entrepreneurship development and rural development.

- Video programmes prepared for EMPC, IGNOU, New Delhi for daily transmission of these programmes in TECH ED Vision on GyanDarshanVigyan Channel
- Mechanical Engineering Department provided its services to technical institutions and other organizations in conduct of aptitude test for recruitment of faculty/executives
- Key Note Addresses at Conferences
- Expert Lectures at Universities, Engineering Colleges, Polytechnics

Implementation of Government of India Schemes

The Department of Rural Development of the institute provides academic support to MSDE, MoE (erstwhile MHRD), Government of India and all DTEs in the northern region for effective implementation of schemes of Government of India on

- (i) Community Development Through Polytechnics (CDTPs) in 155 polytechnics in Northern region

Village Fair Organised at Kharak Jatan, Distt. Rohtak
on 26-11-2016



CDTP Scheme - Sponsored by Govt. of India
Co-ordinated by : C.R. Polytechnic, Rohtak



- (ii) Integrating Persons with Disabilities (PWDs) in the mainstream of Technical and Vocational Education in 15 polytechnics/institutions in Northern region
- (iii) Unnat Bharat Abhiyan for 80 Higher education Institutions in Punjab and Chandigarh. Survey of five villages in district Ropar has been conducted and their needs has been identified for technology interventions and capacity building. Workshops has been organised for orientation regarding strategies for implementing Unnat Bharat Abhiyan Project.




उन्नत भारत अभियान 2.0
Unnat Bharat Abhiyan 2.0
Regional Workshop on
"Review and Orientation on Unnat Bharat Abhiyan"
(For Participating Institutes of North West Region)
27th March, 2019
Venue : Institute Auditorium
Sponsored By -
Ministry of Human Resource Development, Govt. of India
Organized By
IIT Delhi (National Coordinating Institute) of USA
NITTR, Sector26, Chandigarh
Chandigarh Regional office, AICTE & UGC



- The department acts as an effective link between MSDE, MoE and polytechnics, higher education institutions implementing these schemes.
- The department operationalized Disability Information Line (DIL) for Punjab Telecom Circle. The DIL is a sponsored project of Ali Yavar Jung National Institute for the Hearing Handicapped (AYJHNIHH), Mumbai.



- The institute has been providing extension services for the PWDs for the past 15 years through the Scheme for Integrating Persons with Disabilities in the Mainstream of Technical and Vocational Education. In recognition of the exemplary work done by the institute for the empowerment of the PWDs, the institute was conferred the **National Award for the Empowerment of the PWDs by the Hon'ble President of India on 3.12.2013**





- Special Job Fairs organized for Persons with Disabilities organised every year
- Organized 4th National Abilympics– Vocational Skill Contest , 34 Skills contest, 414 contestants, for Persons with Disability, in collaboration with NAAI, Delhi 3-5 November,2014

The institute has faculty equipped with rich experience and expertise in providing extension services for development of technical education and rural development. It is envisaged that in future the extension services will be expanded to international level for development of community through identification of requirements at grassroot level, facilitating need based capacity building programs, technology interventions for smart green villages, promoting training of persons with disabilities, digital resources for information dissemination, curriculum development for skill development and technical training programs, upgradation of laboratories in technical institutions, facilitating effective teaching learning processes in the higher education institutions.

Operational Plan (Activities Calendar) 2020-2021



**NATIONAL INSTITUTE OF TECHNICAL TEACHERS
TRAINING & RESEARCH
SECTOR-26, CHANDIGARH-160019, INDIA
www.nitttrchd.ac.in
ISO 9001 : 2015 CERTIFIED**

Vision

To be a lead resource institute for promoting excellence in technical education system.

Mission

- *To offer continuing education and training programs for the faculty and staff of technical education system.*
- *To develop need-based curricula for technical education programs.*
- *To develop instructional material to enhance effectiveness of teaching-learning process*
- *To undertake research and development in engineering & technology and technical education*
- *To provide extension and consultancy services to technical education system*

QUALITY POLICY

Institute is committed to provide high quality and customized education, training, research and development and extension services to technical and vocational education system, industry and community. The institute shall develop leadership in technical teachers' training and provide educational products and services to enable the technical education system to achieve excellence internationally.

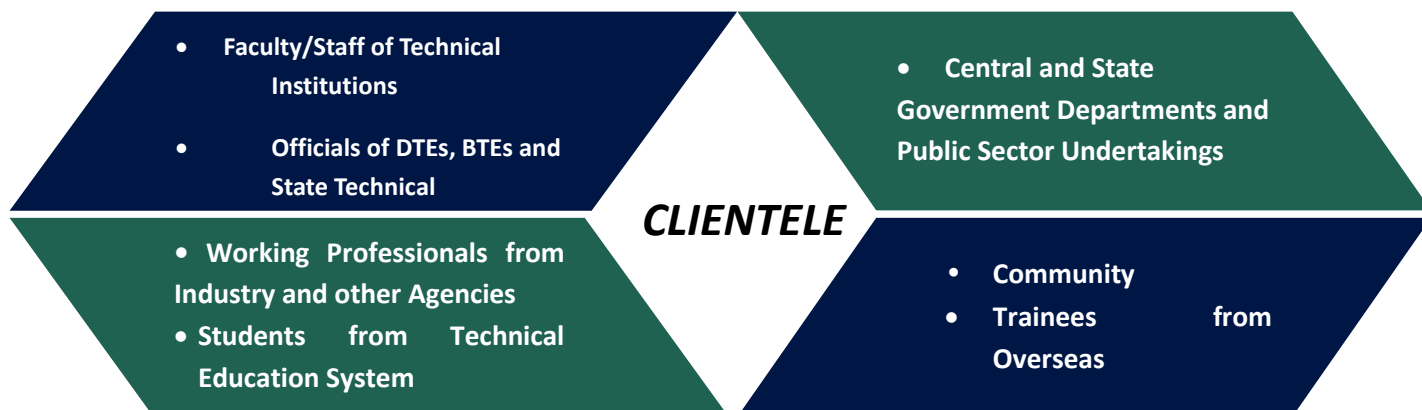
& Core Values Objectives of the Institute

Core Values

- **Quality:** *Focusing on standards of performance and continuous improvement.*
- **Professionalism:** *Demonstrating desired level of performance with prescribed standards of ethical behaviour, intellectual honesty and professional conduct.*
- **Accountability:** *Owning responsibility for academic work.*
- **Creativity and Innovation:** *Promoting and encouraging creativity.*
- **Collaboration:** *Encouraging and supporting networking, within and outside the Institute at national and international level.*
- **Transparency:** *Ensuring transparency in policies, rules and regulations and working.*

Objectives

- **To provide** *professional education and training for teachers of engineering and technology disciplines in technical institutions for advancement of learning towards promoting excellence in technical education and industry.*
 - **To strive** *for continuous improvement in instruction and research in engineering and technology disciplines and research in management of technical education.*
 - **To actively** *support the growth and quality improvement of technical education in the country through involvement in activities at national and state levels.*



INSTRUCTIONS TO THE PARTICIPANTS

1. The institute has planned training programmes out of which some are in contact/physical presence mode and some in ICT mode.
 - For programmes in ICT mode, technical institutions anywhere in India can join the course by virtue of being a remote centre. The remote centre is connected via 'Google Meet' at its own location.
 - For ICT mode programmes participants can join at NITTTR, Chandigarh also.
2. The courses are for all states all over India.
3. Programmes marked "National" implies that Faculty from any state/UT in India can join.
4. Faculty from Engineering Colleges/Polytechnics and Technical Institutions can participate in the Programmes. In addition, technical/academic staff can also join the programme in the relevant area.
5. Faculty from Engineering Colleges/Polytechnics shall have to be sponsored by their employer. An advance application may be made to facilitate the admission. However, all such applicants will have to submit proof of sponsorship at the time of joining the programme.
6. All applicants are advised to ensure confirmation of their admission to the course before joining.
7. Though no deviation is generally made in the schedule, applicants are advised to keep a track on website when the scheduled dates are approaching.
8. For any clarification participants/Sponsors may write to concerned co-ordinator at first instance, if needed write to imco@nitttrchd.ac.in (Attention Prof. Maitreyee Dutta/Prof. K.G. Srinivasa/Prof. S S Gill)
9. For programmes at training hubs e.g. Bhubaneswar, Coimbatore, Faridabad, etc. faculty from northern region and also from other states can participate. (As the programmes are national level)
10. For clustered programme, the communication can be done with any one of the coordinators mentioned.

COURSE FEE, BOARDING AND LODGING

FOR FOR CONTACT/PHYSICAL PRESENCE COURSE:

A. For Programmes at NITTTR, Chandigarh:

A.1 Participants from Government and Government Aided Polytechnics/Engineering Colleges/Universities:

a) Travelling Allowance:

- Limited to 2nd AC for Professor/Principal/Principal-Incharge/ Director/ Director-Incharge. - Limited to 3rd AC/AC Chair Car/ Govt. Volvo Bus for others.

Note: Fare will be reimbursed on providing proof of to and fro travel.

b) Boarding / Lodging:

- Transit DA will be permissible as per institute rules. However, free boarding and lodging will be provided by the institute. There will be no financial liability on the institute if the participants do not stay in accommodation provided by NITTTR and makes his/her own arrangement outside. No DA will be permissible for the duration of course.

c) Local Conveyance:

- Limited to Rs. 200/- at all places including inward and outward local journeys. Local journeys will include residence or place of work to the point of boarding transport, Chandigarh railway station/bus stand/ airport to NITTTR campus, NITTTR to point of boarding transport at Chandigarh and return local journey at the place of posting of the participants. The payment shall be made without submission of bills. If a course participant spends more than Rs. 200/- on local conveyance at different destinations, he/she shall be reimbursed actual expenditure as per local conveyance reimbursement rules of Govt. of India. Such reimbursements shall be processed on submission of genuine printed bills for local conveyance. Participants from other local institutes at Chandigarh, Mohali and Panchkula shall be reimbursed Rs. 100/- per day on account of local conveyance (Rs. 50/- for coming to NITTTR Chandigarh and Rs. 50/- for going back to his/her place of posting or residence) without any local conveyance bill.

d) Course Fee:

- In general, no course fee is charged. However, for some specialized programme, course fee may be charged. Participants are requested to see the details.

A.2 Participants from Self -financing Polytechnics/Engineering Colleges/Universities:

a) Travelling Allowance:

- Not permissible.

b) Boarding / Lodging:

- Free boarding and lodging will be provided by the institute. There will be no financial liability of the institute for participants staying outside on their own.

c) Local Conveyance:

- Not permissible.

d) Course Fee:

- No course fee will be charged. However, for some specialized programme, course fee may be charged. Participants are requested to see the details.

NOTE:

1. Family accommodation will not be provided at the institute to the participants during short term courses.
2. Food/Mess is compulsory for all the residents availing hostel facilities.
3. Participants of STC seeking Guest House accommodation shall be charged Rs. 1000/- per day per room during the course duration.

B. For Programmes at Government and Government Aided Polytechnics/Engineering Colleges/Universities:

B.1 Participants from Government and Government Aided Polytechnics/Engineering Colleges/Universities:

a) Travelling Allowance:

- Limited to 2nd AC for Professor/Principal/Principal-Incharge/ Director/ Director-Incharge. - Limited to 3rd AC/AC Chair Car/ Govt. Volvo Bus for others.

Note: Fare will be reimbursed on providing proof of to and fro travel.

b) Boarding / Lodging:

- Transit DA will be permissible to outstation course participants as per institute rules. No DA will be permissible to the course participants for the duration of the course. The coordinating host institute will make all efforts to provide free lodging otherwise free boarding and lodging will be arranged by the institute, preferably in the Guest House, Hostel, Rest House and Circuit House etc. If such arrangement is not possible, then on confirmation, accommodation can be arranged at some other place subject to availability of budget with a maximum limit of Rs. 600/- per day per person at Y and Z category stations and Rs. 900/- per day per person at X category stations on production of bills.

- Participants staying in hotel/guest house away from the host institute shall be reimbursed local conveyance @ Rs. 100/- per day (Rs. 50/-) for coming to the host institute and Rs. 50/- for going back from the host (institute) without submission of bills.
- Expenditure on account of two times tea and working lunch shall be restricted to Rs. 125/- per day per participant. Out station participants shall be reimbursed tea, breakfast and dinner bill against actual bills subject to a maximum of Rs. 125/- per day per person.

c) Local Conveyance:

- Limited to Rs. 200/- at all places without production of bills (once separately for inward and outward journey). No local mileage shall be payable to the participants from the host institute. If a course participant spends more than Rs. 200/- on local conveyance at different destinations, he/she shall be reimbursed actual expenditure as per local conveyance reimbursement rules of Govt. of India. Such reimbursements shall be processed on submission of genuine printed bills for local conveyance. Participants from other local institute may be reimbursed Rs.100/- per day (Rs. 50/- for coming to the host institute and Rs. 50/- for going back from host institute to place of posting/residence) without any local conveyance bill.

d) Course Fee:

- No course fee is charged. However, for some specialized programme, course fee may be charged. Participants are requested to see the details.

B.2 Participants from Self-financing Polytechnics/Engineering Colleges/Universities:

a) Travelling Allowance:

- Not permissible.

b) Boarding / Lodging:

- Not permissible. However, working lunch and two times tea during the course will be provided.

c) Local Conveyance:

- Not permissible.

d) Course Fee:

- No course fee is charged. However, for some specialized programme, course fee may be charged. Participants are requested to see the details.

B.3 Inaugural/Valedictory: Rs. 25/- per person for inaugural session and Rs. 25/- per person for valedictory session respectively.

B.4 Honorarium to local Coordinator Rs. 2500/- and Payment to supporting Staff Rs. 1500/-

C. For Programmes at Self-financing Institutions / Private Universities (on request):

C.1 Training Programmes for faculty / Staff

- **Course Fee:**
 - i. For 4 or 5 days programme: Rs 1.0 lac will be charged as course fee for upto 20 participants. In case, no. of participants increases beyond 20, additional fee @ Rs. 2,500 per participant will be charged.
 - ii. For 3 day programme: Rs 75,000/- will be charged as course fee for upto 20 participants. In case, no. of participants increases beyond 20, additional fee @ Rs. 2,000 per participant will be charged.
 - iii. For 2 day programme: Rs 50,000/- will be charged as course fee for upto 20 participants. In case, no. of participants increases beyond 20, additional fee @ Rs. 2,000 per participant will be charged.
 - iv. For 1 day programme: Rs 30,000/- will be charged as course fee for upto 20 participants. In case, no. of participants increases beyond 20, additional fee @ Rs. 1,500 per participant will be charged.
 - v. The course fee and other charges for conducting the training programmes at Institutes / Universities covered under TEQIP-II will be as per the existing norms.
- TA/DA, Boarding and lodging facilities to experts and NITTTR faculty will be provided by NITTTR Chandigarh.
- Tea/coffee during sessions and other expenses like stationery, photocopy etc. will be borne by NITTTR Chandigarh.
- Service Tax at the prevailing rates will be extra.

D. Budget Provision for ICT Based Training Programmes

D.1 For Remote Centre at Universities/ Institutions (Govt. / Govt. Aided):

Broad guidelines for expenditure are as under:

- i. Working lunch @ Rs. 125/- per person and Tea with biscuits two times.
- ii. Inaugural and Valediction @ Rs. 25/- each per person (i.e. Rs. 50/- per person for both Inaugural and Valediction).
- iii. Honorarium to Local Co-ordinator Rs. 2500/- Payment to supporting staff Rs. 1500/-

If any participant (s) comes from other Government/Government Aided/Self-financing institute, to this remote centre the norms mentioned at Sr. No. B.1 and B.2 will be followed.

D.2 For Remote Centre at Self-financing Institutions/Universities:

- Only Rs. 4000/- (Rupees four thousand only) will be given to private institutions (Rs. 2500/- to local coordinator and Rs. 1500/- to staff).

E. Participants sponsored by TEQIP Institute(s):

1. Course fee @ Rs. 5000/- +GST per participant shall be charged from TEQIP institute for sponsoring its faculty in institutes O. Plan approved programmes. If a TEQIP institute requests for an exclusive programme, the course fee will be charged @ Rs. 7500/- +GST per participant subject to a minimum of Rs. 1.00 lac. Institute shall not pay any TA/DA to participants from TEQIP institutes and they can avail of boarding and lodging facilities on payment basis.

F. Programmes for Industry or participants from Industry:

F.1 Participants from Industry:

1. Participants from industry admitted in institute's approved/operational plan programmes shall be charged Course fee @ Rs. 5000/- per person plus service tax as applicable. TA/DA boarding and lodging will be borne by the sponsoring agency or the individual participant. This course fee is for a programme of upto 5 working days. Fraction of a week i.e. one, two three or four days would be considered as full week.

F.2 Programmes exclusively offered for Industry:

1. Course fee shall be charged @ Rs. 6000/- per person subject to minimum of Rs. 30,000/- per programme plus service tax as applicable for a duration upto 5 days. The course fee doesn't include boarding and lodging charges. Participants exceeding five shall be charged on pro-rata basis. No TA/DA shall be paid to participants by the institute. However, this course fee would include working lunch and two times tea. Accommodation and catering services, if required by the sponsoring organisation(s) or participants, shall be provided to the course participants on payment basis. The participants shall be charged room rent and catering charges as per rules of the institute (can be seen from the institute website).

ONLINE REGISTRATION THROUGH NITTR CHANDIGARH DIGITAL LEARNING SOURCE APP (NCDLS)

1. Institute has developed an interactive App for managing, automating all FDP/STC related processes, profiling of the faculty and making it completely paperless.
2. All participants are required to create their online account through one time registration.
3. After registration, participants can:
 - a. Manage/Update their profile
 - b. Apply for Training Programme/Short Term Courses/Faculty Development Programmes
 - c. View all the Trainings/Short Term Courses/Faculty Development Programmes they have applied and attended.
4. The participant has to upload their sponsorship letter
5. Confirmation to the participants will be sent by the programme coordinator
6. After successful completion of the course, participants can download completion certificate of Short Term Courses/Faculty Development Programmes.
7. All confirmed participants must report at 9:30 am on the starting day of the training programme.

Note: To activate online account, participants have to pay a nominal convenience fee of Rs. 150/- (Rupees One Hundred Fifty only) per year towards online profile/record management which covers Rs. 100 for the institute and Rs. 50 for the third party.

ADVANTAGES OF REGISTERING THROUGH APP

1. Get your own personalised professional profile to create your online identity and increase your profile visibility.
2. Access your course study materials from anywhere, anytime and on any device
3. Access digital library of 5000+ ebooks and videos on various subjects, streams and discipline such as science, technology, engineering, management, etc.
4. Find and connect with your peers, colleagues and expert faculties across institutions both nationally and internationally.
5. Share and discuss your learning and teaching experiences for enhancing education, skills and careers.
6. Get notified instantly from NITTR, Chandigarh, whenever a new course is available for you.
7. Stay updated with the latest educational news and events that interests you.

8. This app will help the faculty members to associate with the various industries approximately 2500 companies.
9. This app offers them 360 degree personalized guidance and appropriate resources and services for education, skills and careers.

Note: This can also be accessed from the web platform via the following URL:

www.ulektz.com/nitttrchd

GUIDELINES FOR SPONSORING

1. The training calendar of 2019-2020 will be uploaded in the institute website. The sponsoring agencies may plan in advance for sponsoring the faculty members/staff for the training programmes scheduled.
2. The sponsoring agencies may guide their faculty members to view the contents of the training programmes and accordingly plan out to attend the programmes.
3. The sponsoring agency should provide the sponsorship letter to their faculty members well in time so that they can upload their sponsorship letter in the institute website as mentioned above.
4. The institute created an App, NITTTR Chandigarh Digital Learning Source (NCDLS). The institute may guide their faculty members to register in the app so that they can get the regular notifications about training programmes periodically.
5. Any tailor made programme required for the sponsoring agency can be organized by NITTTR Chandigarh.
6. There is no course fee for faculty members of government institutes.
7. For self-financing institutes, the course fee will be charged only for special programmes.

ONLINE SKILL COURSES

1. The institute launched 11 online skill courses in collaboration with Ulektz Limited, Chennai.
2. You can access these courses vide <https://www.ulektz.com/spc/skillCourses>
3. Link also has been provided in institute website www.nitttrchd.ac.in
4. The participants can register for these courses by paying approximately Rs. 1100/-.

All the training programmes have been categorized as per the mandate of NITTTR Chandigarh:



The staff development programmes are sub-categorized into long term programmes and short term programmes. The institute offers industry-oriented and practice based master degree programmes (Regular and Modular mode) in five major areas such as:

Civil Engineering (Construction Technology and Management)

Computer Science and Engineering

Electrical Engineering (Instrumentation and Control)

Electronics and Communication Engineering

Mechanical Engineering (Manufacturing Technology)

Short term programmes in the respective departments are categorized:



TRAINING CALENDAR (2020-21)

1. STAFF DEVELOPMENT PROGRAMMES

1.1 LONG TERM PROGRAMMES:

| Sr. No. | O.Plan No. | Programme Title | Coordinating Dept. | Target Group | Schedule | Venue/ Remarks |
|---------------------------------------|------------|--|---|---|--|----------------|
| MASTER'S DEGREE (REGULAR MODE) | | | | | | |
| 1. | RMCT | Civil Engineering (Construction Technology & Management) | Civil Engineering | Faculty of Technical Institutions/ Industry Personnel/Fresh Graduates | Apr 2020 to Mar 2021 | NITTTR CHD |
| 2. | RCSE | Computer Science and Engineering | Computer Science & Engineering | | | |
| 3. | RMEI | Electrical Engineering (Instrumentation and Control) | Electrical Engineering | | | |
| 4. | RMEC | Electronics & Communication Engineering | Electronics & Communication Engineering | | | |
| 5. | RMMT | Mechanical Engineering (Manufacturing Technology) | Mechanical Engineering | | | |
| 6. | RCSEI OT | Computer Science and Engineering (Specialization in IoT) | Computer Science & Engineering | Fresh Graduates | Subject to approval from Panjab University | NITTTR CHD |
| 7. | RMEC AI | Electronics & Communication Engineering (Specialization in AI) | Electronics & Communication Engineering | | | |
| 8. | RMMR | Mechanical Engineering (Specialization in Robotics) | Mechanical Engineering | | | |
| MASTER'S DEGREE (MODULAR MODE) | | | | | | |
| 9. | MMCT | Civil Engineering (Construction Technology & Management) | Civil Engineering | Faculty of Technical Institutions | June-July and Dec.-Jan | NITTTR CHD |
| 10. | MCSE | Computer Science & Engineering | Computer Science & Engineering | Faculty of Technical Institutions/Working Professionals/ Graduates | July-Dec and Jan-June | |
| 11. | MMEI | Electrical Engineering (Instrumentation and Control) | Electrical Engineering | | | |
| 12. | MMEC | Electronics & Communication Engineering | Electronics & Communication Engineering | | | |
| 13. | MMMT | Mechanical Engineering (Manufacturing Technology) | Mechanical Engineering | | | |

1.2 SHORT TERM PROGRAMMES

A. (CONTACT MODE):

| Sr. No. | O.Plan No. | Category | Name of Programme | Start Date | End Date | Venue | Coordinator | Beneficiary State |
|---|------------|-------------------|---|------------|------------|---------------------------|-------------|-------------------|
| April 2020 | | | | | | | | |
| 1. Applied Science Department | | | | | | | | |
| 1. | AS-1 | General / Skill | Quantum and Energy Materials: Potential & Applications | 20.04.2020 | 24.04.2020 | NITTTR, CHD | PS/AK | National |
| 2. Civil Engineering Department | | | | | | | | |
| 2. | CE-1 | Skill Oriented | Energy Efficient and Innovative Building Construction Practices | 20.04.2020 | 24.04.2020 | NITTTR, CHD | AG/SKS | National |
| 3. Curriculum Development Centre | | | | | | | | |
| 3. | CDC-1 | Pedagogy | Curriculum Implementation | 20.04.2020 | 24.04.2020 | NITTTR, CHD | SKG | National |
| 4. Electrical Engineering Dept. | | | | | | | | |
| 4. | EE-1 | Research Oriented | Machine Learning Using Python | 20.04.2020 | 24.04.2020 | Punjabi Uni., Patiala | RT/PV | |
| 5. Electronics & Communication Engineering Department | | | | | | | | |
| Cluster Programs with Electrical Engineering Department | | | | | | | | |
| 5. | ECE-1 | Research Oriented | Image Processing Techniques | 20.04.2020 | 24.04.2020 | NITTTR, CHD | AMK/PV | |
| 6. Entrepreneurship Development & Industrial Coordination Department | | | | | | | | |
| 6. | ED-1 | Skill oriented | Entrepreneurship Awareness Camp | 13.04.2020 | 17.04.2020 | PUSA Inst. of Tech. Delhi | ADS | Delhi |
| 7. Education & Educational Management Department | | | | | | | | |
| 7. | EEM-1 | Edu. Pedagogy | Induction Training Programme for Newly Recruited Teachers | 20.04.2020 | 01.05.2020 | NITTTR, CHD | AK | National |
| 8. | EEM-2 | Edu. Mgmt. | Life Skills Development | 27.04.2020 | 01.05.2020 | NITTTR, CHD | RC | Northern |

8. Computer Science & Engineering Department

| | | | | | | | | |
|-----|-------|-------------------|--------------------------|------------|------------|--------------------------------|---------|----------|
| 9. | CSE-1 | Advanced Level | Digital Learning | 13.04.2020 | 17.04.2020 | Govt. Poly. Ambala | AD/SS | HR |
| 10. | CSE-2 | Research Oriented | IoT and Machine Learning | 20.04.2020 | 24.04.2020 | SJP Poly., Damla | MK | HR |
| 11. | CSE-3 | Skill Oriented | Linux Applications | 27.04.2020 | 01.05.2020 | NITTTR, CHD | AD | National |
| 12. | CSE-4 | Advanced level | Digital Learning | 27.04.2020 | 01.05.2020 | Outstation/ Govt.Poly., Rohtak | KGS/ SS | HR |

9. Mechanical Engineering Department

| | | | | | | | | |
|-----|------|----------|--|------------|------------|---------------------|---------|----------|
| 13. | ME-1 | Advanced | Engineering Materials & their Testing | 20.04.2020 | 24.04.2020 | NITTTR, CHD | PSR | Northern |
| 14. | ME-2 | Advanced | Additive Manufacturing for Biomedical Applications | 27.04.2020 | 01.05.2020 | Pbi., Univ. Patiala | RS/ SSD | National |

10. Media Engineering Department

| | | | | | | | | |
|-----|-------|----------------|--------------------|------------|------------|-------------|--------------------------|----------|
| 15. | MED-1 | Skill Oriented | Digital Publishing | 20.04.2020 | 24.04.2020 | NITTTR, CHD | RKW /Kamald eep/ Manisha | National |
|-----|-------|----------------|--------------------|------------|------------|-------------|--------------------------|----------|

11. Rural Development Department

| | | | | | | | | |
|-----|------|----------------|---|------------|------------|-------------------------|-----|----------|
| 16. | RD-1 | Research Based | Innovation in Organic Farming | 20.04.2020 | 24.04.2020 | NITTTR, CHD | UNR | National |
| 17. | RD-2 | Research Based | Environment, Energy and Sustainable Development | 27.04.2020 | 01.05.2020 | Outstation/ NITTTR, CHD | PS | National |

May 2020**1. Applied Science Department**

| | | | | | | | | |
|-----|------|-------------------|---|------------|------------|-------------|---------|----------|
| 18. | AS-2 | General / Skill | Renewable Energy Sources and Technologies | 11.05.2020 | 15.05.2020 | NITTTR, CHD | AK/PS | National |
| 19. | AS-3 | Advance | Nanotechnology : Developments & Advances | 18.05.2020 | 22.05.2020 | NITTTR, CHD | PS/ BCC | National |
| 20. | AS-4 | Advance/ Research | Engineering Mathematics with MATLAB | 25.05.2020 | 29.05.2020 | NITTTR, CHD | KCL | National |

2. Civil Engineering Department

| | | | | | | | | |
|-----|------|----------------|-----------------------------------|------------|------------|-------------|----|----------|
| 21. | CE-2 | Skill Oriented | Structural Design Using STAAD PRO | 11.05.2020 | 15.05.2020 | NITTTR, CHD | HS | National |
|-----|------|----------------|-----------------------------------|------------|------------|-------------|----|----------|

| | | | | | | | | |
|-----|------|----------------|---|------------|------------|-------------|----------------------------|----------|
| 22. | CE-3 | Skill Oriented | Construction and Maintenance of Black Top Pavements | 18.05.2020 | 22.05.2020 | NITTTR, CHD | AKD | National |
| 23. | CE-4 | Research Based | Innovative Technologies for Village Development | 18.05.2020 | 22.05.2020 | NITTTR, CHD | AG | National |
| 24. | CE-5 | Research Based | Application of Auto CAD in Engineering | 18.05.2020 | 22.05.2020 | NITTTR, CHD | VKS | National |
| 25. | CE-6 | Research Based | Advanced Construction Materials and Techniques for Roads, Buildings, Bridges and other Civil Engineering Structures | 18.05.2020 | 29.05.2020 | NITTTR, CHD | SKS/ HG/ All Civil Faculty | National |

3. Curriculum Development Centre

| | | | | | | | | |
|-----|-------|--------------------|--|------------|------------|-------------|-----|----------|
| 26. | CDC-2 | Industry Supported | Planning, Execution and Evaluation of Project Work | 11.05.2020 | 15.05.2020 | NITTTR, CHD | ABG | National |
| 27. | CDC-3 | Pedagogy | Outcome Based Curriculum | 18.05.2020 | 22.05.2020 | NITTTR, CHD | MS | National |
| 28. | CDC-4 | Research Oriented | Research Oriented Project Work | 11.05.2020 | 15.05.2020 | NITTTR, CHD | RM | National |

4. Electrical Engineering Dept.

| | | | | | | | | |
|-----|------|-------------------|---|------------|------------|------------------|-------|--|
| 29. | EE-2 | Industry Oriented | ANSYS-EM Software (in collaboration with ANSYS) | 18.05.2020 | 22.05.2020 | NITTTR, CHD | LM/PV | |
| 30. | EE-3 | Research oriented | Embedded C Programming of Microcontroller | 18.05.2020 | 22.05.2020 | IPE, Lonere (MH) | RT | |
| 31. | EE-4 | Skill Oriented | Hands on Practice on LabVIEW and NI-ELVIS | 25.05.2020 | 29.05.2020 | | AM | |

5. Electronics & Communication Engineering Dept.

| | | | | | | | | |
|-----|-------|-------------------|---|------------|------------|-------------|----------|--|
| 32. | ECE-2 | Research oriented | Electronic Product Design Aspects | 11.05.2020 | 16.05.2020 | NITTTR, CHD | SSG | |
| 33. | ECE-3 | General | NBA Accreditation and Examination Reforms | 11.05.2020 | 15.05.2020 | NITTTR, CHD | BSD/ SSG | |
| 34. | ECE-4 | Advanced level | Smart Systems | 18.05.2020 | 22.05.2020 | NITTTR, CHD | KS | |
| 35. | ECE-5 | Research Oriented | Digital Signal Processing Transforms | 18.05.2020 | 22.05.2020 | NITTTR, CHD | AMK | |

6. Entrepreneurship Development & Industrial Coordination Department

| | | | | | | | | |
|-----|------|----------------|---|------------|------------|-------------------------|-----|---------|
| 36. | ED-2 | Advanced level | Entrepreneurship and Start-up Policies 2017 | 18.05.2020 | 22.05.2020 | CMRA Govt.Poly., Rohtak | ADS | Haryana |
|-----|------|----------------|---|------------|------------|-------------------------|-----|---------|

7. Education & Educational Management Department

| | | | | | | | | |
|-----|-------|---------------|--|------------|------------|----------------------------|-----|---------------|
| 37. | EEM-3 | Edu. Pedagogy | Induction Training Programme for Newly Recruited Teachers Phase – II | 04.05.2020 | 15.05.2020 | NITTTR, CHD | SD | National |
| 38. | EEM-4 | Edu. Pedagogy | Enhancing Performance at Work Place (for Technical & Supporting Staff) | 11.05.2020 | 15.05.2020 | NITTTR, CHD | RC | National |
| 39. | EEM-5 | Edu. Pedagogy | Effective Communication & Presentation Skills | 18.05.2020 | 22.05.2020 | Govt. Girls Poly., Lucknow | PKS | Uttar Pradesh |

8. Computer Science & Engineering Department

| | | | | | | | | |
|-----|-------|-------------------|---|------------|------------|------------------|---------|----------|
| 40. | CSE-5 | Research Oriented | Data Science using R | 11.05.2020 | 15.05.2020 | NITTTR, CHD | SS | National |
| 41. | CSE-6 | Advanced Level | Cyber Etiquettes and Cyber Forensics | 11.05.2020 | 22.05.2020 | CCET/PU, Patiala | MD | PB |
| 42. | CSE-7 | Skill Oriented | Data Analytics using Python | 19.05.2020 | 23.05.2020 | NITTTR, CHD | AD | National |
| 43. | CSE-8 | Advanced Level | High Performance Distributed Computing | 19.05.2020 | 23.05.2020 | NITTTR, CHD | KGS | National |
| 44. | CSE-9 | Pedagogy | Outcome based Education for Program Accreditation | 25.05.2020 | 29.05.2020 | NITTTR, CHD | CRK/ MK | National |

9. Mechanical Engineering Department

| | | | | | | | | |
|-----|------|----------|------------------------------|------------|------------|----------------------|----------|----------|
| 45. | ME-3 | Industry | IoT in Manufacturing | 04.05.2020 | 08.05.2020 | YCEPU, Talwandi Sabo | RS/ SSD | National |
| 46. | ME-4 | Advanced | Computer Aided Manufacturing | 04.05.2020 | 08.05.2020 | NITTTR, CHD | PSR | Northern |
| 47. | ME-5 | Advanced | Hybrid Machining | 11.05.2020 | 15.05.2020 | NITTTR, CHD | PSR | Northern |
| 48. | ME-6 | Research | Engineering Optimization | 25.05.2020 | 29.05.2020 | NITTTR, CHD | SSD/ BSP | Northern |

10. Media Engineering Department

| | | | | | | | | |
|-----|-------|----------------|---|------------|------------|-------------|-------------|----------|
| 49. | MED-2 | Skill Oriented | Graphics and Animation for Instructional Material Development | 11.05.2020 | 15.05.2020 | NITTTR, CHD | BB/ MS/ RKW | National |
|-----|-------|----------------|---|------------|------------|-------------|-------------|----------|

11. Rural Development Department

| | | | | | | | | |
|-----|------|----------------|---|------------|------------|------------------|-----|----------|
| 50. | RD-3 | Research Based | Climate Change, Disaster Management and Sustainable Development | 11.05.2020 | 15.05.2020 | G.P., Uttarkashi | UNR | National |
|-----|------|----------------|---|------------|------------|------------------|-----|----------|

June 2020

1. Civil Engineering Dept.

| | | | | | | | | |
|-----|------|-------------------|---|------------|------------|-------------|--------|----------|
| 51. | CE-7 | Research Oriented | Disaster Management and Sustainable Development | 22.06.2020 | 26.06.2020 | NITTTR, CHD | AG/SKS | National |
|-----|------|-------------------|---|------------|------------|-------------|--------|----------|

2. Electrical Engineering Dept.

| | | | | | | | | |
|-----|------|-------------------|---|------------|------------|---------------|-------|--|
| 52. | EE-5 | Research Oriented | Power Quality Analysis of Power Electronic Converters (2 weeks) | | | | UK | |
| 53. | EE-6 | Research Oriented | Transformer Diagnostic Study | 01.06.2020 | 05.06.2020 | NIT, Hamirpur | PV/RT | |

3. Electronics & Communication Engineering Dept.

| | | | | | | | | |
|-----|-------|-------------------|--|------------|------------|------------------------|-----------|--|
| 54. | ECE-6 | Research Oriented | VLSI Physical Design Techniques | 08.06.2020 | 12.06.2020 | NITTTR, CHD | SSG/B Raj | |
| 55. | ECE-7 | Advanced Level | Digital and Analog VLSI Design | 15.06.2020 | 19.06.2020 | Outstation/NITTTR, CHD | B Raj | |
| 56. | ECE-8 | Advanced Level | Applications of Embedded Systems | 22.06.2020 | 26.06.2020 | Outstation/NITTTR, CHD | KS | |
| 57. | ECE-9 | Advanced Level | ECE Lab Practices for Polytechnic Teachers (Two weeks) | 22.06.2020 | 03.07.2020 | NITTTR, CHD | BSD/GS | |

4. Entrepreneurship Development & Industrial Coordination

| | | | | | | | | |
|-----|------|----------------|---|------------|------------|---------------------|-----|---------|
| 58. | ED-3 | Advanced level | Entrepreneurship and Start-up Policies 2017 | 08.06.2020 | 12.06.2020 | Govt.Poly., Sonipat | HKV | Haryana |
| 59. | ED-4 | Skill oriented | Entrepreneurship Awareness Camp | 22.06.2020 | 26.06.2020 | GPW, Srinagar | HKV | J &K |

5. Education & Educational Management

| | | | | | | | | |
|-----|-------|-------------------|--|------------|------------|-------------|--------|----------|
| 60. | EEM-6 | Research Oriented | Research Methodology | 01.06.2020 | 12.06.2020 | NITTTR, CHD | SD | National |
| 61. | EEM-7 | Edu.Mgmt. | Mentoring, Coaching, Guidance & Counselling Skills | 15.06.2020 | 19.06.2020 | NITTTR, CHD | PKS/RC | Northern |

6. Computer Science & Engineering Department

| | | | | | | | | |
|-----|--------|----------------|---------------------------------------|------------|------------|-------------|----|----------|
| 62. | CSE-10 | Advanced Level | Cyber Attacks & Mitigation Techniques | 01.06.2020 | 05.06.2020 | NITTTR, CHD | MD | National |
|-----|--------|----------------|---------------------------------------|------------|------------|-------------|----|----------|

| | | | | | | | | |
|-----|--------|----------|---------------------------|------------|------------|----------------|-----|----------|
| 63. | CSE-11 | Pedagogy | Digital Learning/Pedagogy | 15.06.2020 | 19.06.2020 | NITTTR, CHD | KGS | National |
|-----|--------|----------|---------------------------|------------|------------|----------------|-----|----------|

7. Mechanical Engineering Department

| | | | | | | | | |
|-----|-------|----------|---|------------|------------|---------------------|-------------|----------|
| 64. | ME-7 | Advanced | Rapid Manufacturing | 01.06.2020 | 05.06.2020 | GZSCET, Bathinda | RS/ PSR | National |
| 65. | ME-8 | Research | Advance Material Processing and Characterization | 08.06.2020 | 12.06.2020 | NITTTR, CHD | RS | National |
| 66. | ME-9 | Skill | Teaching Practices in Engineering Design | 15.06.2020 | 19.06.2020 | NITTTR, CHD | SJ | National |
| 67. | ME-10 | Research | Modeling & Simulation using MATLAB | 15.06.2020 | 19.06.2020 | NITTTR, CHD | SSD | National |
| 68. | ME-11 | Pedagogy | Outcome Based Education in Mechanical Engineering | 29.06.2020 | 03.07.2020 | NITTTR, CHD | BSP/ SSB | Northern |

8. Media Engineering Department

| | | | | | | | | |
|-----|-------|--|--------------------------|------------|------------|----------------|---------------|----------|
| 69. | MED-3 | | Video Editing Techniques | 01.06.2020 | 05.06.2020 | NITTTR, CHD | SB/HS/ RKW | National |
|-----|-------|--|--------------------------|------------|------------|----------------|---------------|----------|

July 2020

1. Applied Science Department (Interdisciplinary)

| | | | | | | | | |
|-----|------|-----------------|---|------------|------------|----------------|-------|----------|
| 70. | AS-5 | General | Nanomaterials, Sensors & Devices | 06.07.2020 | 10.07.2020 | NITTTR, CHD | AK/PS | National |
| 71. | AS-6 | General / Skill | Engineering Mathematics with MATHEMATICA | 13.07.2020 | 17.07.2020 | NITTTR, CHD | KCL | National |
| 72. | AS-7 | General / Skill | Emerging Semiconducting Materials: Prospective & Applications | 13.07.2020 | 17.07.2020 | NITTTR, CHD | PS/AK | National |
| 73. | AS-8 | General | Nuclear Radiations : Applications & Safety Measures | 20.07.2020 | 24.07.2020 | NITTTR, CHD | BCC | National |
| 74. | AS-9 | General | Numerical Methods & Applied Statistics for Engineers | 27.07.2020 | 31.07.2020 | NITTTR, CHD | KCL | National |

2. Civil Engineering Department

| | | | | | | | | |
|-----|------|----------------|---|------------|------------|----------------|------------|----------|
| 75. | CE-8 | Skill Oriented | Laboratory Practices in Environmental Engineering | 06.07.2020 | 10.07.2020 | NITTTR, CHD | SKS/ AG | National |
| 76. | CE-9 | Research Based | Programming in Finite Element Method and its application to practical problems using ABAQUS | 06.07.2020 | 10.07.2020 | NITTTR, CHD | HG/ SKS | National |

Cluster Programs with Rural Development Department

| | | | | | | | | |
|-----|-------|--|--|------------|------------|----------------|----|----------|
| 77. | CE-10 | | Skill Based Creative Tourism for Employment Generation | 20.07.2020 | 24.07.2020 | NITTTR, CHD | AG | National |
|-----|-------|--|--|------------|------------|----------------|----|----------|

| 3. Electrical Engineering Dept. | | | | | | | | |
|--|--------|--------------------|--|------------|------------|------------------|------------------|----------|
| 78. | EE-7 | | Analog Circuit Design (2 weeks) | July 2020 | | | UK | |
| 79. | EE-8 | | Recent Advances in Electrical Engineering | 13.07.2020 | 17.07.2020 | NITTTR, CHD | PV | |
| 80. | EE-9 | | PLC Practices and its Programming | 20.07.2020 | 24.07.2020 | NITTTR, CHD | RT/LM | |
| 81. | EE-10 | | Lab Practices in IoT and Artificial Intelligence | 27.07.2020 | 31.07.2020 | NITTTR, CHD | LM | |
| 4. Electronics & Communication Engineering Dept. | | | | | | | | |
| 82. | ECE-10 | Advanced Level | Nanoelectronics: Materials, Devices, Circuits and Systems | 06.07.2020 | 10.07.2020 | NITTTR, CHD | B Raj | |
| 83. | ECE-11 | Advanced Level | Augmented Reality (AR) and Virtual Reality (VR) | 13.07.2020 | 17.07.2020 | NITTTR, CHD | BSD | |
| 84. | ECE-12 | Advanced Level | Digital System Design | 27.07.2020 | 31.07.2020 | NITTTR, CHD | KS | |
| Cluster Programs with Electrical Engineering Department | | | | | | | | |
| 85. | ECE-13 | Advanced Level | Biomedical Instrumentation | 27.07.2020 | 31.07.2020 | NITTTR, CHD | AMK/LM | |
| 5. Entrepreneurship Development & Industrial Coordination | | | | | | | | |
| 86. | ED-5 | Advanced level | Entrepreneurship and Start-up Policies 2017 | 20.07.2020 | 24.07.2020 | Govt.Poly. Hisar | SKD/ New Faculty | Haryana |
| 87. | ED-6 | Industry Supported | Strategic Industry Institute Partnership in Technical Education | 27.07.2020 | 31.07.2020 | PTU, Jalandhar | ADS | PB |
| 6. Education & Educational Management | | | | | | | | |
| 88. | EEM-8 | Edu. Pedagogy | Cooperative & Collaborative Instructional Methods to promote Meaningful Learning | 13.07.2020 | 17.07.2020 | NITTTR, CHD | AK | National |
| 7. Computer Science & Engineering Department | | | | | | | | |
| 89. | CSE-12 | Research Oriented | Machine Learning using Python | 20.07.2020 | 24.07.2020 | NITTTR, CHD | SS/SG | National |
| 90. | CSE-13 | General | Academic Administration and Leadership for Engineering Colleges | 20.07.2020 | 24.07.2020 | NITTTR, CHD | SSG | National |
| 91. | CSE-14 | Skill Oriented | Data Science using Open Source | 20.07.2020 | 24.07.2020 | NITTTR, CHD | AD | National |
| 92. | CSE-15 | Research oriented | Cloud Computing | 27.07.2020 | 31.07.2020 | NITTTR, CHD | MK | National |

| | | | | | | | | |
|-----|--------|--------------------|--|------------|------------|-------------|----|----------|
| 93. | CSE-16 | Industry Supported | Digital Marketing with Search Engine Optimization and E-Commerce | 27.07.2020 | 31.07.2020 | NITTTR, CHD | AS | National |
|-----|--------|--------------------|--|------------|------------|-------------|----|----------|

8. Mechanical Engineering Department

| | | | | | | | | |
|-----|-------|----------|--|------------|------------|---------------|-----|----------|
| 94. | ME-12 | Industry | Supervisory Development for Workshop Instructors | 06.07.2020 | 10.07.2020 | NITTTR, CHD | SSB | Northern |
| 95. | ME-13 | Advanced | CAD using CREO | 27.07.2020 | 31.07.2020 | NIT Jalandhar | PSR | Northern |

9. Media Engineering Department

| | | | | | | | | |
|-----|-------|----------------|---|------------|------------|------------|-----------|----------|
| 96. | MED-4 | General | NBA Accreditation through Outcome Based Education | 06.07.2020 | 10.07.2020 | NITTTR CHD | RKW | National |
| 97. | MED-5 | Skill Oriented | Use of Camera for e- Content Generation | 27.07.2020 | 31.07.2020 | NITTTR CHD | AS/MA RKW | National |

10. Rural Development Department

| | | | | | | | | |
|-----|------|-------------------|--|------------|------------|-----------------|-----|----------|
| 98. | RD-4 | Research Oriented | Unnat Bharat Abhiyan | 20.07.2020 | 24.07.2020 | Only for Punjab | UNR | Northern |
| 99. | RD-5 | Skill Oriented | Skill Development and Rural Entrepreneurship for Employment Generation | 27.07.2020 | 31.07.2020 | NITTTR, CHD | PS | National |

August 2020

1. Applied Science Department

| | | | | | | | | |
|------|-------|---------------|---|------------|------------|-------------|--------|----------|
| 100. | AS-10 | General/Skill | Laboratory Practices in Applied Physics | 17.08.2020 | 21.08.2020 | NITTTR, CHD | PS/BCC | National |
| 101. | AS-11 | General/Skill | Emerging Engineering Technologies | 24.08.2020 | 28.08.2020 | NITTTR, CHD | AK/PS | National |

2. Civil Engineering Department

| | | | | | | | | |
|------|-------|----------------|--|------------|------------|-------------|-----|----------|
| 102. | CE-11 | Skill Oriented | Sustainable Planning for Rural and Urban Development | 17.08.2020 | 21.08.2020 | NITTTR, CHD | AG | National |
| 103. | CE-12 | Advanced | Software Applications in Project Management | 24.08.2020 | 28.08.2020 | NITTTR, CHD | VKS | National |
| 104. | CE-13 | Skill Oriented | New Generation Concrete Mixes | 31.08.2020 | 04.09.2020 | NITTTR, CHD | HS | National |

3. Curriculum Development Centre

| | | | | | | | | |
|------|-------|----------|------------------------|------------|------------|-------------|-----|----------|
| 105. | CDC-5 | Pedagogy | Curriculum Development | 03.08.2020 | 07.08.2020 | NITTTR, CHD | ABG | National |
|------|-------|----------|------------------------|------------|------------|-------------|-----|----------|

| Cluster Programs with Education & Educational Management Department | | | | | | | | |
|--|--------|-------------------|---|------------|------------|-------------------|---------|----------|
| 106. | CDC-6 | Skill Oriented | Mentoring and Clustering | 17.08.2020 | 21.08.2021 | NITTTR, CHD | MS/ PKS | National |
| 4. Electrical Engineering Dept. | | | | | | | | |
| 107. | EE-11 | Research Oriented | Power Quality Improvement Techniques | Aug. 2020 | | | UK | |
| 108. | EE-12 | Research Oriented | Solar Thermal Technologies for Process heat and power | 03.08.2020 | 07.08.2020 | NITTTR, CHD | PV/LM | |
| 5. Electronics & Communication Engineering Dept. | | | | | | | | |
| 109. | ECE-14 | Advanced Level | Digital Circuits and System Design | 24.08.2020 | 28.08.2020 | NITTTR, CHD | B Raj | |
| 110. | ECE-15 | Advanced Level | Antenna Design Simulations | 24.08.2020 | 28.08.2020 | NITTTR, CHD | GS | |
| 6. Entrepreneurship Development & Industrial Coordination | | | | | | | | |
| 111. | ED-7 | Advanced level | Entrepreneurship and Start-up Policies 2017 | 03.08.2020 | 07.08.2020 | Govt.Poly. Ambala | SKD | Haryana |
| 7. Education & Educational Management | | | | | | | | |
| 112. | EEM-9 | Edu. Pedagogy | Classroom Communication in Digital Era | 03.08.2020 | 07.08.2020 | NITTTR, CHD | AK | Northern |
| 113. | EEM-10 | Edu. Mgmt. | Developing Values & Ethics | 03.08.2020 | 07.08.2020 | NITTTR, CHD | PKS | Northern |
| 114. | EEM-11 | Edu. Pedagogy | Instructional Planning & Delivery | 10.08.2020 | 14.08.2020 | NITTTR, CHD | AK | Northern |
| 115. | EEM-12 | Research Oriented | Action Research for improving Quality of Technical Education System | 17.08.2020 | 21.08.2020 | NITTTR, CHD | SD | National |
| 116. | EEM-13 | Edu. Pedagogy | Communication Skills, Modes & Knowledge Dissemination | 24.08.2020 | 28.08.2020 | NITTTR, CHD | AK | Northern |
| 117. | EEM-14 | Advanced Level | Advances in Pharmacy Education | 24.08.2020 | 28.08.2020 | NITTTR, CHD | RC | Northern |
| 8. Computer Science & Engineering Department | | | | | | | | |
| 118. | CSE-17 | Research Oriented | Artificial Intelligence and Deep Learning | 03.08.2020 | 07.08.2020 | NITTTR, CHD | AD | National |
| 119. | CSE-18 | Skill oriented | Multimedia Content Generation Using Open Source Tools | 17.08.2020 | 21.08.2020 | NITTTR, CHD | SS | National |

| | | | | | | | | |
|------|--------|-------------------|--------------------------------------|------------|------------|-------------------|-----|----------|
| 120. | CSE-19 | Advanced Level | A Hacker's Approach to Cyber Attacks | 17.08.2020 | 28.08.2020 | NITTTR, CHD | MD | National |
| 121. | CSE-20 | Research Oriented | IoT and AI | 17.08.2020 | 21.08.2020 | Govt.Poly. Rohtak | KGS | HRY |
| 122. | CSE-21 | Advanced | Internet of Things | 24.08.2020 | 28.08.2020 | NITTTR, CHD | MK | National |

9. Mechanical Engineering Department

| | | | | | | | | |
|------|-------|----------|---|------------|------------|-------------------|---------|----------|
| 123. | ME-14 | Advanced | Additive Manufacturing | 03.08.2020 | 07.08.2020 | NITTTR/ Hyderabad | PSR | National |
| 124. | ME-15 | Advanced | Sustainable Manufacturing | 03.08.2020 | 07.08.2020 | BCET, Gurdaspur | RS/ BSP | National |
| 125. | ME-16 | Industry | Repair and Maintenance of Machine Tools | 17.08.2020 | 21.08.2020 | NITTTR, CHD | PSR/ SJ | Northern |
| 126. | ME-17 | Research | Material Processing Technologies | 24.08.2020 | 28.08.2020 | NITTTR, CHD | RS | National |

10. Rural Development Department

| | | | | | | | | |
|------|------|----------------|--|------------|------------|---------------------------|-----|----------|
| 127. | RD-6 | Research Based | Rural and Vernacular Architecture and Eco- and Rural Tourism | 24.08.2020 | 28.08.2020 | G.P., Kangra/ GEC, Kangra | UNR | National |
| 128. | RD-7 | Industry Based | Environmental Pollution- Instrumentation and Control | 31.08.2020 | 04.09.2020 | NITTTR, CHD | PS | National |

September 2020

1. Applied Science Department (Interdisciplinary)

| | | | | | | | | |
|------|-------|-----------------|---|------------|------------|-------------|--------|----------|
| 129. | AS-12 | General | Optical Fibers : Potential & Applications | 07.09.2020 | 11.09.2020 | NITTTR, CHD | BCC | National |
| 130. | AS-13 | General / Skill | Differential Equation Theory and Engineering Applications | 14.09.2020 | 18.09.2020 | NITTTR, CHD | KCL | National |
| 131. | AS-14 | General / Skill | Optical Properties & Processes in Semiconductors | 14.09.2020 | 18.09.2020 | NITTTR, CHD | PS/AK | National |
| 132. | AS-15 | General / Skill | Nanomaterials and Characterization Techniques | 21.09.2020 | 25.09.2020 | NITTTR, CHD | AK/ PS | National |

2. Civil Engineering Department

| | | | | | | | | |
|------|-------|----------------|---|------------|------------|-------------|-----|----------|
| 133. | CE-14 | Advanced | Artificial Intelligence in Civil Engineering | 07.09.2020 | 11.09.2020 | NITTTR, CHD | HG | National |
| 134. | CE-15 | Skill Oriented | Construction and Maintenance of Black Top Pavements | 07.09.2020 | 11.09.2020 | NITTTR, CHD | AKD | National |

| | | | | | | | | |
|------|-------|----------------|---|------------|------------|-------------|-----------------------|----------|
| 135. | CE-16 | Skill Oriented | Testing of Latest Civil Engineering Materials | 07.09.2020 | 11.09.2020 | NITTTR, CHD | HS/ All Civil Faculty | National |
| 136. | CE-17 | Skill Oriented | Low Cost Housing Techniques and Practices | 07.09.2020 | 11.09.2020 | NITTTR, CHD | AG/ SKS | National |
| 137. | CE-18 | Advanced | Slip Form work to Construction | 14.09.2020 | 18.09.2020 | NITTTR, CHD | SKS/ HG/ AG | National |
| 138. | CE-19 | Advanced | Earthquake Resistant affordable Housing | 21.09.2020 | 25.09.2020 | NITTTR, CHD | AG | National |
| 139. | CE-20 | Research Based | Construction Management | 21.09.2020 | 25.09.2020 | NITTTR, CHD | VKS | National |
| 140. | CE-21 | Advanced | Evaluation and Rehabilitation of Pavements | 21.09.2020 | 25.09.2020 | NITTTR, CHD | AKD | National |

3. Curriculum Development Centre

| | | | | | | | | |
|------|-------|----------------|------------------------|------------|------------|-------------|-----|----------|
| 141. | CDC-7 | Skill Oriented | Lab Practices Tools | 31.08.2020 | 04.09.2020 | NITTTR, CHD | RM | National |
| 142. | CDC-8 | Pedagogy | Curriculum Development | 21.09.2020 | 25.09.2020 | NITTTR, CHD | SKG | National |

4. Electrical Engineering Dept.

| | | | | | | | | |
|------|-------|----------------|--|------------|------------|--|----|--|
| 143. | EE-13 | Advanced level | Renewable Energy Systems | Sept.2020 | | | UK | |
| 144. | EE-14 | Advanced level | Microcontroller 8051 and its Programming | 14.09.2020 | 18.09.2020 | | AM | |

5. Electronics & Communication Engineering Dept.

| | | | | | | | | |
|------|--------|----------------|--|------------|------------|------------------------|-----|----------|
| 145. | ECE-16 | Advanced Level | Image Processing through MATLAB | 14.09.2020 | 18.09.2020 | NITTTR, CHD | AMK | National |
| 146. | ECE-17 | Advanced Level | Recent Communication Concepts & Technologies | 21.09.2020 | 25.09.2020 | NITTTR CHD/ Outstation | GS | National |

6. Entrepreneurship Development & Industrial Coordination

| | | | | | | | | |
|------|------|-------------------|--|------------|------------|-------------|--------------|-------|
| 147. | ED-8 | Research oriented | Social Entrepreneurship for Technical Entrepreneurs | 14.09.2020 | 18.09.2020 | GP, Jammu | ADS | J &K |
| 148. | ED-9 | Advanced level | Entrepreneurial Career Orientation for ECE and allied disciplines (Cluster Programme) | 21.09.2020 | 25.09.2020 | NITTTR, CHD | SKD/ SSG/ AK | Delhi |

7. Education & Educational Management

| | | | | | | | | |
|------|--------|---------------|---|------------|------------|-------------|----|----------|
| 149. | EEM-15 | Edu. Pedagogy | Induction Training Programme for Newly Recruited Teachers | 07.09.2020 | 18.09.2020 | NITTTR, CHD | AK | National |
| 150. | EEM-16 | Edu. Pedagogy | Managerial Skills for Technical Teachers & Administrators | 14.09.2020 | 18.09.2020 | NITTTR, CHD | SD | National |

| | | | | | | | | |
|------|--------|----------------|--|------------|------------|-------------|----|----------|
| 151. | EEM-17 | Advanced Level | Latest Practices in Chemical Engineering | 21.09.2020 | 25.09.2020 | NITTTR, CHD | RC | Northern |
|------|--------|----------------|--|------------|------------|-------------|----|----------|

8. Computer Science & Engineering Department

| | | | | | | | | |
|------|--------|-------------------|---|------------|------------|--------------|--------|----------|
| 152. | CSE-22 | Skill Oriented | Secure Web Designing using PHP and MYSQL | 07.09.2020 | 11.09.2020 | IRDT, KANPUR | AS/CRK | UP |
| 153. | CSE-23 | Skill Oriented | Matlab for Engineering Applications | 07.09.2020 | 11.09.2020 | NITTTR, CHD | AD | National |
| 154. | CSE-24 | General | Academic Administration and Leadership for Poly. Colleges | 14.09.2020 | 18.09.2020 | NITTTR, CHD | SSG | National |
| 155. | CSE-25 | Research Oriented | Python Programming | 14.09.2020 | 18.09.2020 | NITTTR, CHD | SS | National |
| 156. | CSE-26 | Advanced Level | Cyber Security & Cyber Forensics | 21.09.2020 | 25.09.2020 | NITTTR, CHD | MD | National |
| 157. | CSE-27 | Pedagogy | Design of Learner Centric MOOCs | 21.09.2020 | 25.09.2020 | NITTTR, CHD | KGS | National |

9. Mechanical Engineering Department

| | | | | | | | | |
|------|-------|----------|-----------------------------|------------|------------|-------------|--------|----------|
| 158. | ME-18 | Advanced | Advances in Manufacturing | 07.09.2020 | 11.09.2020 | NITTTR, CHD | SJ/PSR | National |
| 159. | ME-19 | Advanced | Ergonomics & Product Design | 21.09.2020 | 25.09.2020 | NITTTR, CHD | SSB | Northern |

10. Media Engineering Department

| | | | | | | | | |
|------|-------|----------------|---|------------|------------|-------------|-----------|----------|
| 160. | MED-6 | Skill Oriented | Video Production Techniques for MOOCs Development | 14.09.2020 | 18.09.2020 | NITTTR, CHD | SB/AS/RKW | National |
|------|-------|----------------|---|------------|------------|-------------|-----------|----------|

11. Rural Development Department

| | | | | | | | | |
|------|------|----------------|---|------------|------------|-------------|----|----------|
| 161. | RD-8 | Industry Based | Unnat Bharat Abhiyan and Technology Application | 21.09.2020 | 25.09.2020 | NITTTR, CHD | PS | National |
|------|------|----------------|---|------------|------------|-------------|----|----------|

October 2020

1. Applied Science Department (Interdisciplinary)

| | | | | | | | | |
|------|-------|---------|---------------------------------------|------------|------------|-------------|-------|----------|
| 162. | AS-16 | General | Energy Harvesting and Storage Devices | 05.10.2020 | 09.10.2020 | NITTTR, CHD | AK/PS | National |
| 163. | AS-17 | General | Lasers & Laser based Technologies | 12.10.2020 | 16.10.2020 | NITTTR, CHD | BCC | National |

2. Civil Engineering Department

| | | | | | | | | |
|------|-------|----------|-------------------------------------|------------|------------|-------------|----|----------|
| 164. | CE-22 | Advanced | Fire Resistant Design of Structures | 05.10.2020 | 09.10.2020 | NITTTR, CHD | HG | National |
|------|-------|----------|-------------------------------------|------------|------------|-------------|----|----------|

| | | | | | | | | |
|---|----------|--------------------|---|------------|------------------------|-------------|------------------|----------|
| 165. | CE-23 | Advanced | Recycling Materials in Highway Construction | 05.10.2020 | 09.10.2020 | NITTTR, CHD | AKD | National |
| 166. | CE-24 | Research Based | Alternate Technologies in Road Construction | 19.10.2020 | 23.10.2020 | NITTTR, CHD | AKD | National |
| 167. | CE-25 | Advanced | Bearing Capacity Estimation for Foundations | 19.10.2020 | 23.10.2020 | NITTTR, CHD | VKS | National |
| 3. Curriculum Development Centre | | | | | | | | |
| 168. | CDC-9 | Advance Level | Next-Generation Futuristic Curriculum Design | 12.10.2020 | 16.10.2020 | NITTTR, CHD | MS | National |
| 169. | CDC-10 | Industry Supported | Planning, Execution and Evaluation of Project Work | 19.10.2020 | 23.10.2020 | NITTTR, CHD | SKG | National |
| Cluster Programme with Education & Educational Management Department | | | | | | | | |
| 170. | CDC-11 | Pedagogy | Curriculum Implementation | 12.10.2020 | 16.10.2020 | NITTTR, CHD | ABG /SD | National |
| 4. Centre for Clean Technologies and Sustainable Development | | | | | | | | |
| 171. | CCTSD -1 | General | Smart City | 05.10.2020 | 09.10.2020 | NITTTR, CHD | SKS/ HG | National |
| 5. Electrical Engineering Dept. | | | | | | | | |
| 172. | EE-15 | Industry Supported | Microgrid Systems using Renewable Energy | Oct. 2020 | | | UK/PV | |
| 173. | EE-16 | Research Oriented | Big Data Analysis for Smart Grid | 12.10.2020 | 16.10.2020 | IIT, Bhilai | RT | |
| 174. | EE-17 | Skill Oriented | Laboratory Practices in Electrical Machines Control | 12.10.2020 | 16.10.2020 | | AM | |
| 6. Electronics & Communication Engineering Dept. | | | | | | | | |
| 175. | ECE-18 | Research Oriented | Flexible Antennas for Next Generation Applications | 12.10.2020 | 16.10.2020 | NITTTR, CHD | BSD | |
| 176. | ECE-19 | Advanced Level | MATLAB & it's Applications | 12.10.2020 | 23.10.2020 (Two weeks) | NITTTR CHD | GS/AM K | National |
| 7. Entrepreneurship Development & Industrial Coordination | | | | | | | | |
| 177. | ED-10 | Advanced level | Innovations and Technological Entrepreneurship | 05.10.2010 | 09.10.2020 | RIT Delhi | HKV | Delhi |
| 178. | ED-11 | Industry Supported | Management of Small and Medium enterprises | 12.10.2010 | 16.10.2020 | GP, Jammu | HKV/ New Faculty | J&K |

8. Education & Educational Management

| | | | | | | | | |
|------|--------|----------|---------------------------------------|------------|------------|-------------|-----|----------|
| 179. | EEM-18 | Edu.Mgmt | Preparing Students for Job Interviews | 05.10.2020 | 09.10.2020 | NITTTR, CHD | PKS | National |
| 180. | EEM-19 | Edu.Mgmt | HRD & Training Methods | 12.10.2020 | 16.10.2020 | NITTTR, CHD | SD | Northern |
| 181. | EEM-20 | Edu.Mgmt | Stress Management | 26.10.2020 | 30.10.2020 | NITTTR, CHD | PKS | Northern |

9. Computer Science & Engineering Department

| | | | | | | | | |
|------|--------|----------------|--------------------------------|------------|------------|-------------|-----|----------|
| 182. | CSE-28 | Advanced Level | Web & Social Networks Security | 05.10.2020 | 16.10.2020 | NITTTR, CHD | MD | National |
| 183. | CSE-29 | Skill Oriented | GPU Programming | 05.10.2020 | 09.10.2020 | NITTTR, CHD | KGS | National |
| 184. | CSE-30 | Industry Based | Big Data Analytics | 12.10.2020 | 16.10.2020 | NITTTR, CHD | MK | National |

10. Mechanical Engineering Department

| | | | | | | | | |
|------|-------|----------|---------------------------------------|------------|------------|-------------|-----|----------|
| 185. | ME-20 | Research | Finite Element Analysis using ANSYS | 05.10.2020 | 09.10.2020 | NITTTR, CHD | BSP | National |
| 186. | ME-21 | Industry | CNC Machines: Operation & Programming | 19.10.2020 | 23.10.2020 | NITTTR, CHD | BSP | Northern |

11. Media Engineering Department

| | | | | | | | | |
|------|-------|----------|-------------------|------------|------------|-------------|------------|----------|
| 187. | MED-7 | Industry | Digital Marketing | 26.10.2020 | 30.10.2020 | NITTTR, CHD | MA/HS /RKW | National |
|------|-------|----------|-------------------|------------|------------|-------------|------------|----------|

12. Rural Development Department

| | | | | | | | | |
|------|------|----------------|--------------------------------------|------------|------------|-------------|-----|----------|
| 188. | RD-9 | Research Based | Rural Entrepreneurship and Start-ups | 12.10.2020 | 16.10.2020 | NITTTR, CHD | UNR | National |
|------|------|----------------|--------------------------------------|------------|------------|-------------|-----|----------|

November 2020

1. Applied Science Department (Interdisciplinary)

| | | | | | | | | |
|------|-------|-----------------|--|------------|------------|-------------|---------|----------|
| 189. | AS-18 | General | Opto-electronic Devices & Interfaces | 02.11.2020 | 06.11.2020 | NITTTR, CHD | BCC/ PS | National |
| 190. | AS-19 | General / Skill | Spectroscopic Techniques and Instrumentation | 23.11.2020 | 27.11.2020 | NITTTR, CHD | AK/PS | National |

2. Civil Engineering Department

| | | | | | | | | |
|------|-------|----------------|-----------------------------|------------|------------|-------------|-----|----------|
| 191. | CE-26 | Skill Oriented | Quality Control of Concrete | 02.11.2020 | 06.11.2020 | NITTTR, CHD | HS | National |
| 192. | CE-27 | Advanced | Yoga and Meditation | 02.11.2020 | 06.11.2020 | NITTTR, CHD | AKD | National |

| | | | | | | | | |
|---|--------|--------------------|---|------------|------------|-------------------------|------------------|----------|
| 193. | CE-28 | Skill Oriented | Concrete Lab Practices | 09.11.2020 | 13.11.2020 | NITTTR, CHD | HS | National |
| 3. Curriculum Development Centre | | | | | | | | |
| Cluster Programme with Education & Educational Management Department | | | | | | | | |
| 194. | CDC-12 | Industry Supported | Communication Skills and Personality Development | 23.11.2020 | 27.11.2020 | NITTTR, CHD | MS/ PKS | National |
| 4. Electrical Engineering Department | | | | | | | | |
| 195. | EE-18 | | Hands on Approach to Semiconductor devices | 02.11.2020 | 06.11.2020 | NITTTR, CHD | PV | |
| 196. | EE-19 | | HIL for Power System and Power Electronics Applications (In collaboration with Typhoon HIL) | 23.11.2020 | 27.11.2020 | NITTTR, CHD | LM/RT | |
| 5. Entrepreneurship Development & Industrial Coordination | | | | | | | | |
| 197. | ED-12 | Skill Oriented | Entrepreneurial Personality Development through Achievement Motivation Training | 02.11.2020 | 06.11.2020 | GP, Gandharba 1 | HKV/ New Faculty | J & K |
| 6. Education & Educational Management | | | | | | | | |
| 198. | EEM-21 | Edu. Pedagogy | Effective Teaching Learning using Social Media | 02.11.2020 | 06.11.2020 | NITTTR, CHD | RC | Northern |
| 199. | EEM-22 | Advanced Level | Applied Catalysis for Environmentally Sustainable Industries | 02.11.2020 | 06.11.2020 | NITTTR, CHD | AK/HG | National |
| 200. | EEM-23 | Edu. Pedagogy | Digital Transformation of Teaching | 16.11.2020 | 20.11.2020 | NITTTR, CHD | AK | Northern |
| 201. | EEM-24 | Edu. Pedagogy | Induction Training Programme for Newly Recruited Teachers | 23.11.2020 | 04.12.2020 | NITTTR, CHD | PKS | National |
| 7. Computer Science & Engineering Department | | | | | | | | |
| 202. | CSE-31 | Pedagogy | Outcome based Education for Program Accreditation (AICTE Sponsored) | 02.11.2020 | 06.11.2020 | Outstation/ NITTTR, CHD | CRK/ MK | National |
| 203. | CSE-32 | General | Preparing Poly. Colleges for Quality Certifications | 09.11.2020 | 13.11.2020 | NITTTR, CHD | SSG | National |
| 204. | CSE-33 | Research Oriented | Social Network Analysis using Python | 16.11.2020 | 20.11.2020 | NITTTR, CHD | SS | National |
| 205. | CSE-34 | Research Oriented | Cyber Security | 23.11.2020 | 27.11.2020 | NITTTR, CHD | CRK/ AS | National |
| 206. | CSE-35 | Skill Oriented | Use of VR/AR in Teachers Education | 23.11.2020 | 27.11.2020 | NITTTR, CHD | SS/AD/ MD | National |

| | | | | | | | | |
|---|------------------------|-------------------|---|------------|------------|---------------------|-------------------------|----------|
| 207. | CSE-36 | Industry Oriented | Digital Repository and Storage Management | 23.11.2020 | 27.11.2020 | NITTTR, CHD | AD | National |
| 8. Mechanical Engineering Department | | | | | | | | |
| | Cluster Program | | | | | | | |
| 208. | ME-22 | Advanced | Reverse Engineering | 02.11.2020 | 06.11.2020 | NITTTR, CHD | BSP/SSD | National |
| 209. | ME-23 | Advanced | Advanced AutoCAD | 16.11.2020 | 20.11.2020 | NITTTR, CHD | SJ | National |
| 210. | ME-24 | Advanced | Automation and Robotics | 23.11.2020 | 27.11.2020 | NITTTR, CHD | SSD | National |
| 211. | ME-25 | Research | 3D and 4D Printing Applications | 23.11.2020 | 27.11.2020 | Pbi. Univ., Patiala | RS | National |
| 9. Media Engineering Department | | | | | | | | |
| 212. | MED-8 | | Smart Classroom: Concept, Design ,Operation & Maintenance | 09.11.2020 | 13.11.2020 | NITTTR, CHD | RKW/MS/DK | National |
| 213. | MED-9 | | Academic and Scientific Writing: Tools and Techniques | 23.11.2020 | 27.11.2020 | NITTTR, CHD | Kamald eep/Manisha /RKW | National |
| 10. Rural Development Department | | | | | | | | |
| 214. | RD-10 | Industry Based | Role of Technical Institutions in Integrated Village Development through Unnat Bharat Abhiyan | 02.11.2020 | 06.11.2020 | Only for Punjab | UNR | National |
| December 2020 | | | | | | | | |
| 1. Civil Engineering Department | | | | | | | | |
| 215. | CE-29 | Research Based | Computer Aided Analysis of Laboratory and Design Data in Civil Engineering | 28.12.2020 | 01.01.2021 | NITTTR, CHD | HG/SKS | National |
| 2. Curriculum Development Centre | | | | | | | | |
| 216. | CDC-13 | Pedagogy | Outcome Based Curriculum | 07.12.2020 | 11.12.2020 | NITTTR, CHD | SKG | National |
| 217. | CDC-14 | Pedagogy | NSQF Aligned Curriculum- Design and Implementation | 14.12.2020 | 18.12.2020 | NITTTR, CHD | ABG | National |
| 3. Electrical Engineering Department | | | | | | | | |
| 218. | EE-20 | | Real Time Power System Analysis (in collaboration with Opal-RT) | 07.12.2020 | 11.12.2020 | MNNIT, Allahabad | RT | |

| | | | | | | | | |
|--|--------|--------------------|---|------------|------------|--------------------|---------|-----------|
| 219. | EE-21 | | Image Processing and its application | 14.12.2020 | 18.12.2020 | NITTTR, CHD | PV | |
| 4. Electronics & Communication Engineering Dept. | | | | | | | | |
| 220. | ECE-20 | Advanced Level | Machine Learning Applications using Various Softwares (Two weeks) | 07.12.2020 | 18.12.2020 | NITTTR, CHD | BSD/GS | |
| 221. | ECE-21 | Advanced Level | Artificial Intelligence Techniques | 07.12.2020 | 11.12.2020 | NITTTR, CHD | AMK | |
| 222. | ECE-22 | Advanced Level | Nanoelectronics Devices and Circuits | 14.12.2020 | 18.12.2020 | NITTTR, CHD | B Raj | |
| 5. Entrepreneurship Development & Industrial Coordination | | | | | | | | |
| 223. | ED-13 | Industry Supported | How to start a Business Start-up (Cluster Programme) | 07.12.2020 | 11.12.2020 | Govt.Poly. Sonipat | HKV/SSD | Haryana |
| 224. | ED-14 | Industry Supported | Fostering Innovation and Incubation for Business Start ups | 14.12.2020 | 25.12.2020 | Govt.Poly. Bikaner | ADS | Rajasthan |
| 6. Education & Educational Management | | | | | | | | |
| 225. | EEM-25 | Edu. Mgmt. | Motivation, Team Building & Creativity | 07.12.2020 | 11.12.2020 | NITTTR, CHD | SD/RC | Northern |
| 7. Computer Science & Engineering Department | | | | | | | | |
| 226. | CSE-37 | Industry Oriented | Website Security & Penetration Testing | 07.12.2020 | 11.12.2020 | NITTTR, CHD | AS/CRK | National |
| 227. | CSE-38 | Advanced Level | A Practical Approach to Malware Analysis | 07.12.2020 | 11.12.2020 | NITTTR, CHD | MD | National |
| 8. Mechanical Engineering Department | | | | | | | | |
| 228. | ME-26 | Research | Optimization Using MATLAB | 14.12.2020 | 18.12.2020 | NITTTR, CHD | SSD/BSP | National |
| 229. | ME-27 | General/Skill | Mechanical Measurements & Control | 21.12.2020 | 25.12.2020 | NITTTR, CHD | SJ | Northern |
| 230. | ME-28 | Advanced | Mechatronics | 28.12.2020 | 01.01.2021 | NITTTR, CHD | SSD | Northern |
| 9. Rural Development Department | | | | | | | | |
| 231. | RD-11 | Research Based | Innovative Technologies for Village Development | 07.12.2020 | 11.12.2020 | NITTTR, CHD | UNR | National |

January 2021

1. Applied Science Department

| | | | | | | | | |
|------|-------|-----------------|--|------------|------------|-------------|-------|----------|
| 232. | AS-20 | Advance | Advanced Operational Research with LINGO | 11.01.2021 | 15.01.2021 | NITTTR, CHD | KCL | National |
| 233. | AS-21 | General / Skill | Characterization of Multi-functional Materials | 11.01.2021 | 15.01.2021 | NITTTR, CHD | PS/AK | National |
| 234. | AS-22 | General | Nuclear Power : Benefits and Issues | 18.01.2021 | 22.01.2021 | NITTTR, CHD | BCC | National |

2. Civil Engineering Department

Cluster Programs with Civil Engineering Department + Mechanical Engineering Department

| | | | | | | | | |
|------|-------|----------------|--|------------|------------|-------------|---------|----------|
| 235. | CE-30 | Research Based | MATLAB & Simulink for Engineering Applications | 18.01.2021 | 22.01.2021 | NITTTR, CHD | HG/ BSP | National |
|------|-------|----------------|--|------------|------------|-------------|---------|----------|

3. Curriculum Development Centre

Cluster Programs with Applied Science Department

| | | | | | | | | |
|------|--------|-------------------|--|------------|------------|-------------|--------|----------|
| 236. | CDC-15 | Research Oriented | Emerging Materials: Applications in Green Technology | 11.01.2021 | 15.01.2021 | NITTTR, CHD | MS /AK | National |
|------|--------|-------------------|--|------------|------------|-------------|--------|----------|

4. Electrical Engineering Dept.

| | | | | | | | | |
|------|-------|-------------------|---|------------|------------|-------------|----|--|
| 237. | EE-22 | Research Oriented | Bio Inspired Optimisation Techniques | 11.01.2021 | 15.01.2021 | NITTTR, CHD | LM | |
| 238. | EE-23 | Research Oriented | Research Areas in Electrical Engineering using Real time Simulation (in collaboration with Opal-RT) | 11.01.2021 | 15.01.2021 | NITTTR, CHD | RT | |
| 239. | EE-24 | General/ Skill | Arduino Based Application Projects | 18.01.2021 | 22.01.2021 | | AM | |

5. Electronics & Communication Engineering Dept.

| | | | | | | | | |
|------|--------|----------------|--|------------|------------|-------------|-----------|--|
| 240. | ECE-23 | Advanced Level | ECE Lab Practices for polytechnic Teachers (Two weeks) | 04.01.2021 | 15.01.2021 | NITTTR, CHD | B Raj /KS | |
| 241. | ECE-24 | Advanced Level | Advanced Digital Signal Processing | 11.01.2021 | 15.01.2021 | NITTTR, CHD | AMK | |

6. Education & Educational Management

| | | | | | | | | |
|------|--------|------------|-------------------------------|------------|------------|-------------|-----|----------|
| 242. | EEM-26 | Edu. Mgmt. | Project Planning & Management | 04.01.2021 | 08.01.2021 | NITTTR, CHD | PKS | Northern |
|------|--------|------------|-------------------------------|------------|------------|-------------|-----|----------|

| | | | | | | | | |
|------|--------|------------|---|------------|------------|-------------|----|----------|
| 243. | EEM-27 | Edu. Mgmt. | Managing Your Ego and Emotions at Workplace | 11.01.2021 | 15.01.2021 | NITTTR, CHD | SD | Northern |
|------|--------|------------|---|------------|------------|-------------|----|----------|

7. Computer Science & Engineering Department

| | | | | | | | | |
|------|--------|----------------|--|------------|------------|-------------|-------|----------|
| 244. | CSE-39 | General | Governance issues in engineering Education in current scenario | 11.01.2021 | 15.01.2021 | NITTTR, CHD | SSG | National |
| 245. | CSE-40 | Skill Oriented | Open Source Technologies | 18.01.2021 | 22.01.2021 | NITTTR, CHD | AD | National |
| 246. | CSE-41 | Advanced Level | Art of Network Exploitation | 18.01.2021 | 22.01.2021 | NITTTR, CHD | MD | National |
| 247. | CSE-42 | Advanced Level | MATLAB and SCILAB for engineering | 18.01.2021 | 29.01.2021 | AIT, Delhi | MD/AD | DELHI |

8. Mechanical Engineering Department

| | | | | | | | | |
|------|-------|----------|-----------------------|------------|------------|-------------|---------|----------|
| 248. | ME-29 | Advanced | Industry 4.0 | 11.01.2021 | 15.01.2021 | NITTTR, CHD | BSP/SSD | National |
| 249. | ME-30 | Advanced | Production Management | 18.01.2021 | 22.01.2021 | NITTTR, CHD | SSB | Northern |

February 2021

1. Applied Science Department

| | | | | | | | | |
|------|-------|-----------------|-------------------------------------|------------|------------|-------------|-------|----------|
| 250. | AS-23 | General | Fiber Optic Sensors & Applications | 08.02.2021 | 12.02.2021 | NITTTR, CHD | BCC | National |
| 251. | AS-24 | General / Skill | Solar Cell Materials & Fundamentals | 15.02.2021 | 19.02.2021 | NITTTR, CHD | PS/AK | National |

Cluster Programme with Education & Educational Management Department

| | | | | | | | | |
|------|-------|---------|---------------------------------|------------|------------|-------------|-------|----------|
| 252. | AS-25 | General | Research and Publication Ethics | 01.02.2021 | 05.02.2021 | NITTTR, CHD | AK/SD | National |
|------|-------|---------|---------------------------------|------------|------------|-------------|-------|----------|

Cluster Programme with Mechanical Engineering Department

| | | | | | | | | |
|------|-------|-------------------|--------------------------|------------|------------|-------------|---------|----------|
| 253. | AS-26 | Advance/ Research | Optimization with MATLAB | 15.02.2021 | 19.02.2021 | NITTTR, CHD | KCL/SSD | National |
|------|-------|-------------------|--------------------------|------------|------------|-------------|---------|----------|

2. Civil Engineering Department

| | | | | | | | | |
|------|-------|----------------|-----------------------------------|------------|------------|-------------|-----------|----------|
| 254. | CE-31 | Advanced | Green Buildings & Services | 15.02.2021 | 19.02.2021 | NITTTR, CHD | HG/SKS/AG | National |
| 255. | CE-32 | Skill Oriented | Lab Practices in Soil Engineering | 22.02.2021 | 26.02.2021 | NITTTR, CHD | VKS | National |

| | | | | | | | | |
|--|----------|------------------------|---|---------------|---------------|-----------------------------|------------------|----------|
| 256. | CE-33 | Research Based | Use of Robotic Total Station and GNSS | February 2021 | February 2021 | NITTTR, CHD | HS | National |
| 257. | CE-34 | Research Based | Design and Construction of Foundation for Bridges | February 2021 | February 2021 | NITTTR, CHD | AKD | National |
| Cluster Programs with EDIC Dept. | | | | | | | | |
| 258. | CE-35 | Advanced | Bridge Construction Retrofitting and Monitoring | 22.02.2021 | 26.02.2021 | NITTTR, CHD/ GP Sundarnagar | HG/ HKV | National |
| 3. Curriculum Development Centre | | | | | | | | |
| 259. | CDC-16 | Skill Oriented | Practical Skills in Technical Education | 01.02.2021 | 05.02.2021 | NITTTR, CHD | RM | National |
| 260. | CDC-17 | Pedagogy | Accreditation and Outcome Based Curriculum Design | 07.02.2021 | 12.02.2021 | NITTTR, CHD | MS | National |
| 4. Centre for Clean Technologies and Sustainable Development | | | | | | | | |
| 261. | CCTSD -2 | General/ Skill | Clean Technologies for Sustainable Development | 22.02.2021 | 26.02.2021 | NITTTR, CHD | SKS/ HG | National |
| 5. Electrical Engineering Department | | | | | | | | |
| 262. | EE-25 | Research Oriented | Distributed Generation and Microgrid | 01.02.2021 | 05.02.2021 | NITTTR, CHD | LM/PV | |
| 6. Electronics & Communication Engineering Dept. | | | | | | | | |
| Cluster Programs with Computer Science & Engineering Department | | | | | | | | |
| 263. | ECE-25 | Advanced Level | Digital Marketing | 15.02.2021 | 19.02.2021 | NITTTR, CHD | BSD/ KGS | Northern |
| 7. Entrepreneurship Development & Industrial Coordination | | | | | | | | |
| 264. | ED-15 | Industry Supported | Employability Schemes for Industry | 01.02.2021 | 05.02.2021 | IRDT Dehradun | HKV | UK |
| 265. | ED-16 | Research oriented | Achievement Motivation Training for Entrepreneurship | 08.02.2021 | 12.02.2021 | Govt.Poly. Bathinda | ADS | PB |
| 266. | ED-17 | Industry Supported | Strategic planning for effective Industry Institute Partnership | 22.02.2021 | 26.02.2021 | GPW Jammu | HKV/ New Faculty | J & K |
| 8. Education & Educational Management | | | | | | | | |
| 267. | EEM-28 | Educational Management | Developing Employable Skills | 01.02.2021 | 05.02.2021 | NITTTR, CHD | RC | National |
| 268. | EEM-29 | Educational Pedagogy | Flipped Classroom & Project Based Learning | 15.02.2021 | 19.02.2021 | NITTTR, CHD | AK/ SD | Northern |

| | | | | | | | | |
|------|--------|----------------------|----------------------------------|------------|------------|-------------|----|----------|
| 269. | EEM-30 | Educational Pedagogy | Soft Skills & Classroom Teaching | 22.02.2021 | 26.02.2021 | NITTTR, CHD | RC | National |
|------|--------|----------------------|----------------------------------|------------|------------|-------------|----|----------|

9. Computer Science & Engineering Department

| | | | | | | | | |
|------|--------|-------------------|---|------------|------------|-------------|----------|----------|
| 270. | CSE-43 | Skill Oriented | Computer Network & Hardware Maintenance | 01.02.2021 | 05.02.2020 | NITTTR, CHD | PB/AN/SN | National |
| 271. | CSE-44 | Advanced Level | Semantic Web | 01.02.2021 | 05.02.2021 | NITTTR, CHD | KGS | National |
| 272. | CSE-45 | Skill oriented | Virtual Reality | 08.02.2021 | 12.02.2021 | NITTTR, CHD | SS/AD | National |
| 273. | CSE-46 | Skill Oriented | Software Essentials for Start Up | 08.02.2021 | 12.02.2021 | NITTTR, CHD | KGS | National |
| 274. | CSE-47 | Skill oriented | No SQL Databases | 15.02.2021 | 19.02.2021 | NITTTR, CHD | MK | National |
| 275. | CSE-48 | Advanced Level | Art of Web Exploitation | 15.02.2021 | 19.02.2021 | NITTTR, CHD | MD | National |
| 276. | CSE-49 | Research Oriented | R Programming | 22.02.2021 | 26.02.2021 | NITTTR, CHD | SS | National |
| 277. | CSE-50 | General | Cyber Crimes and Forensic Tools | 22.02.2021 | 05.03.2021 | BEC | MD | RAJ |

10. Mechanical Engineering Department

| | | | | | | | | |
|------|-------|----------|--|------------|------------|------------|---------|----------|
| 278. | ME-31 | Advanced | Green Manufacturing | 01.02.2021 | 05.02.2021 | NITTTR CHD | SJ | Northern |
| 279. | ME-32 | Advanced | Recent Trends in Automobile Technology | 22.02.2021 | 26.02.2021 | NITTTR CHD | SSB/SSD | National |

11. Media Engineering Department

| | | | | | | | | |
|------|--------|--|---|------------|------------|------------|-------------------------|----------|
| 280. | MED-10 | | Teaching with Technology: Possibilities of Learning | 08.02.2021 | 12.02.2021 | NITTTR CHD | Manisha/Kamald eep/RK W | National |
|------|--------|--|---|------------|------------|------------|-------------------------|----------|

12. Rural Development Department

| | | | | | | | | |
|------|-------|----------------|---|------------|------------|-------------|----|----------|
| 281. | RD-12 | Research Based | Renewable Energy Sources- Aspects and Prospects | 01.02.2021 | 05.02.2021 | NITTTR, CHD | PS | National |
|------|-------|----------------|---|------------|------------|-------------|----|----------|

March 2021

1. Applied Science Department

| | | | | | | | | |
|------|-------|---------|---|------------|------------|-------------|-------|----------|
| 282. | AS-27 | General | Solid State Physics & Chemistry for Engineers | 01.03.2021 | 05.03.2021 | NITTTR, CHD | AK/PS | National |
|------|-------|---------|---|------------|------------|-------------|-------|----------|

Cluster Programs with Electronics & Communication Engineering Department

| | | | | | | | | |
|---|--------|----------------------|---|------------|------------|-------------------|-------------|------------------|
| 283. | AS-28 | Advance/ Research | OFC Systems: Design & Performance Evaluation Cluster with ECE | 15.03.2021 | 19.03.2021 | NITTTR, CHD | BCC/ SSG | National |
| 2. Civil Engineering Department | | | | | | | | |
| 284. | CE-36 | Research Based | Environmental Pollution: Issues and Remedies | 15.03.2021 | 19.03.2021 | NITTTR, CHD | SKS/ HG | National |
| 3. Curriculum Development Centre | | | | | | | | |
| 285. | CDC-18 | Pedagogy | Curriculum Implementation | 01.03.2021 | 05.03.2021 | NITTTR, CHD | SKG | National |
| 286. | CDC-19 | Research Oriented | Research Oriented Project Work | 15.03.2021 | 19.03.2021 | NITTTR, CHD | RM | National |
| 4. Education and Educational Management | | | | | | | | |
| 287. | EEM-31 | Research Oriented | Student Assessment and Evaluation | 08.03.2021 | 12.03.2021 | NITTTR, CHD | SD/AK | National |
| 288. | EEM-32 | Edu. Mgmt. | Personality Development | 08.03.2021 | 12.03.2021 | IRDT, Dehradun | PKS | Uttara- khand |
| 289. | EEM-33 | Edu. Pedagogy | Guidance, Counselling & Mentoring Skills | 15.03.2021 | 19.03.2021 | NITTTR, CHD | RC/ PKS | Northern |
| 5. Computer Science & Engineering Department | | | | | | | | |
| 290. | CSE-51 | Advanced Level | Cyber Threat and Vulnerability Assessment | 15.03.2021 | 19.03.2021 | NITTTR, CHD | MD | National |
| 291. | CSE-52 | Advanced Level | Digital Repositories for library professionals | 15.03.2021 | 19.03.2021 | NITTTR, CHD | KGS | National |
| 292. | CSE-53 | Advanced Level | Data Breaches and Counter Measures | 15.03.2021 | 26.03.2021 | GPW-11, CHD. | MD | |
| 6. Mechanical Engineering Department | | | | | | | | |
| 293. | ME-33 | Advanced | CAD/CAM | 15.03.2021 | 19.03.2021 | NITTTR CHD | PSR | National |
| 294. | ME-34 | Advanced | CAD Using SOLIDWORKS | 22.03.2021 | 26.03.2021 | NITTTR CHD | SJ | National |
| 7. Rural Development Department | | | | | | | | |
| 295. | RD-13 | Research Based | Unnat Bharat Abhiyan- Participation of Technical Institutions | 01.03.2021 | 05.03.2021 | NITTTR, CHD | PS | National |

1.2 SHORT TERM PROGRAMMES

B. [ICT MODE (Through Google Hangout/other Video Conferencing Mode)]

| Sr. No. | O.Plan No. | Category | Name of Programme | Start Date | End Date | Venue | Coordinator | Beneficiary State |
|--|------------|-------------------|--|------------|------------|-------------|-------------|-------------------|
| April 2020 | | | | | | | | |
| 1. Civil Engineering Department | | | | | | | | |
| 1. | ICT-1 | Advanced Level | Water Resources Management | 27.04.2020 | 01.05.2020 | NITTTR, CHD | HG/SKS | National |
| 2. Curriculum Development Centre | | | | | | | | |
| 2. | ICT-2 | Pedagogy | Curriculum Implementation | 20.04.2020 | 24.04.2020 | NITTTR, CHD | SKG | National |
| 3. Electronics & Communication Engineering Department | | | | | | | | |
| 3. | ICT-3 | Advanced Level | Specifications to System Development | 13.04.2020 | 17.04.2020 | NITTTR CHD | KS | National |
| 4. | ICT-4 | Advanced Level | Low Power VLSI Design | 20.04.2020 | 24.04.2020 | NITTTR CHD | B Raj/SSG | National |
| 5. | ICT-5 | Advanced Level | Future Technologies | 27.04.2020 | 01.05.2020 | NITTTR CHD | GS | National |
| 4. Entrepreneurship Development & Coordination Dept. | | | | | | | | |
| 6. | ICT-6 | Research Oriented | Startup of Business Incubation in Technical Institutions | 27.04.2020 | 01.05.2020 | NITTTR, CHD | SKD | National |
| 5. Computer Science & Engineering Department | | | | | | | | |
| 7. | ICT-7 | Research Oriented | Cloud, Fog and Edge Computing | 20.04.2020 | 24.04.2020 | NITTTR, CHD | KGS | National |
| 8. | ICT-8 | Research Oriented | Image Processing and Signal Processing using SCILAB | 27.04.2020 | 01.05.2020 | NITTTR, CHD | MD | National |
| May 2020 | | | | | | | | |
| 1. Civil Engineering Department | | | | | | | | |
| 9. | ICT-9 | Research Based | Defect Free Construction Repair and Maintenance | 25.05.2020 | 29.05.2020 | NITTTR, CHD | SKS/HG | National |

| Sr. No. | O.Plan No. | Category | Name of Programme | Start Date | End Date | Venue | Coordinator | Beneficiary State |
|--|------------|--------------------|---|------------|------------|-------------|-------------|-------------------|
| 2. Curriculum Development Centre | | | | | | | | |
| 10. | ICT-10 | Research Oriented | Research Oriented Project Work | 11.05.2020 | 15.05.2020 | NITTTR, CHD | RM | National |
| 3. Electronics & Communication Engineering Department | | | | | | | | |
| 11. | ICT-11 | Advanced Level | 5G Technology | 18.05.2020 | 22.05.2020 | NITTTR, CHD | GS | National |
| 4. Entrepreneurship Development & Coordination Dept. | | | | | | | | |
| 12. | ICT-12 | Industry Supported | Employability Skills for Industry 4.0 | 11.05.2020 | 15.05.2020 | NITTTR, CHD | HKV | National |
| 5. Computer Science & Engineering Department | | | | | | | | |
| 13. | ICT-13 | Research Oriented | Big Data Analytics through ICT | 11.05.2020 | 15.05.2020 | NITTTR, CHD | MK | National |
| 6. Media Engineering Department | | | | | | | | |
| 14. | ICT-14 | | Strategic Management and SWOT Analysis for Institutional Excellence | 04.05.2020 | 08.05.2020 | NITTTR, CHD | RKW | National |
| June 2020 | | | | | | | | |
| 1. Applied Science (Inter-Disciplinary) | | | | | | | | |
| 15. | ICT-15 | Advance | Advances in Laser Technology | 01.06.2020 | 05.06.2020 | NITTTR, CHD | BCC | National |
| 16. | ICT-16 | Advance/Skill | Advances in Nanostructured Materials | 15.06.2020 | 19.06.2020 | NITTTR, CHD | AK/PS | National |
| 2. Mechanical Engineering Department: | | | | | | | | |
| 17. | ICT-17 | Research | Advance Material Processing and Characterization | 08.06.2020 | 12.06.2020 | NITTTR, CHD | RS | National |
| 18. | ICT-18 | Research | Modeling & Simulation using MATLAB | 15.06.2020 | 19.06.2020 | NITTTR, CHD | SSD | National |

| Sr. No. | O.Plan No. | Category | Name of Programme | Start Date | End Date | Venue | Coordinator | Beneficiary State |
|--|------------|-------------------|--|------------|------------|-------------|-------------|-------------------|
| July 2020 | | | | | | | | |
| 1. Civil Engineering Dept. | | | | | | | | |
| 19. | ICT-19 | Advanced | Skill Development and Technological Innovation for Employment Generation | 13.07.2020 | 17.07.2020 | NITTTR, CHD | AG | National |
| 2. Electronics & Communication Engineering Department | | | | | | | | |
| 20. | ICT-20 | Advanced Level | 5G & IoT | 20.07.2020 | 24.07.2020 | NITTTR, CHD | GS | National |
| 3. Education & Educational Management Dept. | | | | | | | | |
| 21. | ICT-21 | Edu. Pedagogy | Cooperative & Collaborative Instructional Methods to promote Meaningful Learning | 13.07.2020 | 17.07.2020 | NITTTR, CHD | AK | National |
| 4. Computer Science & Engineering Department | | | | | | | | |
| 22. | ICT-22 | Research Oriented | Penetration Testing with Kali Linux | 20.07.2020 | 31.07.2020 | NITTTR, CHD | MD | National |
| August 2020 | | | | | | | | |
| 1. Electrical Engineering Dept. | | | | | | | | |
| 23. | ICT-23 | Advanced Level | Electric Vehicle Technology | 10.08.2020 | 14.08.2020 | NITTTR, CHD | LM | National |
| 2. Electronics & Communication Engineering Dept. | | | | | | | | |
| 24. | ICT-24 | Advanced Level | System Designing with Embedded Processors | 17.08.2020 | 21.08.2020 | NITTTR, CHD | KS | National |
| 25. | ICT-25 | Advanced Level | Digital Media Tools for Effective Teaching-Learning | 17.08.2020 | 21.08.2020 | NITTTR, CHD | BSD | National |
| 26. | ICT-26 | Advanced Level | Artificial Neural Networks | 17.08.2020 | 21.08.2020 | NITTTR, CHD | AMK | National |
| 3. Entrepreneurship Development & Coordination Dept. | | | | | | | | |
| 27. | ICT-27 | Advanced Level | E-Governance and Green Technology Entrepreneurship | 17.08.2020 | 21.08.2020 | NITTTR, CHD | ADS | National |

| Sr. No. | O.Plan No. | Category | Name of Programme | Start Date | End Date | Venue | Coordinator | Beneficiary State |
|---|------------|----------------|--|------------|------------|-------------|-------------|-------------------|
| 4. Mechanical Engineering Department | | | | | | | | |
| 28. | ICT-28 | Research | Material Processing Technologies | 24.08.2020 | 28.08.2020 | NITTTR, CHD | RS | National |
| 5. Media Engineering Department | | | | | | | | |
| 29. | ICT-29 | | Sustainable Creativity & Innovation Management in Institutions | 17.08.2020 | 21.08.2020 | NITTTR, CHD | RKW | National |
| September 2020 | | | | | | | | |
| 1. Civil Engineering Dept. | | | | | | | | |
| 30. | ICT-30 | Advanced | Low Cost Housing Techniques and Practices (Cluster) | 07.09.2020 | 11.09.2020 | NITTTR, CHD | SKS/AG | National |
| 2. Curriculum Development Centre | | | | | | | | |
| 31. | ICT-31 | Pedagogy | Curriculum Development | 21.09.2020 | 25.09.2020 | NITTTR, CHD | SKG | National |
| 3. Education & Educational Management Dept. | | | | | | | | |
| 32. | ICT-32 | Edu. Mgmt. | Managerial Skills for Technical Teachers & Administrators | 14.09.2020 | 18.09.2020 | NITTTR, CHD | SD | National |
| 4. Mechanical Engineering Department | | | | | | | | |
| 33. | ICT-33 | Advanced | Advances in Manufacturing | 07.09.2020 | 11.09.2020 | NITTTR, CHD | SJ/PSR | National |
| 5. Media Engineering Department | | | | | | | | |
| 34. | ICT-34 | | Institutional Management for Excellence | 07.09.2020 | 11.09.2020 | NITTTR, CHD | RKW | National |
| October 2020 | | | | | | | | |
| 1. Electronics & Communication Engineering Dept. | | | | | | | | |
| 35. | ICT-35 | Advanced Level | Embedded System in IoTs | 05.10.2020 | 09.10.2020 | NITTTR, CHD | KS | National |
| 36. | ICT-36 | Advanced Level | Design Challenges in Low Power VLSI Design | 12.10.2020 | 16.10.2020 | NITTTR, CHD | SSG/B Raj | National |

| Sr. No. | O.Plan No. | Category | Name of Programme | Start Date | End Date | Venue | Coordinator | Beneficiary State |
|--|------------|--------------------|---|------------|------------|-------------|-------------|-------------------|
| 2. Entrepreneurship Development & Coordination Dept. | | | | | | | | |
| 37. | ICT-37 | Industry Supported | Industry Academic Likings: National & International Practices | 19.10.2020 | 23.10.2020 | NITTTR, CHD | SKD | National |
| 3. Education & Educational Management Dept. | | | | | | | | |
| 38. | ICT-38 | Edu. Mgmt. | Preparing Students for Job Interviews | 05.10.2020 | 09.10.2020 | NITTTR, CHD | PKS | National |
| 4. Computer Science & Engineering Department | | | | | | | | |
| 39. | ICT-39 | Research Oriented | Machine Learning using Python | 12.10.2020 | 16.10.2020 | NITTTR, CHD | SS/SG | National |
| 5. Media Engineering Department | | | | | | | | |
| 40. | ICT-40 | | Managing your self | 12.10.2020 | 16.10.2020 | NITTTR, CHD | RKW | National |
| 6. Rural Development Department | | | | | | | | |
| 41. | ICT-41 | Research Based | Clean and Green Technologies for Sustainable Development | 19.10.2020 | 23.10.2020 | NITTTR, CHD | PS | National |
| November 2020 | | | | | | | | |
| 1. Electronics & Communication Engineering Department | | | | | | | | |
| 42. | ICT-42 | Advanced Level | Artificial Intelligence for Engineering Applications | 02.11.2020 | 06.11.2020 | NITTTR, CHD | B Raj | National |
| 2. Education & Educational Management Department | | | | | | | | |
| 43. | ICT-43 | Edu. Pedagogy | Personality Development | 09.11.2020 | 13.11.2020 | NITTTR, CHD | PKS | National |
| 3. Mechanical Engineering Department | | | | | | | | |
| 44. | ICT-44 | Advanced | AutoCAD | 16.11.2020 | 20.11.2020 | NITTTR, CHD | SJ | National |

| Sr. No. | O.Plan No. | Category | Name of Programme | Start Date | End Date | Venue | Coordinator | Beneficiary State |
|---|------------|-------------------|---|------------|------------|-------------|-------------|-------------------|
| December 2020 | | | | | | | | |
| 1. Applied Science (Inter-Disciplinary) | | | | | | | | |
| 45. | ICT-45 | Advance/Skill | Advances in Energy Materials | 07.12.2020 | 11.12.2020 | NITTTR, CHD | PS/AK | National |
| 46. | ICT-46 | Advance/Skill | Operations Research with Engineering Applications | 14.12.2020 | 18.12.2020 | NITTTR, CHD | KCL | National |
| 2. Mechanical Engineering Department | | | | | | | | |
| 47. | ICT-47 | Research | Optimization Using MATLAB | 14.12.2020 | 18.12.2020 | NITTTR, CHD | SSD/BSP | National |
| 3. Media Engineering Department | | | | | | | | |
| 48. | ICT-48 | | Achieving Managerial Excellence | 14.12.2020 | 18.12.2020 | NITTTR, CHD | RKW | National |
| 4. Rural Development Department | | | | | | | | |
| 49. | ICT-49 | Research Based | Emerging Areas of Research and Innovation in Science and Technology | 07.12.2020 | 11.12.2020 | NITTTR, CHD | PS | National |
| January 2021 | | | | | | | | |
| 1. Curriculum Development Centre | | | | | | | | |
| Cluster Program with Applied Science Department | | | | | | | | |
| 50. | ICT-50 | Research Oriented | Emerging Materials: Applications in Green Technology | 11.01.2021 | 15.01.2021 | NITTTR, CHD | MS/AK | National |
| 2. Electrical Engineering Dept. | | | | | | | | |
| 51. | ICT-51 | | MATLAB and its Hardware Interface | 11.01.2021 | 15.01.2021 | NITTTR, CHD | RT | National |
| 3. Electronics & Communication Engineering Dept. | | | | | | | | |
| 52. | ICT-52 | Advanced Level | Energy Efficient sensor Network | 18.01.2021 | 22.01.2021 | NITTTR, CHD | KS | National |

| Sr. No. | O.Plan No. | Category | Name of Programme | Start Date | End Date | Venue | Coordinator | Beneficiary State |
|---|------------|-------------------|--|------------|------------|-------------|-------------|-------------------|
| 53. | ICT-53 | Advanced Level | Antennas and Wireless Communication Technologies for IOT | 18.01.2021 | 22.01.2021 | NITTTR, CHD | BSD | National |
| 4. Entrepreneurship Development & Coordination Dept. | | | | | | | | |
| 54. | ICT-54 | Research Oriented | Project Management in SMEs | 25.01.2021 | 29.01.2021 | NITTTR, CHD | HKV | National |
| 5. Computer Science & Engineering Department | | | | | | | | |
| 55. | ICT-55 | Research Oriented | Safety Awareness in Cyber Space | 04.01.2020 | 08.01.2020 | NITTTR, CHD | CRK/AS | National |
| 56. | ICT-56 | Advanced | Industry 4.0 | 11.01.2021 | 15.01.2021 | NITTTR, CHD | BSP/SSD | National |
| 6. Media Engineering Department | | | | | | | | |
| 57. | ICT-57 | | NBA Accreditation for Quality Assurance | 18.01.2021 | 22.01.2021 | NITTTR, CHD | RKW | National |
| February 2021 | | | | | | | | |
| 1. Civil Engineering Dept. | | | | | | | | |
| 58. | ICT-58 | Research Based | Green and Energy Efficient Buildings for Sustainable Development | 15.02.2021 | 19.02.2021 | NITTTR, CHD | HG/SKS | National |
| 2. Curriculum Development Centre | | | | | | | | |
| 59. | ICT-59 | Skill Oriented | Practical Skills in Technical Education | 01.02.2021 | 05.02.2021 | NITTTR, CHD | RM | National |
| 60. | ICT-60 | Pedagogy | Curriculum Implementation | 09.02.2021 | 13.02.2021 | NITTTR, CHD | ABG | National |
| 3. Centre for Clean Technologies and Sustainable Development | | | | | | | | |
| 61. | ICT-61 | | Clean Technologies for Sustainable Development | 22.02.2021 | 26.02.2021 | NITTTR, CHD | SKS/HG | National |
| 4. Electrical Engineering Dept. | | | | | | | | |
| 62. | ICT-62 | | Energy from waste : sustainable application | 15.02.2021 | 19.02.2021 | NITTTR, CHD | PV | National |

| Sr. No. | O.Plan No. | Category | Name of Programme | Start Date | End Date | Venue | Coordinator | Beneficiary State |
|---|------------|-------------------|--|------------|------------|-------------|-------------|-------------------|
| 5. Electronics & Communication Engineering Dept. | | | | | | | | |
| 63. | ICT-63 | Advanced Level | Recent Trends in VLSI Design | 01.02.2021 | 05.02.2021 | NITTTR, CHD | B Raj/SSG | National |
| 6. Education & Educational Management Dept. | | | | | | | | |
| 64. | ICT-64 | Edu. Mgmt. | Developing Employable Skills | 01.02.2021 | 05.02.2021 | NITTTR, CHD | RC | National |
| 65. | ICT-65 | Edu. Pedagogy | Soft Skills & Classroom Teaching | 22.02.2021 | 26.02.2021 | NITTTR, CHD | RC | National |
| 7. Computer Science & Engineering Department | | | | | | | | |
| 66. | ICT-66 | Research Oriented | Engineering Applications using Open Source | 15.02.2021 | 19.02.2021 | NITTTR, CHD | AD | National |
| 8. Mechanical Engineering Department | | | | | | | | |
| 67. | ICT-67 | Advanced | Recent Trends in Automobile Technology | 22.02.2021 | 26.02.2021 | NITTTR, CHD | SSB/SSD | National |
| 9. Rural Development Department | | | | | | | | |
| 68. | ICT-68 | Research Oriented | Organic Farming, Vernacular Architecture and Rural Tourism | 08.02.2021 | 12.02.2021 | NITTTR, CHD | UNR | National |

March 2021

| | | | | | | | | |
|---|--------|-------------------|--|------------|------------|-------------|--------|----------|
| 1. Civil Engineering Dept. | | | | | | | | |
| 69. | ICT-69 | Research Based | Innovative Building Construction Practices for Environment and Health Protection | 08.03.2021 | 12.03.2021 | NITTTR, CHD | AG | National |
| 70. | ICT-70 | Research Based | Application of Auto CAD in Engineering | 15.03.2021 | 19.03.2021 | NITTTR, CHD | VKS | National |
| 71. | ICT-71 | Research Based | Sustainable Environmental Management | 15.03.2021 | 19.03.2021 | NITTTR, CHD | SKS/HG | National |
| 72. | ICT-72 | Research Based | Remote Sensing and GIS in Civil Engineering | March-2021 | March-2021 | NITTTR, CHD | HS | National |
| 2. Curriculum Development Centre | | | | | | | | |
| 73. | ICT-73 | Research Oriented | Research Oriented Project Work | 15.03.2021 | 19.03.2021 | NITTTR, CHD | RM | National |

| Sr. No. | O.Plan No. | Category | Name of Programme | Start Date | End Date | Venue | Coordinator | Beneficiary State |
|---|------------|-------------------|--|------------|------------|-------------|-------------|-------------------|
| 3. Electronics & Communication Engineering Dept. | | | | | | | | |
| 74. | ICT-74 | Advanced Level | Bio-inspired Computation | 01.03.2021 | 05.03.2021 | NITTTR, CHD | AMK | National |
| 75. | ICT-75 | Advanced Level | Technology Management for Electronic Product Design | 15.03.2021 | 19.03.2021 | NITTTR CHD | SSG | National |
| 76. | ICT-76 | Advanced Level | AI & Soft Computing Algorithms for Antenna Design | 15.03.2021 | 19.03.2021 | NITTTR, CHD | BSD | National |
| 4. Entrepreneurship Development & Coordination Dept. | | | | | | | | |
| 77. | ICT-77 | Research Oriented | Strategic Planning and SWOT Analysis of Technical Institutions | 01.03.2021 | 05.03.2021 | NITTTR, CHD | SKD | National |
| 5. Education & Educational Management Dept. | | | | | | | | |
| 78. | ICT-78 | Research Oriented | Research Methodology | 01.03.2021 | 05.03.2021 | NITTTR, CHD | AK/SD | National |
| 79. | ICT-79 | Edu. Pedagogy | Student Assessment and Evaluation | 08.03.2021 | 12.03.2021 | NITTTR, CHD | SD/AK | National |
| 6. Mechanical Engineering Department | | | | | | | | |
| 80. | ICT-80 | Advanced | CAD/CAM | 15.03.2021 | 19.03.2021 | NITTTR, CHD | PSR | National |
| 81. | ICT-81 | Advanced | CAD Using SOLIDWORKS | 22.03.2021 | 26.03.2021 | NITTTR, CHD | SJ | National |
| 7. Media Engineering Department | | | | | | | | |
| 82. | ICT-82 | General | Technical Teachers Self Esteem, Motivation and Professionalism and Development | 15.03.2021 | 19.03.2021 | NITTTR CHD | RKW | National |

1.2 STUDENT TRAINING PROGRAMMES THROUGH ICT-CUM CONTACT MODE

| Sr. No. | O.Plan No. | Category | Name of Programme | Start Date | End Date | Venue | Coordinator | Beneficiary State |
|---------|------------|----------------------|---|------------|------------|------------------------------|------------------------|-------------------|
| 1. | ST-1 | Skill Oriented | Entrepreneurship Awareness Camp | 13.04.2020 | 17.04.2020 | PIT, Delhi | ADS EDIC | Delhi |
| 2. | ST-2 | Educational Pedagogy | Developing Life Skills | 06.05.2020 | 06.05.2020 | NITTTR, CHD | RC EMGT | National |
| 3. | ST-3 | Skill Oriented | Entrepreneurship and Start-up Policies 2017 | 21.05.2020 | 22.05.2020 | CMRA Govt.Poly. Rohtak | ADS EDIC | Haryana |
| 4. | ST-4 | Skill Oriented | Entrepreneurship and Start-up Policies 2017 | 11.06.2020 | 12.06.2020 | Govt.Poly. Sonipat | HKV EDIC | Haryana |
| 5. | ST-5 | Skill Oriented | Using MATLAB & Simulink for Project Work | 15.06.2020 | 19.06.2020 | NITTTR, CHD | SSD MECH | National |
| 6. | ST-6 | Skill Oriented | Entrepreneurship Awareness Camp | 25.06.2020 | 26.06.2020 | GPW, Bemina Srinagar | HKV EDIC | J&K |
| 7. | ST-7 | Skill Oriented | Entrepreneurship and Start-up Policies 2017 | 23.07.2020 | 24.07.2020 | Govt.Poly. Hisar | SKD/ New Faculty | Haryana |
| 8. | ST-8 | Skill Oriented | Entrepreneurship and Start-up Policies 2017 | 06.08.2020 | 07.08.2020 | Govt.Poly. Ambala | SKD EDIC | Haryana |
| 9. | ST-9 | Educational Pedagogy | Developing Employable Skills | 18.09.2020 | 18.09.2020 | NITTTR, CHD | AK EMGT | National |
| 10. | ST-10 | General | Social Media Management | 19.10.2020 | 20.10.2020 | NITTTR CHD | HS/MA | National |
| 11. | ST-11 | Skill Oriented | Students Grooming for Entrepreneurship | 23.11.2020 | 27.11.2020 | AIT, Delhi | ADS EDIC | Delhi |
| 12. | ST-12 | Educational Pedagogy | Preparing Students for Job Interviews | 25.11.2020 | 25.11.2020 | NITTTR, CHD | SD EMGT | National |
| 13. | ST-13 | Educational Pedagogy | Communication Skills | 29.01.2021 | 29.01.2021 | NITTTR, CHD | PKS EMGT | National |
| 14. | ST-14 | Skill Oriented | Students Grooming for Entrepreneurship | 15.03.2021 | 19.03.2021 | GP, Budgam | ADS/ New Faculty | J&K |

1.3 CONFERENCES/SEMINARS

| Sr. No. | O.Plan No. | Name of Programme | Start Date | End Date | Venue | Coordi-nator | Benefi-ciary State |
|---------|------------|--|---------------|------------|-------------|---------------|--------------------|
| 1. | NC-1 | International Conference on Clean Technologies & Sustainable Development | February 2021 | | NITTTR, CHD | SKS | National |
| 2. | NC-2 | National Conference on Business startups, Innovation and Entrepreneurship | 03.09.2020 | 04.09.2020 | NITTTR, CHD | SKD/ HKV/ ADS | National |
| 3. | NC-3 | Academic Excelling through Outcome based Accreditation | 03.12.2020 | 04.12.2020 | NITTTR, CHD | MS/ SSP | National |
| 4. | IC-1 | International Conference on Clean Technologies | 25.02.2021 | 26.02.2021 | NITTTR CHD | SSB/ RKW | National |
| 5. | NC-4 | National Conference on Advances in Manufacturing Technology - 2021 (CAMT-2021) | 11.03.2021 | 12.03.2021 | NITTTR, CHD | SSD/ RS | National |
| 6. | IC-2 | International Conference on Virtual Reality for Teachers Education | 18.03.2021 | 19.03.2021 | NITTTR, CHD | CSE Faculty | National |

1.4 WORKSHOPS

| Sr. No. | O.Plan No. | Category | Name of Programme | Start Date | End Date | Venue | Coordi-nator | Benefi-ciary State |
|---------|------------|--------------------|--|------------|------------|---------------------|--------------|--------------------|
| 1. | W-1 | Pedagogy | Training of Trainers Workshop on 'Student Evaluation & Paper Setting' | 09.04.2020 | 09.04.2020 | Govt.Poly., Hisar | SD/ AK | Haryana |
| 2. | W-2 | Pedagogy | Training of Trainers Workshop on 'Student Evaluation & Paper Setting' | 17.04.2020 | 17.04.2020 | Govt.Poly. Rohtak | AK/ SD | Haryana |
| 3. | W-3 | Pedagogy | Training of Trainers Workshop on 'Student Evaluation & Paper Setting' | 24.04.2020 | 24.04.2020 | Govt.Poly. Ambala | SD/ AK | Haryana |
| 4. | W-4 | General | National Workshop on NDT Analysis and Repair of Concrete Structures | 21.05.2020 | 22.05.2020 | NITTTR, CHD | SKS/ AG | All States |
| 5. | W-5 | Pedagogy | Training of Trainers Workshop on 'Student Evaluation & Paper Setting' | 22.05.2020 | 22.05.2020 | Govt.Poly. Sonapat | PKS/ RC | Haryana |
| 6. | W-6 | Pedagogy | Student Evaluation & Paper Setting | 05.06.2020 | 05.06.2020 | Govt.Poly. Dehradun | SD/ AK | Uttarakhand |
| 7. | W-7 | Industry Supported | 3 days workshop on Antenna Simulations and Measurements in Collaboration with Key sight Technologies | 10.06.2020 | 12.06.2020 | NITTTR, CHD | BSD/ GS | National |
| 8. | W-8 | Industry Supported | Refresher workshop for Training and Placement officers | 09.07.2020 | 10.07.2020 | NITTTR, CHD | HKV/ ADS | Northern States |

| Sr. No. | O.Plan No. | Category | Name of Programme | Start Date | End Date | Venue | Coordinator | Beneficiary State |
|---------|------------|--------------------|--|-----------------|------------|---------------------------|-------------|-------------------|
| 9. | W-9 | | National Workshop on Energy Simulations for ECBC Compliant Green Buildings | 16.07.2020 | 17.07.2020 | NITTTR, CHD | HG/ SKS | All States |
| 10. | W-10 | Skill | Nano-scale Characterization & Analysis | 05.08.2020 | 07.08.2020 | NITTTR, CHD | BCC/ AK/ PS | Northern Region |
| 11. | W-11 | General | National Workshop on Enhancing Structural Durability with Advanced Waterproofing Solutions | 20.08.2020 | 21.08.2020 | NITTTR, CHD | SKS/ HG/AG | All States |
| 12. | W-12 | General/ Skill | Fiber Optic Testing & Measurements | 22.02.2021 | 24.02.2021 | NITTTR, CHD | BCC | National |
| 13. | W-13 | Industry Supported | Workshop on Additive Manufacturing for Students | 11.03.2021 | 12.03.2021 | NITTTR, CHD | RS | National |
| 14. | W-14 | Pedagogy | Curricula workshop for designing of NSQF Aligned Diploma Programme for various States | As Per Need | | NITTTR, CHD | CDC Faculty | National |
| 15. | W-15 | General | Workshop on “Swachh Bharat Abhiyan” for Haryana, Himachal Pradesh, Delhi and Chandigarh States | Sept.-Oct. 2020 | | NITTTR, CHD | RD Faculty | HYA, HP CHD, DLI |
| 16. | W-16 | General | Workshop on “Swachh Bharat Abhiyan” for Punjab and Jammu & Kashmir State | Sept.-Oct. 2020 | | NITTTR, CHD | RD Faculty | PB J&K |
| 17. | W-17 | General | Workshop on “Swachh Bharat Abhiyan” for Uttarakhand State | Sept.-Oct. 2020 | | NITTTR, CHD / UK | RD Faculty | UK |
| 18. | W-18 | General | Workshop on “Swachh Bharat Abhiyan” for Uttar Pradesh State | Sept.-Oct. 2020 | | NITTTR, CHD / UP State | RD Faculty | UP |
| 19. | W-19 | General | Workshop on “Swachh Bharat Abhiyan” for Rajasthan State | Sept.-Oct. 2020 | | NITTTR, CHD / Rajasthan | RD Faculty | RAJ |
| 20. | W-20 | General | Workshop on “Unnat Bharat Abhiyan” for Haryana, Himachal Pradesh, Delhi and Chandigarh States | Feb.-Mar 2021 | | NITTTR, CHD | RD Faculty | HYA, HP CHD, DLI |
| 21. | W-21 | General | Workshop on “Unnat Bharat Abhiyan” for Punjab and Jammu & Kashmir States | Feb.-Mar 2021 | | NITTTR, CHD | RD Faculty | PB J&K |
| 22. | W-22 | General | Workshop on “Unnat Bharat Abhiyan” for Uttarakhand State | Feb.-Mar 2021 | | NITTTR, CHD / Uttarakhand | RD Faculty | UK |
| 23. | W-23 | General | Workshop on “Unnat Bharat Abhiyan” for Uttar Pradesh state | Feb.-Mar 2021 | | NITTTR, CHD / UP State | RD Faculty | UP |
| 24. | W-24 | General | Workshop on “Unnat Bharat Abhiyan” for Rajasthan State | Feb.-Mar 2021 | | NITTTR, CHD / Rajasthan | RD Faculty | RAJ |

| Sr. No. | O.Plan No. | Category | Name of Programme | Start Date | End Date | Venue | Coordinator | Beneficiary State |
|---------|------------|----------|--|---------------|---------------|------------|-------------|-------------------|
| 25. | W-25 | Pedagogy | Workshop on “Orientation on NBA Accreditation Process” | To be decided | To be decided | Outstation | CRK/MK | HR/UP/UK |
| 26. | W-26 | Pedagogy | Workshop on “Examination Reforms” | To be decided | To be decided | Outstation | CRK/MK | HR/UP/UK |
| 27. | W-27 | Pedagogy | Workshop on “Filling of SAR Performance” | To be decided | To be decided | Outstation | CRK/MK | HR/UP/UK |
| 28. | W-28 | Pedagogy | Workshop on “Defining and Mapping of COs, POs, PSOs” | To be decided | To be decided | Outstation | CRK/MK | HR/UP/UK |

2.0 CURRICULUM DEVELOPMENT

2.1 CURRICULUM DESIGN

| Sr.No. | Oplan No. | Programme Title | Coordinator | Dept. |
|--------|-----------|--|-------------|-------------|
| 1. | CD-1 | Curriculum Design for MBA (Rural Entrepreneurship) | SKD/UNR/RM | EDIC/RD/CDC |
| 2. | CD-2 | M.E. Mechanical Engineering (Manufacturing Technology) | SSD | MECH |
| 3. | CD-3 | M.E. Mechanical Engineering (Robotics) | SSD | MECH |
| 4. | CD-4 | M.E. in Computer Science & Engineering | MD | CSE |
| 5. | CD-5 | M.E. in Computer Science & Engineering (IoT) | MD | CSE |
| 6. | CD-6 | Curriculum for Study Scheme, Syllabus and Course Contents for ME in Civil Engineering “Construction Technology and Management” (Modular & Regular) will be revised and finalized in the next Meeting of Board of Studies to be held in 2020. | All Faculty | CIVIL |
| 7. | CD-7 | NSQF Aligned Curriculum Design of Diploma Programme for Delhi State | CDC faculty | CDC |
| 8. | CD-8 | NSQF Aligned Curriculum Design of Diploma Programme for Punjab State | CDC faculty | CDC |
| 9. | CD-9 | NSQF Aligned Curriculum Design for Jammu and Kashmir State | CDC faculty | CDC |
| 10. | CD-10 | NSQF Aligned Curriculum Design for Himachal Pradesh State | CDC faculty | CDC |

3.0 INSTRUCTIONAL MATERIAL DEVELOPMENT

3.1 Print Material

| Sr. No. | Oplan No. | Programme Title | Coordinator | Dept. |
|---------------------------|-----------|---|-----------------|----------|
| Readers | | | | |
| 1. | R-1 | Worksheet on Information Education and Communication (IEC) material on Entrepreneurship, Innovation and start up for students. | SKD/HKV/ ADS | EDIC |
| 2. | R-2 | Hybrid Machining | PSR | MECH |
| 3. | R-3 | PLC Programming for Mechanical Engineers | SSD | MECH |
| 4. | R-4 | Worksheets : Applied Physics Experiments - 03 | BCC | APP. SC. |
| 5. | R-5 | Worksheets: Applied Physics Experiments - 03 | PS/AK | App Sc. |
| 6. | R-6 | Worksheets: Applied Physics Experiments - 03 | AK/PS | App Sc. |
| 7. | R-7 | Reader –Artificial Intelligence in Civil Engineering | HG | CIVIL |
| 8. | R-8 | Readers-Revision and Reprinting 1. Improvement of foundation Soils 2. Pre-Fabricated Construction 3. Bearing Capacity of Shallow Foundations 4. Composite Materials | AKD | CIVIL |
| 9. | R-9 | Reader in Construction Management | VKS | CIVIL |
| 10. | R-10 | e-learning web based module on Design of RCC Structures - Content updation | SKS/HG | CIVIL |
| Modules | | | | |
| 1. | M-1 | Intellectual Property Rights and Patenting | SKD/ADS/ HKV | EDIC |
| 2. | M-2 | Course Material/Modules for all the training Programmes (STCs) for 2020-21 | EMGT Faculty | EMGT |
| 3. | M-3 | Dye Sensitized Solar Cell - 01 | AK/PS | APP. SC. |
| 4. | M-4 | Optical Characterization of Thin Films - 01 | PS/AK | App Sc. |
| Laboratory Manuals | | | | |
| 1. | LM-1 | Laboratory Manual for Applied Physics Experiments | PS/BCC/AK | App Sc. |
| 2. | LM-2 | Laboratory Manuals on Cyber Security Tools | MD | CSE |
| 3. | LM-3 | Material Testing | RS/SSB | MECH |
| 4. | LM-4 | Image Processing | AMK | ECE |
| 5. | LM-5 | Signal Processing | AMK | ECE |
| 6. | LM-6 | AI Lab | SSG | ECE |
| 7. | LM-7 | VLSI Lab | BR | ECE |
| 8. | LM-8 | Digital System Design | KS | ECE |
| 9. | LM-9 | Instrumentation and Computational Laboratory | RT | EE |

3.2 Massive Open Online Courses (MOOCs)

| Sr. No. | Oplan No. | Programme Title | Coordinator | Dept. |
|---------|-----------|---|-------------|--------|
| 1. | MO-1 | Entrepreneurship Development | SKD | EDIC |
| 2. | MO-2 | Additive Manufacturing | RS/SSD | MECH |
| 3. | MO-3 | Artificial Intelligence | SSG | ECE |
| 4. | MO-4 | Pedagogy for teaching cloud computing | KGS/MK | CSE |
| 5. | MO-5 | Video Films : Integer Programming Problems and Solution Algorithm - 02 | KCL | APP.SC |
| 6. | MO-6 | Video Films : Optical Fiber Communication (OFC) - 02 | BCC | APP.SC |
| 7. | MO-7 | Video Films : (i) Vapor Deposition Techniques – 01 (ii) Spectroscopic Techniques - 01 | AK | APP.SC |
| 8. | MO-18 | IoT Driven Embedded Systems Applications | RT | EE |

3.3 Non Print Material

Video Films on MOOCs format

| Sr. No. | Oplan No. | Programme Title | Coordinator | Dept. |
|---------|-----------|---|-------------|---------|
| 1. | VF-1 | Rural Innovative Projects for Entrepreneurs | HKV | EDIC |
| 2. | VF-2 | Video Film on Cloudsim (3) | MK | CSE |
| 3. | VF-3 | Shortest Path Algorithms Using Python (4) | SS | CSE |
| 4. | VF-4 | Speech recognition using python | AD | CSE |
| 5. | VF-5 | Face recognition using python | AD | CSE |
| 6. | VF-6 | Object detection using python | AD | CSE |
| 7. | VF-7 | Flexible Manufacturing Systems | BSP/SSD | MECH |
| 8. | VF-8 | Rapid Manufacturing | PSR | MECH |
| 9. | VF-9 | Relative Density of Soil | VKS | CIVIL |
| 10. | VF-10 | Abrasion Test of Concrete | HS | CIVIL |
| 11. | VF-11 | Video Clipping on Road Construction | AKD | CIVIL |
| 12. | VF-12 | Pavement Evaluation by- Benkelman Beam Test | AKD | CIVIL |
| 13. | VF-13 | Resource Efficient Bricks | SKS/HG | CIVIL |
| 14. | VF-14 | Mastic Asphalt Construction | AKD | CIVIL |
| 15. | VF-15 | Permeability of Soil | VKS | CIVIL |
| 16. | VF-16 | Marshal Stability Value | AKD | CIVIL |
| 17. | VF-17 | Bee Keeping | UNR | RD |
| 18. | VF-18 | Video Films : Assignment and Transportation Problems - 04 | KCL | APP SC. |
| 19. | VF-19 | Video Films : Optical Fiber Communication (OFC) - 02 | BCC | APP.SC |
| 20. | VF-20 | Video Films : Vapor Deposition Techniques – 02 | AK | APP SC. |

| Sr. No. | Oplan No. | Programme Title | Coordinator | Dept. |
|---------|-----------|---|-------------|---------|
| 21. | VF-21 | Video Films : Ceramics: Properties and Applications -02 | PS | APP SC. |

4.0 RESEARCH AND DEVELOPMENT

4.1 Ph.D Work

| Sr. No. | Oplan No. | Programme Title | Guide | Department |
|---------|-----------|--------------------|------------------------|------------|
| 1. | RS-1 | Ph.D Thesis Work | SKS/HS/AG | CIVIL |
| 2. | RS-2 | Ph.D Thesis Work | MD/CRK/KG S/MK/RK | CSE |
| 3. | RS-3 | Ph.D Thesis Work | LM/PV/PS/ RT/UK | ELECT |
| 4. | RS-4 | Ph.D Thesis Work | SSG/RM/ AMK/ KS | ECE/CDC |
| 5. | RS-5 | Ph.D Thesis Work | SKD/HKV | EDIC |
| 6. | RS-6 | Ph.D Thesis Work | RKW | MEDIA |
| 7. | RS-7 | Ph. D. Thesis Work | BSP/SSB/ SSD/RS/PSR | MECH |

4.2 M.E. Thesis:

| Sr. No | O Plan Code | Programme Title | Coordinator | Dept. |
|--------|-------------|--|-------------|---------|
| 1. | RS-8 | Construction Technology & Management | All Faculty | CIVIL |
| 2. | RS-9 | Electrical Engineering (Instrumentation & Control) | All Faculty | ELECT |
| 3. | RS-10 | Electronics & Communication Engineering | All Faculty | ECE/CDC |
| 4. | RS-11 | Manufacturing Technology | All Faculty | MECH |
| 5. | RS-12 | Computer Science & Engineering | All Faculty | CSE |

4.3 Research Projects:

| Sr. No | O Plan Code | Programme Title | Coordinator | Dept. |
|--------|-------------|---|-----------------|-------|
| 1. | RS-1 | R&D Project on "Bio-Energy Solution" with IIT, Delhi | UNR | RD |
| 2. | RS-2 | Impact Assessment of Entrepreneurial Interventions in HP State | SKD/HKV/ ADS | EDIC |
| 3. | RS-3 | Impact Studies of Seven years' activities of two selected departments (to be assigned by the Director) of the institute | SD/PKS/AK | EMGT |
| 4. | RS-4 | Pedagogy and Curriculum: Collection of feedback from industry about latest technical advances related to various diploma programmes | CDC Faculty | CDC |
| 5. | RS-17 | Impact of Massive Open Online Courses (MOOCs) on Higher Education | SD/AK | EMGT |

5. EXTENSION SERVICES AND CONSULTANCY PROJECTS

Extension Services:

| Sr. No. | O Plan Code | Programme Title | Coordinator | Dept. |
|-----------------------------------|---------------|--|---------------------------|-------------|
| 1. | EXT-1 | Providing assistance to MHRD, EDCIL, AICTE, ISTE, NPIU, DTE, BTE, Engineering Colleges, Polytechnics, Industries and other Institutions/Organisations in the areas of: Educational Planning and Management | EMGT Faculty | EMGT |
| 2. | EXT-2 | MHRD Grant-in-Aid Project to Polytechnics | AKD | CIVIL |
| 3. | EXT-4 | Testing of various Electrical Works from various organizations- As per requirement | All faculty | ELECT |
| 4. | EXT-7 | Establishing network of Polytechnics Guiding/Assisting State/Polytechnics in Promoting Continuing Education and Innovation and Creativity Development in Students and Teachers. | RKW | MC |
| 5. | EXT-8 | Guiding /Assisting States/Polytechnic in Media Design and Development | RKW | MC |
| 6. | EXT-9 | Unnat Bharat Abhiyan – IIT Delhi Activities | UNR/PS/SKS/CRK | RD |
| 7. | EXT-10 | Swachh Bharat Abhiyan | UNR | RD |
| 8. | EXT-11 | Sansad Adarsh Gram Yojana | UNR | RD |
| 9. | EXT-12 | Assistance in Implementation of Scheme for Training of Masons, Carpenters and Bar Binders on Hazard Resistant Construction for HP State Disaster Management Authority | HKV/SKD | EDIC |
| 10. | EXT-13 | Assistance in Implementation of Scheme for Creation of Task Force of Youth Volunteers for Disaster Preparedness and Response for HP Disaster Management Authority | HKV/SKD | EDIC |
| 11. | EXT-14 | Scheme for Person with Disability | ADS | EDIC |
| 12. | EXT-15 | Material Testing | SSD/BSP/RS | MECH |
| 13. | EXT-16 | Student Training (6 Weeks / 6 Months); Nanotech, OFC | BCC/PS/AK | APP SC. |
| 14. | EXT-17 | Student Training on “Basics of Machine Learning with MATLAB” (01.06.2020 – 15.07.2020) – National Level | KCC | APP SC. |
| 15. | EXT-18 | Providing assistance to MHRD, EDCIL, AICTE, ISTE, NPIU, DTE, BTE, Engineering Colleges, Polytechnics, Industries and other Institutions/Organisations etc. in the areas of: Curriculum Development Centre | CDC Faculty | CDC |
| <i>Sponsored Projects:</i> | | | | |
| 1. | SP-1 | Confidential work of AICTE as per guidelines/budget approved by AICTE. | Dr.S.S.Pattnaik, Director | |
| 2. | SP-2 | Sustain and Enhance Technical Knowledge in Solar Energy Systems under Green Skill Dev. Program of ENVISD Scheme | SKS | CIVIL |
| 3. | SP-4 | ABB India Sponsored Research Work (Project/Ph.D./M.E.) in Mechanical and Electrical Engineering | SSD/LM | MECH./ELECT |

| | | | | |
|-----|-------|---|----------------------------|----------------------|
| 4. | SP-5 | Unnat Bharat Abhiyan- AICTE Sponsored | SKS/UNR/ ADS/AG | CIVIL |
| 5. | SP-6 | MOOCs on various courses | MD/PKT/SD SKD/ RKW/ | ETV/EMGT /EDIC/MC |
| 6. | SP-9 | Capacity Building Training Program for implementing for Punjab ECBC (PEDA Sponsored) | SKS/HG/ PS/AG | CCT&SD |
| 7. | SP-11 | Solid Waste Management Technologies and Regulatory Compliance | SKS | CCT&SD |
| 8. | SP-14 | Start-up Training Program (Enovate Skills) | Mech/Enova- tion Skills | ECE |
| 9. | SP-16 | Creation of Barrier-free Environment and other facilities for Persons with Disabilities under the Scheme. | CRK/MD | CSE |
| 10. | SP-18 | Develop Curriculum of a Course to enhance the employability of students. | ABG | CDC |
| 11. | SP-19 | Recruitment of Project Staff under Unnat Bharat Abhiyan | UNR | RD |
| 12. | SP-20 | Research Promotion Scheme entitled SEBOT Securing Billion of Things | MD | CSE |
| 13. | SP-21 | FDP on “Digital Learning: The Prospectus of IoT Technology in Education | MD | CSE |
| 14. | SP-23 | Establishment of Advanced Cyber Security Laboratory for Technical Teachers Training. | MD | CSE |
| 15. | SP-24 | ATAL Training Program (AICTE) | MD | CSE |
| 16. | SP-25 | Sponsored Project under Share & Mentor Institutions (Margdarshan) Scheme by AICTE. | CRK | CSE |
| 17. | SP-26 | AICTE Atal Course on Internet of Things from 23 – 27 December, 2019. | KGS | CSE |
| 18. | SP-27 | Capacity Building Training Programme (SWAYAM) 04.11.2019 to 06.11.2019 | MD | ETV |
| 19. | SP-28 | International Conference on IoT inclusive Life (IC-1) | RK | COMP |
| 20. | SP-29 | AICTE Training and Learning (ATAL) Academy Sponsored Programme on Robotics from 23 – 27 December, 2019. | SSD | MECH |
| 21. | SP-30 | AICTE Training and Learning (ATAL) Academy sponsored program on “3D Printing & Design” from 16-20 December, 2019. | SSD | MECH |
| 22. | SP-31 | Green Skill Development Course on ETP/STPs/CETPs operation and Maintenance under ENVIS Scheme. | SKS | CCTSD |
| 23. | SP-33 | National Conference on Biomedical Engineering. | SSG | ECE |
| 24. | SP-34 | Solid Waste Management Technologies and Regulatory Compliance | SKS | CIVIL |
| 25. | SP-35 | Structural Safety Audit of Lifeline Buildings of HP state (to be sponsored by HPSDMA) | HKV/SKD | EDIC |
| 26. | SP-36 | Safe Hospitals in HP State in Emergencies and Disasters (to be sponsored by HPSDMA) | HKV/SKD | EDIC |

| Consultancy Projects: | | | | |
|------------------------------|-------|---|-------------|----------------------|
| 1. | CP-1 | Material Testing, Design and Technical Services to industry: i. Concrete Mix Design ii. Testing of Engineering Materials like: Steel, Concrete, Paver Blocks, Bitumen, Soil, Tiles, Cement, Aggregate, Water etc. iii. Geotechnical Investigations and bearing capacity determination iv. Design of Pavement Mixes and Quality Control v. Condition Assessment of Structures using NDT and Material Testing 3rd Party Audit, Environmental Testing vi. Laboratory Management System and Internal Auditing per IS/ISO/IEC 17025 : 2017 NABL Assessors Course | HS | CIVIL |
| | | | HS/SKS | |
| | | | VKS | |
| | | | AKD | |
| | | | SKS | |
| | | | SKS/HG | |
| 2. | CP-02 | Testing of various Electrical Works from various organizations- As per requirement | All faculty | ELECT |
| 3. | CP-03 | Testing of Antenna/Circuits through Vector Analyzer in Communication Engineering Lab for outsider Researchers | GS | ECE |
| 4. | CP-4 | Laboratory Testing and Consultation | SSD & Team | MECH |
| 5. | CP-8 | Training of Students and Faculty from Engineering Colleges and Polytechnics | PB/CRK | CSE |
| 6. | CP-8A | Six Months Training Programs from Engineering Colleges and Polytechnics | CRK | CSE |
| 7. | CP-8B | Six Months Training Programs from Engineering Colleges and Polytechnics | CRK | CSE |
| 8. | CP-8C | Six Months Training Programs from Engineering Colleges and Polytechnics | CRK | CSE |
| 9. | CP-8D | Six Months Training Programs from Engineering Colleges and Polytechnics | CRK | CSE |
| 10. | CP-8E | Six Months Training Programs from Engineering Colleges and Polytechnics | CRK | CSE |
| 11. | CP-8F | Six Months Training Programs from Engineering Colleges and Polytechnics | CRK | CSE |
| 12. | CP-9 | Training of Students and Faculty from Engineering Colleges and Polytechnics in Wireless Communication, Antenna Design, Embedded System Design, Digital System Design and CAD/CAM. | All Faculty | ECE |
| 13. | CP-11 | Training of students and Faculty from Engineering Colleges and Polytechnics | | ELECT |
| 14. | CP-12 | Product Design & Development | SSB/BSP | MECH |
| 15. | CP-13 | Training of students and Faculty from Engineering Colleges and Polytechnics | | MECH |
| 16. | CP-15 | Lab. Management System and Internal Auditing as per ISO/IEC 17025:2005 (8 programmes on different dates) | SKS | CCT&SD |
| 17. | CP-16 | Recruitment/Examination Projects | SSB/SD/RKW | Concerned Department |
| 18. | CP-17 | Documentary Film by HSBTE, Panchkula | MD | ETV |
| 19. | CP-18 | Practical Subject to perform for Civil Engineering Students | HS | CIVIL |
| 20. | CP-19 | Facilities and services for training, examinations etc. to outside agencies | CRK & Team | CSE |

| | | | | |
|-----|--------|---|------------|----------------------|
| 21. | CP-20 | Preparing MOOCs on various courses. | MD | ETV |
| 22. | CP-22 | Translation of Annual Report in Hindi of SLIET Longowal. | VV | HINDI SECTION |
| 23. | CP-53 | Pre-Job Training of MBA Students from Integrated Institute of Himalayan Studies, Himachal Pradesh University, Shimla Jan-Feb. 2018 | UNR | RD |
| 24. | CP-62 | Drafting/Designing/Updation of Curriculum of three years Diploma Level Courses for the State of Himachal Pradesh (10 Nos.) | BSP & Team | MECH |
| 25. | CP-64 | Punjab State Cooperative Agriculture Development Bank | SSB/SD/RKW | MECH. |
| 26. | CP-66 | Development of Curricula for 9 diploma level programs for MRSPTU, Bathinda | ABG | CDC |
| 27. | CP-69 | Development Of Mobile app for CEC, New Delhi. | CRK | CSE |
| 28. | CP-70 | Training to the Newly Recruited Junior Engineers (Civil) on Basic Computers and use of Computer Lab. For Executive Engineer Public Health Engineering Division, Panchkula (1-12 May 2017 and 15-26 Nov. 2017) | CRK & Team | CSE |
| 29. | CP-78 | Cyber Security (Skill Development Program) | MD | CSE/ETV |
| 30. | CP-81 | Training to Students of Haryana | MD | ETV |
| 31. | CP-82 | Development of NSQF compliant Curricula for 6 diploma level programs for UP State. | ABG | CDC |
| 32. | CP-83 | Making of Documentary Film on GRIID, Sector 34, Chandigarh | MD | ETV |
| 33. | CP-84 | Recruitment to teaching faculty | SKD | |
| 34. | CP-85 | Punjab State Cooperative Milk Producers Federation Limited, Chandigarh | SSB | MECH |
| 35. | CP-87 | Consultancy work of 3rd party, Design Repair and Rehabilitation of Buildings Estimation, Costing etc. | SKS/HG | CCT&SD |
| 36. | CP-89 | Product Manufacturing | PSR | MECH |
| 37. | CP-90 | Educational/Documentary film for outside agencies | MD | ETV |
| 38. | CP-91 | Training of students and Field Engineers | HS | CIVIL |
| 39. | CP-92 | Conduct of Typing Test for Clerk-cum Data Entry Operators in English and Punjabi Language. | SSB/SD/RKW | Concerned Department |
| 40. | CP-94 | Punjab Urban Planning and Development Authority, SAS Nagar. | SSB/RKW/SD | MECH |
| 41. | CP-95 | Training Program for non-teaching staff of PDA College of Engineering, Gulbarga, Karnataka. | BSP | MECH |
| 42. | CP-96 | Evaluation of Learning Materials (English, Physics, Chemistry and Mathematics) | BCC | APP. SC. |
| 43. | CP-97 | Samagra Shiksha, School Education, U.T., Chandigarh | SSB | MECH |
| 44. | CP-98 | PMKVY Project | GS | ECE |
| 45. | CP-99 | Punjab State Milk Producer's Federation Ltd., Chandigarh | SSB | MECH |
| 46. | CP-101 | Workshop on Outcome Based Education (OBE) CO, PO, PSO, PEO Mapping and Attainment for faculty of Vignad and Foundation for Science, Technology & Research, Guntur (A.P.) | CRK | CSE |

| | | | | |
|-----|--------|---|--------------|----------------------|
| 47. | CP-102 | Recruitment for Post of TGTs for Samagra Siksha, School Education Union Territory of Chandigarh Administration. | SSB/SD/RKW | Concerned Department |
| 48. | CP-103 | Punjab State Coop, Supply & Marketing Federations Ltd. (Markfed) Sector 35, Chandigarh (Recruitment of various posts) | SSB/SD/RKW | Concerned Department |
| 49. | CP-104 | Student Training Program | RKW/Shimi SL | CDTC |
| 50. | CP-105 | Recruitment Project | SJ & Team | MECH |
| 51. | CP-106 | Research Methodology 06.05.2019 to 10.05.2019 at KIET Group of Institutions, Ghaziabad) | SD | EMGT |
| 52. | CP-107 | Effective Teaching 10.06.2019 to 14.06.2019 at KIET Group of Institutions, Ghaziabad) | AK | EMGT |
| 53. | CP-108 | Training of Students for Polytechnics and Engineering Colleges | MD | ETV |
| 54. | CP-109 | Data Analysis using Open Source for Faculty/Research Scholars/Ind. Personal/others. | MD | CSE |
| 55. | CP-110 | Data Analytics: A Hands on Approach for Application Development 29.07.2019 to 02.08.2019 at BPIT, Rohini, Delhi | KGS | CSE |
| 56. | CP-111 | Effective Teaching Methods using ICT and Digital Pedagogy 27.06.2019 to 02.07.2019 at SRIT, Ananthpur | KGS | CSE |
| 57. | CP-112 | STC/FDP on Design And Development of RPA Solutions (22-26 July at NITTTTR Campus through UiPath Academic Alliance | KGS | CSE |
| 58. | CP-113 | Student Training in Electrical Engineering Department | All Faculty | ELECT |
| 59. | CP-114 | Recruitment for Post of Nursery Teachers under Education Department, UT Chandigarh Administration. | SSB/SD/RKW | - |
| 60. | CP-115 | Training Program for Non-Teaching Staff of PDA College of Engg., Gulbarga (Karnataka) | BSP | MECH |
| 61. | CP-116 | Recruitment for the Post of Headmasters/Headmistresses on Contact basis under Shiksha Abhiyan Society, UT, Chandigarh. | SSB | MECH |
| 62. | CP-117 | FDP on Outcome Based Education and NBA Accreditation at Kurukshetra University, Kurukshetra from 4 th to 8 th November, 2019. | BSP | MECH |
| 63. | CP-118 | Recruitment for Posts of Junior Engineers (Civil) in B&R Research Laboratory, UT Chandigarh. | SSB | MECH |
| 64. | CP-119 | Recruitment for Various Posts in `The Punjab State Cooperative Milk Producer's Federation Ltd., Chandigarh (MILKFED). | SSB | MECH |
| 65. | CP-120 | Recruitment for Subordinate Services Selection Board, Punjab. | SSB | MECH |
| 66. | CP-121 | Recruitment for Various Posts in Department of Urban Planning, Chandigarh Administration | SSB | MECH |
| 67. | CP-122 | STC on Engineering Applications of Machine Learning and Artificial Intelligence from 27 – 31 January, 2020. | BS | ECE |
| 68. | CP-123 | The Punjab State e-Governance Society, Mohali | SSB | MECH |
| 69. | CP-124 | Sample Analysis with AFM & PLS | BCC/PS/AK | APP.SC. |
| 70. | CP-125 | Assistance to various States for designing NSQF Aligned Curricula | CDC Faculty | CDC |

6. COORDINATION ACTIVITIES:

| Sr. No. | O Plan Code | Programme Title | Coordinator | Dept. |
|---------|-------------|--|-----------------|-------|
| 1. | CO-1 | Alumni Meet at NITTTR, Chandigarh | PS | RD |
| 2. | CO-2 | Activities with NPIU, AICTE, NBA, DTEs, BTEs ,MHRS. Etc. for Mentoring, Performance Auditing and other assistance | SKD/HKV/ ADS | EDIC |
| 3. | CO-3 | Audio visual aids & learning material development for different projects & program of institute | RKW | MEDIA |
| 4. | CO-4 | Concrete Mix Design – Central and State Govt. organisation including Pvt. Builders and Contractors | HS | CIVIL |
| 5. | CO-5 | Testing of Engineering Materials like : Steel, Concrete Cubes, Paver Blocks, Bricks, Doors etc. | HS/ SKS | CIVIL |
| 6. | CO-6 | Geotechnical Investigations and Bearing Capacity Determination | VKS | CIVIL |
| 7. | CO-7 | Design of Pavement Mixes & Quality Control | AKD | CIVIL |
| 8. | CO-8 | Condition Assessment of Structures using NDT and Material Testing 3 rd Party Audit, Environmental Testing | SKS | CIVIL |
| 9. | CO-9 | Laboratory Management System & Internal Auditing per IS/ISO/IEC 17025 : 2017 NABL Assessors Course | SKS/HG | CIVIL |

7. PROMOTIONAL AND INDUSTRY LINKED ACTIVITIES:

| Sr. No. | O Plan Code | Programme Title | Coordinator | Dept. |
|---------|-------------|--|-------------|----------------|
| 1. | PDA-1 | Journal of Engineering & Technology Education, Newsletter etc. | SD and Team | EMGT |
| 2. | PDA-2 | Advanced Instrumentation and Control Lab (AICTE MODROBS Project) | LM | ELECT |
| 3. | PDA-3 | Advanced Sensor Network Technologies Lab - AICTE MODROB project | CRK/RK | CSE |
| 4. | PDA-8 | Setting up of Simulation Centre of Excellence with ABB India Ltd. | SSD/LM | ELECT/ MECH |
| 5. | PDA-10 | Centre for Smart Rural and Urban Technologies for Sustainable Development. | UNR/AG | RD |
| 6. | PDA-15 | Field visit of M.E. Students to Industries | All faculty | ELECT |
| 7. | PDA-16 | MOU with Industries | All faculty | ELECT |
| 8. | PDA-18 | Institute Newsletter | SD and Team | EMGT |
| 9. | PDA-19 | Interactive Online Training Management Software for managing automating all FDP/STC related processes and making it completely paperless. | CRK | CSE |
| 10. | PDA-20 | Tech Spardha 2020 (to be Organized by Student Welfare Committee)) | MD | CSE |
| 11. | PDA-21 | 50 KWp Solar PV Power Plant at Rooftop of Homi Bhaba Block by M/s. Su-Kam Power System Ltd. In 2014 through CREST, DST Chandigarh. | PS | RD |
| 12. | PDA-22 | Coordination of linking industry with HPSDMA, District Administration, and Institutions for set up of Resource centre for carrying out Training and Capacity building of Grass root Construction Workers | HKV/SKD | EDIC |

| Sr. No. | O Plan Code | Programme Title | Coordinator | Dept. |
|---|--------------------|---|--------------------|--------------|
| 13. | PDA-23 | Environmental solution for industry | SKS & Team | |
| 14. | PDA-24 | Automation Solution for Industry | SSD & Team | |
| 15. | PDA-25 | Digital Marketing Solution for Industry | KGS & Team | |
| <i>Note: Any program/activity in addition to above if required can be taken up with due approval of Director.</i> | | | | |

ABBREVIATIONS USED

| Departments/Centres/Units of the Institute | |
|--|---|
| APP. SC. | Applied Science |
| CIVIL | Civil Engineering |
| CSE | Computer Science and Engineering |
| CCTSD | Centre for Clean Technology and Sustainable Development |
| CDC | Curriculum Development Centre |
| CPC | Centre for Physically Challenged |
| EDIC | Entrepreneurship Development & Industrial Coordination |
| EMGT | Education and Educational Management |
| ELECT | Electrical Engineering |
| ECE | Electronics and Communication Engineering |
| ESC | Electronics Service Centre |
| Lib | Library |
| Mech. | Mechanical Engineering |
| Media Engg. | MEDIA |
| RD | Rural Development |

| Miscellaneous | |
|---------------|--|
| BOG | Board of Governors |
| BTE | Board of Technical Education |
| CAD | Computer Aided Design |
| CAM | Computer Aided Manufacturing |
| CNC | Computer Numerical Control |
| CDTPs | Community Development Through Poly.s |
| DSP | Digital Signal Processing |
| DTE | Directorate of Technical Education |
| EACs | Entrepreneurial Awareness Camps |
| EDPs | Entrepreneurship Development Programmes |
| EdCIL | Educational Consultants India Ltd |
| HOD | Head of Department |
| ICT | Information Communication Technology |
| ID | Interdisciplinary |
| III | Industry Institute Interaction |
| ISO | International Organisation for Standardisation |
| ISTE | Indian Society for Technical Education |
| MHRD | Ministry of Human Resources Development |
| NPIU | National Project Implementation Unit |
| Orgn (s) | Organisation(s) |
| PLCs | Programmable Logic Controllers |
| Polys | Poly.s |
| PWDs | Persons with Disabilities |
| CPSC | Colombo Plan Staff College, Manila |

| States / UTs | |
|------------------------|---|
| National/ National | National and UTs of Country |
| Northern Region States | 8 States and One UT in Northern Region as below |
| CH | CHD |
| DE | Delhi |
| HR | Haryana |
| HP | Himachal Pradesh |
| J & K | Jammu and Kashmir |
| PU | Punjab |
| RA | Rajasthan |
| UK | Uttarakhand |
| UP | Uttar Pradesh |

Annexure-II

(227 Pages)

Detailed Study and Evaluation Scheme of Unique PG Programmes Proposed to be launched in First Phase

MASTER OF BUSINESS ADMINISTRATION IN DIGITAL KINEMATICS FOR ORGANIZATIONAL RESILIENCE

RATIONALE:

The world order has changed significantly in the last two decades. This change is to a large extent explained because of the numerous technological advancements in the digital domain. These digital advancements are genesis of the digital kinematics making the incumbents jittery not only due to the volatile business environment but also because of the rise of many new players especially the ones that are platform based. The organizational capability to digitally transform itself is a function of its resilience to sustain itself competitively in this highly dynamic digital laced business environment. This MBA program will introduce participants to the many ways networked markets and firms are transforming the economy and aims to facilitate the process of enhancing the participant's capabilities for designing, monetizing, and launching a digitally laced venture.

OBJECTIVE:

The objective of this program is to help participants in enhancing their capabilities for identifying and evaluating various paths in firm's journey as it encounters various digital kinematic forces testing the firm's resilience to be future ready.

LEARNING OUTCOMES:

- Able to understand and manage various digital forces acting on / in business / market.
- Able to Identify and evaluate opportunities / challenges for launching future ready business.
- Able to analyze huge amount of data to support decision making related to enterprise management
- Able to foresee the issues and challenges while embracing new technology along with the ways to exploit it commercially

ELIGIBILITY CRITERIA:

Any graduate or / and similar qualification as approved by UGC / AICTE is eligible for this programme.

Salient Features :

1. It is interdisciplinary program and admission is open to all graduates.
2. Students will have the option to select some the courses offered through MOOCs.
3. Evaluation focuses more on formative evaluation to enable development of desired competencies.
4. In fifth and sixth trimesters, one of the electives being offered is field driven.
5. Project specific subject to be selected by the subject will be supervised and monitored by institute faculty.
6. After first year, student will be required to undergo internship in industry/Non-profit/Start-up etc for hands on training on relevant eco-system.
7. Effective implementation of NEP-2020 is ensured by offering a number of multidisciplinary courses.
8. To have better industry relevance, industry experts will be engaged to run industry relevant subjects.
9. To ensure attainment of program outcomes, emerging pedagogical approaches will be inbuilt in the teaching learning methodology.

Total Credits: 100
Proposed Intake: 30

MBA in Digital Kinematics for Organizational Resilience

Tentative Program Scheme

| 1st Year | | Year Break | 2nd Year | |
|----------------------------|---|---|---|--|
| Term I | | | Term IV | |
| 1 | Managerial Economics: Firms and Markets | 1 week holidays followed by 8 weeks Internship in various profit and non-profit organizations preferably start-ups | Elective I | |
| 2 | Financial Reporting and Analysis | | Elective II | |
| 3 | Statistics for Decision Making | | #Elective III | |
| 4 | Managerial Communication | | *Practicum / Lab: Artificial Intelligence | |
| 5 | Data Modeling and Simulation | | **Colloquium | |
| 6 | Competitive Strategy | | ## Course of Independent Study (CIS) | |
| Term II | | | Term V | |
| 1 | Online Platform Based Business | | Elective IV | |
| 2 | Marketing Management | | Elective V | |
| 3 | Operations Management | | #Elective VI | |
| 4 | Behavioral Sciences | | *Practicum / Lab: AR / VR | |
| 5 | Financial Management | | *Practicum / Lab: IoT | |
| 6 | Gig Economy | | ### Prep for Dissertation | |
| Term III | | Term VI | | |
| 1 | Digital Transformation Strategies and Practices | ### Dissertation | | |
| 2 | Cybercrime and Cyber laws | | | |
| 3 | Digital and Social Media Marketing | | | |
| 4 | Research Methodology | | | |
| 5 | Supply Chain Analytics | | | |
| 6 | Business Ethics and Corporate Social Responsibility | | | |

Indicative Scheme for Evaluation of Grade:

End Trimester Evaluation: 40%

Project Work / Assignment(s): 20%

Mid Trimester Evaluation: 20%

Class Participation: 20%

This elective will be a Field prescribed elective which the participant can choose from any of the various MOOC platforms available (like SWAYAM, EDEX, Coursera to name a few) in-line with his / her career orientation.

* Practicums will be with the MTech students undergoing the similar programmes as it will aid in significant peer to peer learning resulting in enhancing the technical capabilities of MBA students and at the same time enhancing the managerial capabilities of MTech students.

** Student will be required to present their work in front of the faculty members along with a submission of Detailed Report (DR) based on the work carried out by them during the preceding internship

The end deliverable of CIS will require a student to submit a document containing the ideation of a business project (either product based or service based). This will involve the identification of gaps, opportunities and intended audience / customers. A summary of tentative budgeted expenditure as well as potential revenue generation will also be the part of the same.

Under MBA dissertation student is expected to carry out comprehensive fieldwork for

becoming a digital kinematic expert who can help organizations in building strong resilience. The CIS document submitted in the IVth Trimester will form the basis of the MBA dissertation. Here the student will be expected to come-out with the detailed report of the project identified. Desirably, it is expected that this project can be submitted for practical purposes preferably incubated if possible.

MBA in Digital Kinematics for Organizational Resilience
Scheme of Digital Kinematics for Organizational Resilience

| S. | Course Code | Course Name | Periods | | | Evaluation scheme | | | | Course |
|----------------|-------------|---|----------|---|---|-------------------|----|----|-----|--------|
| | | | Per week | | | Sessional | | | TEE | |
| | | | L | T | P | Credit | CT | TA | | |
| Year I | | | | | | | | | | |
| Term – I | | | | | | | | | | |
| Theory | | | | | | | | | | |
| 1 | DKR-C-101 | Managerial Economics: Firms and Markets | 5 | 0 | 0 | 3 | 40 | 20 | 40 | 100 |
| 2 | DKR-C-102 | Financial Reporting and Analysis | 5 | 0 | 0 | 3 | 40 | 20 | 40 | 100 |
| 3 | DKR-C-103 | Statistics for Decision Making | 5 | 0 | 0 | 3 | 40 | 20 | 40 | 100 |
| 4 | DKR-C-104 | Managerial Communication | 5 | 0 | 0 | 3 | 40 | 20 | 40 | 100 |
| 5 | DKR-C-105 | Data Modeling and Simulation | 5 | 0 | 0 | 3 | 40 | 20 | 40 | 100 |
| 6 | DKR-C-106 | Competitive Strategy | 5 | 0 | 0 | 3 | 40 | 20 | 40 | 100 |
| | | | | | | 18 | | | | 600 |
| Term – II | | | | | | | | | | |
| Theory | | | | | | | | | | |
| 1 | DKR-C-201 | Online Platform Based Business | 5 | 0 | 0 | 3 | 40 | 20 | 40 | 100 |
| 2 | DKR-C-202 | Marketing Management | 5 | 0 | 0 | 3 | 40 | 20 | 40 | 100 |
| 3 | DKR-C-203 | Operations Management | 5 | 0 | 0 | 3 | 40 | 20 | 40 | 100 |
| 4 | DKR-C-204 | Behavioral Sciences | 5 | 0 | 0 | 3 | 40 | 20 | 40 | 100 |
| 5 | DKR-C-205 | Financial Management | 5 | 0 | 0 | 3 | 40 | 20 | 40 | 100 |
| 6 | DKR-C-206 | Gig Economy | 5 | 0 | 0 | 3 | 40 | 20 | 40 | 100 |
| | | | | | | 18 | | | | 600 |
| Term – III | | | | | | | | | | |
| Theory | | | | | | | | | | |
| 1 | DKR-C-301 | Digital Transformation Strategies and Practices | 5 | 0 | 0 | 3 | 40 | 20 | 40 | 100 |
| 2 | DKR-C-302 | Cybercrimes and Cyber laws | 5 | 0 | 0 | 3 | 40 | 20 | 40 | 100 |
| 3 | DKR-C-303 | Digital and Social Media Marketing | 5 | 0 | 0 | 3 | 40 | 20 | 40 | 100 |
| 4 | DKR-C-304 | Research Methodology | 5 | 0 | 0 | 3 | 40 | 20 | 40 | 100 |
| 5 | DKR-C-305 | Supply Chain Analytics | 5 | 0 | 0 | 3 | 40 | 20 | 40 | 100 |
| 6 | DKR-C-306 | Business Ethics and Corporate Social | 5 | 0 | 0 | 3 | 40 | 20 | 40 | 100 |
| | | | | | | 18 | | | | 600 |
| II Year | | | | | | | | | | |
| Term - IV | | | | | | | | | | |
| Theory | | | | | | | | | | |
| 1 | DKR-E-401 | Elective I | 5 | 0 | 0 | 3 | 40 | 20 | 40 | 100 |
| 2 | DKR-E-402 | Elective II | 5 | 0 | 0 | 3 | 40 | 20 | 40 | 100 |
| 3 | DKR-E-403 | #Elective III | 5 | 0 | 0 | 3 | 40 | 20 | 40 | 100 |
| Practicum | | | | | | | | | | |
| 4 | DKR-P-404 | *Practicum / Lab: Artificial Intelligence | 0 | 0 | 3 | 2 | 40 | 20 | 40 | 100 |
| 5 | DKR-P-405 | Colloquium | 0 | 0 | 0 | 6 | | | | 200 |
| | | | | | | 17 | | | | 600 |
| Term - V | | | | | | | | | | |
| Theory | | | | | | | | | | |

| | | | | | | | | | | |
|------------|------------------------|--------------------------------------|---|---|---|----|----|----|----|-----|
| 1 | DKR-E-501 | Elective IV | 5 | 0 | 0 | 3 | 40 | 20 | 40 | 100 |
| 2 | DKR-E-502 | Elective V | 5 | 0 | 0 | 3 | 40 | 20 | 40 | 100 |
| 3 | DKR-E-503 | #Elective VI | 5 | 0 | 0 | 3 | 40 | 20 | 40 | 100 |
| Practicum | | | | | | | | | | |
| 4 | DKR-P-504 | *Practicum / Lab: AR / VR | 0 | 0 | 3 | 2 | 40 | 20 | 40 | 100 |
| 5 | DKR-P-505 | *Practicum / Lab: IoT | 0 | 0 | 3 | 2 | 40 | 20 | 40 | 100 |
| Field Work | | | | | | | | | | |
| 6 | DKR-P-404 | ## Course of Independent Study (CIS) | 0 | 0 | 0 | 2 | 40 | 20 | 40 | 100 |
| | | | | | | | 15 | | | |
| Field Work | | | | | | | | | | |
| 6 | DKR-D-601 DKR-P-405 | ### Dissertation | | | | 14 | | | | 500 |

CT – Cumulative Test
Examination

TA – Teachers Assessment

TEE Terms End

ELECTIVES

Term IV: Elective (Elective I, II III)

DKR-E-XXX Managing Change for Organizational Resilience
DKR-E-XXX Technology Management
DKR-E-XXX Digital Market Research
DKR-E-XXX Project Management
DKR-E-XXX Big Data Analytics
DKR-E-XXX MOOCS

Term V: Elective ((Elective IV, V VI)

DKR-E-XXX Innovation and Intellectual Property Rights Management
DKR-E-XXX Business Startup Setup and Practices
DKR-E-XXX IoT for Platform Based Business
DKR-E-XXX Knowledge Management
DKR-E-XXX Management of Fintech
DKR-E-XXX MOOCS

4.0 DETAILED CONTENT

TERM-I

DKR-C-101 Managerial Economics: Firms and Markets

The Nature and Scope of Managerial Economics; Demand, Supply, and Equilibrium Analysis; Measurement of Demand; Optimization Techniques and New Management Tools; Demand Estimation for Infrastructure; Demand Forecasting for Infrastructural Assets; Production Theory and Estimation; Cost Theory and Estimation; Market Structure: Perfect Competition, Monopoly, and Monopolistic Competition; Oligopoly and Infrastructure Firm Architecture.

DKR-C-102 Financial Reporting and Analysis

Nature and Role of Accounting; Accounting concepts and conventions; Accounting Process; Inventory Valuation Methods; Depreciation accounting and Policy; Cost-accounting; Management accounting; Financial statements; Budgeting and Budgetary Control; Marginal costing.

DKR-C-103 Statistics for Decision Making

Grouping and Displaying Data to Convey Meaning: Tables and Graphs; Measures of Central Tendency and Dispersion in Frequency Distributions; Probability I: Introductory Ideas; Probability Distributions; Sampling and Sampling Distributions; Estimation; Testing: One Sample Tests, Two-Sample Tests; Analysis of Variance; Simple Regression and Correlation

DKR-C-104 Managerial Communication

Introduction to communication, effective communication skills, process of communication, Barriers and gateways in communication, business report writing, Oral and non-verbal communication, Public speaking and presentation, Communication- negotiation and legal aspects.

DKR-C-105 Data Modeling and Simulations

Introduction to Data Modeling: Graphs and Charts, using different functions & formulas, Using Referencing, Using sort and filter, Pivot Tables, Freeze panes, Scenario Manager, What-If Analysis, Data Validation, Creating Macros, Data Modeling for time value of money, NPV, IRR, annuities and depreciation, budgeting, Forecasting and Analysing Financial Statements, determining efficient portfolios, risk analysis, project appraisal and project viability.

DKR-C-106 Competitive Strategy

Basic concepts and terminology used in the field of Strategy; Scanning the External Environment: Analyzing the task environment; Porter's Five Forces Analysis; How Industry Structure Drives Competition and Profitability; Concept of Strategic Groups; Resource-Based Approach Organizational Analysis; Value Chain Analysis, Basic Competitive Strategies and choosing appropriate competitive strategy for future.

TERM-II

DKR-C-201 Online Platform Based Business

Basics of Network Effects — The Power of the Online Platform Business ; Fundamentals of a Platform Business, Finding the problem space, Evaluating Market Viability and Target, What is the Network Effect in a Platform Business, Economics of the Network (supply-demand, subsidized-priced), Case Study analysis of some popular platform based businesses.

DKR-C-202 Marketing Management

Introduction to marketing management; Elements of marketing strategy and planning; Analyzing the Marketing Environment; Customer relationship management & marketing information management; Segmentation, Targeting, Positioning; Product strategy and brand management; New product development; Managing pricing decisions; Managing marketing channels.

DKR-C-203 Operations Management

Introduction to Operations Management and Need of Operations Management; Concept of Goods vs Services, Demand – Supply Mismatch; Operations Strategy, concept of productivity and theory of slack ropes; Process design, Product – process matrix; Concept of Reliability, Failure Mode & Effect Analysis; Quality Function Deployment and Quality Management; Facility Location; Facility Layout: Product layout, Process Layout, Supply Chain Management, Forecasting and its different methods; Capacity Planning and Aggregate Production Planning.

DKR-C-204 Behavioral Sciences

Diversity in Organizations; Attitudes and Job Satisfaction; Emotions and Moods; Personality and Values; Perception and Individual Decision Making; Cognitive processes of judgment and decision making; Motivation and self-control; Psychological aspects of economic behavior; Learning, reasoning, and problem solving by individuals, Processes of negotiation power and influence.

DKR-C-205 Financial Management

Introduction to Corporate Finance: Basic Valuation, Risk and Return, Payout Policy and Capital Structure, Financial Planning and Working Capital Management.

DKR-C-206 Gig Economy

Introduction to Gig Economy: What is Gig economy, Factors impacting emergence of Gig economy, Different dimensions of Gig Economy, Behavioral aspect of Gig economy; Stakeholder involved in Gig economy, Murkiness in Gig economy: Perception vs Reality, Issues and Challenges; Impact of Gig economy on organizations both profit and non-profit; Market Externalities: Free Market Economies v/s Collectivist Economies, Risk of Free Rider Products and Limitations of Market Regulations

TERM – III

DKR-C-301 Digital Transformation Strategies and Practices

Introduction to Digital Transformation: what is digital transformation, various paths to transformation, difference between Social and mobile strategy for firm, Cloud Computing as an enablers for digital transformation;

DKR-C-302 Cybercrime and Cyber laws

Cyber Crimes Introduction, Computer crime and cyber-crimes; Distinction between cyber crime and conventional crime; Kinds of cyber-crimes: cyber stalking, cyber terrorism, phishing, cyber bullying, identity theft, forgery and fraud, crimes related to IPRs, cyber vandalism; cyber forensic, Indian laws for cyber crimes

DKR-C-303 Digital and Social Media Marketing

Digital marketing - Introduction, Segmentation, Targeting, Positioning; Analyzing Digital Marketing platform, content marketing, Analyzing the digital marketing Environment; Managing Customer relationship in the digital era, Marketing information management, Pay per click marketing and analytics, Online Trust Building, Digital Brand Management and brand communication, Social Media Marketing, Difference between social media and digital marketing, community building for online brand, Managing online marketing channels

DKR-C-304 Research Methodology

Research - Qualities, Types, approaches, problem formulation, research design, Data collection and sampling, data collection & sampling, Measurement and Scaling techniques, Statistical analysis, Interpretation and Research report writing.

DKR-C-305 Supply Chain Analytics

Introduction to supply chain management and supply chain analytics; The management components of supply chain management; Eight supply chain processes; Electronically linking the supply chain; Supply chain performance measurement; Supply chain strategy: achieving strategic fit; dual sourcing; Supply chain risk sharing contracts Supply chain risk pooling: centralization, postponement, Omni channel Supply chain coordination: sales & operations planning; bullwhip effect; pipeline vs platform dependent supply chains.

DKR-C-306 Business Ethics and Corporate Social Responsibility

Ethical problems in management, Ethical theories, Work ethic, Values, Norms, Beliefs and Standards, Ethics in practice- in functional areas (Like HR, Marketing, Finance), Intellectual Property rights, ethical Decision Making, Models of Decision making, Individual Factors, Corporate Governance Theories and Models, Corporate Social Responsibility - Stakeholder Management and Social Responsibility, Big Business and society Business, Ecological/ Environmental issues in the Indian context, Understanding CSR, CSR in India, World Economic Growth and the Evolution of CSR.

ELECTIVES

Elective Term IV

DKR-E-XXX Managing Change for Organizational Resilience

Understanding Organisational Change; Forces for Change; Overcoming Resistance to Change; Framework for Bringing Change; Role of Managerial Leadership, Developing Organization Culture for Creativity & Innovation, Managerial Style & Practices supportive of Creativity & Innovation, Strategic Issues & Company Culture.

DKR-E-XXX Technology Management

Technology and its Classification, Business strategy for New Technologies: Adding value, Gaining competitive advantage, Timing and capability development; Technology Planning: Forecasting Technology, Technology Mapping, Technology Audit; Technology Acquisition & Transfer: Methods of Acquiring Technology, Stages of Technology Development, Technology Transfer Classifications, Channels of Technology Flow.

DKR-E-XXX Digital Market Research

Types, understanding digital consumer, Listen, Analyze, Understand, Engage, Qualitative versus Quantitative research, Optimizing your Audience and Sample Size, E-Community, Co-Creation and Advocacy, Data Collection and integration from various sources; understanding advanced data analytics;

DKR-E-XXX Project Management

Project Management: project success factors, Project Management job functions, Concept of Project Life Cycle and phases; Strategic Planning and Project Selection methods; Project Scope Management, Work Breakdown Structure (WBS) and other processes of Project Scope Management; Project Time Management, Activity sequencing, Network Diagrams, CPM and PERT Analysis, Schedule Development, Critical Chain Scheduling; Project Cost Management.

DKR-E-XXX Big Data Analytics

Definition, Characteristics of, Challenges with Data Types, Data Warehouse environment, Traditional Business Intelligence versus Big Data, Analytical Theory and Methods, HDFS(Hadoop Distributed File System) - Concepts, Apache Hadoop, Analysing Data, Streaming, Hadoop Echo System, Analysing Data with Unix tools, IBM Big Data Strategy, Data Analytics with R Machine Learning : Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR

DKR-E-XXX MOOCS

This elective will be a Field prescribed elective which the participant can choose from any of the various MOOC platforms available (like SWAYAM, EDEX, Coursera to name a few) in-line with his / her career orientation.

Elective Term V

DKR-E-XXX Innovation and Intellectual Property Rights Management

Innovation: Nature of Innovation-Technological Innovations and their Management-Inter-Organizational and Network Innovations- Design of a Successful Innovative Organization- Training for Innovation-Management of Innovation-Agents of Innovation- Skills for Sponsoring Innovation. Introduction to IPR: Patents; Copyrights; Trademarks; Industrial Designs; Trade Secrets, and related rights; Patents and Filing of Patents: Indian Patent System, Transfer and Commercialization of Intellectual Property: IP Valuation; Strategy for IP Commercialization, and allied aspects.

DKR-E-XXX Business Startup Setup and Practices

Online Business Demand Forecasting; Requisites for Online business Setup and establishment; Online order processing; Order fulfillment by aggregator; Taxation on online sales; Affiliate Programs; Key Performance indicators; Vendor Relationship Management System

DKR-E-XXX IoT for Platform Based Business

Embedded Systems, M2M (Machine to Machine Communication), Internet of Everything (IoE), Machine Learning, Industrial automation; Interoperability, Identification, localization, Communication, Software Defined Assets; Understanding IT and OT convergence; Risks and rewards for Early adopters, Development, deployment and monetization of applications as service, Industry 4.0: Smart Factory & Cyber-physical systems (CPS), Predictive and remote maintenance, Smart logistics and grid management, Smart Asset performance management,

DKR-E-XXX Knowledge Management

Need, implications, Types of knowledge, Knowledge codification and system development, testing and deployment, Knowledge creation process, transfer and knowledge sharing- the role of culture, Technologies to Manage Knowledge, tools and Portals, Life Cycle, capturing tacit knowledge – strategy, Infrastructure, audit, Systems - Analysis design and development, Evaluation of KM effectiveness: Tools and metrics, Ethical, legal and managerial issues, Experiences form Indian companies, innovation and Learning organization

DKR-E-XXX Management of Fintech - Recent developments, Major areas, Future prospects and potential issues, Blockchain and Cryptocurrency Technologies: Cryptographic Hash Functions, Digital Signature, Public and Private Keys, Blockchains, Proof of Work, Mining , Bitcoin and Other Cryptocurrencies I:Bitcoin, Ethereum, Other Altcoins, Wallets, Exchange Markets, Payments, Transaction Fees, Anonymity, Mining, Ecosystem, Politics, Regulation, Ethereum and Smart Contracts: Decentralized Applications, DAOs, Alternative Lending, Crowdfunding, and P2P Technology, Machine Learning and Applications: LASSO, Decision-Tree Analysis, Robo-advising.

DKR-E-XXX MOOCS

This elective will be a Field prescribed elective which the participant can choose from any of the various MOOC platforms available (like SWAYAM, EDEX, Coursera to name a few) in-line with his / her career orientation.

M.TECH. IN 3D/4D PRINTING, INNOVATIVE DESIGN AND PRODUCTION

Program: M.Tech. in 3D/4D Printing, Innovative Design and Production

Rationale

The 3D/4D printing innovative design and production is conceptualized as an interdisciplinary course wherein the three cutting edge technology areas viz. 3D printing, smart materials and production systems are combined together to propose technological solutions to myriad problems in the social landscape. 3D/4D printing is used in intelligent homes, smart buildings, factory automation systems, intelligent transportation systems, modern construction and biomedical systems. The 3D/4D printing system consists of a number of additive manufacturing techniques and required stimulus for process activation. This course shall explore the technological aspects of the 3D/4D printing for various applications in innovative design and production. Since course is interdisciplinary in nature suitable bridge course will be given after consultation with board of study on case to case basis. The candidate is expected to devote his time aiming prototype fabrication during his research work. This course will help to make the students appreciate the need, applications and advantages of 3D/4D printing. Also this will invoke an interest in using alternate technologies and promote make in India (to make India Atmanirbhar).

Total no. of credits: 76 credits

Eligibility: B.E./B.Tech. in any Engineering discipline

Salient Features :

1. It is interdisciplinary program and admission is open to all engineering graduates.
2. Students will have the option to select some the courses offered through MOOCs.
3. Evaluation focuses more on formative evaluation to enable development of desired competencies.
4. In first and second semester, one of the electives being offered is industry driven.
5. Project specific subject to be selected by the subject will be supervised and monitored by institute faculty.
6. In third semester, student will be attached to industry/NGO/Start up etc for hands on training on relevant echo system.
7. The program is designed to allow the students to spend one full year in field and explore the possibility of developing prototype.
8. Effective implementation of NEP-2020 is ensured by offering a number of multidisciplinary
9. To have better industry relevance, industry experts will be engaged to run industry relevant subjects.
10. To ensure attainment of program outcomes, emerging pedagogical approaches will be inbuilt in the teaching learning methodology.
11. Since the program is of interdisciplinary nature, bridge courses will be offered to meet the pre requisites of the program.

Aim: To produce engineering manpower in the 3D/4D printing technologies.

Course/ Learning Outcomes:

At the end of the program, the students will be able to:

- Carry out independent research/investigation and development to solve complex engineering problems.

- Write and present a research proposal and technical report/document.
- Demonstrate a degree of mastery in 3D/4D printing in providing solution to complex engineering problems.
- Apply engineering knowledge, techniques and modern tools to analyze problems in 3D/4D printing.
- Suggest tools and techniques in rapid manufacturing and tooling for optimal solutions.
- Engage in lifelong learning adhering to professional, ethical, legal, safety, environmental and societal aspects for career excellence

Study and Evaluation Scheme:

First Semester

| Sr. No. | Course Code | Course Title | Hours / Week | | | Credits | Internal Marks | External Marks | Total |
|--|-------------|---|--------------|---|---|---------|----------------|----------------|-------|
| | | | L | T | P | | | | |
| Programme Specific Core | | | | | | | | | |
| 1. | PI-C101 | Modelling for 3D/4D Printing | 4 | - | - | 4 | 60 | 40 | 100 |
| 2. | PI-C102 | 3D/4D Printing Processes | 4 | - | - | 4 | 60 | 40 | 100 |
| Interdisciplinary / Industry Oriented Electives | | | | | | | | | |
| 3. | PI-E- | Elective 1 | 3 | - | - | 3 | 60 | 40 | 100 |
| 4. | PI-E- | Elective 2 | 3 | - | - | 3 | 60 | 40 | 100 |
| 5. | PI-E- | Elective 3 | 3 | - | - | 3 | 60 | 40 | 100 |
| Laboratory Courses | | | | | | | | | |
| 6. | - | Internet of Things (Common to all M.Tech. Programmes) | - | - | 4 | 2 | 60 | 40 | 100 |
| 7. | PI-C103 | 3D/4D Printing Laboratory | - | - | 4 | 2 | 60 | 40 | 100 |
| Total | | | 25 | | | 21 | 420 | 280 | 700 |

Second Semester

| Sr. No. | Course Code | Course Title | Hours / Week | | | Credits L-T-P | Internal Marks | External Marks | Total |
|--|-------------|--|--------------|---|---|---------------|----------------|----------------|-------|
| | | | L | T | P | | | | |
| Programme Specific Core | | | | | | | | | |
| 1. | PI-C104 | Mechanical Behavior and Material Characterization for 3D/4D Printing | 4 | - | - | 4 | 60 | 40 | 100 |
| 2. | PI-C105 | Finite Element Analysis for 3D/4D printing | 4 | - | - | 4 | 60 | 40 | 100 |
| Interdisciplinary / Industry Oriented Electives | | | | | | | | | |
| 3. | PI-E- | Elective 1 | 3 | - | - | 3 | 60 | 40 | 100 |
| 4. | PI-E- | Elective 2 | 3 | - | - | 3 | 60 | 40 | 100 |
| 5. | PI-E- | Elective 3 | 3 | - | - | 3 | 60 | 40 | 100 |
| Laboratory Courses | | | | | | | | | |
| 6. | - | Artificial Intelligence Lab (Common to all M.Tech Programmes) | - | - | 4 | 2 | 60 | 40 | 100 |
| 7. | PI-C106 | Material characterization Laboratory | - | - | 4 | 2 | 60 | 40 | 100 |
| Total | | | 25 | | | 21 | 250 | 280 | 700 |

Third Semester

| Sr. No. | Course Code | Course Title | Hours / Week | | | Credits | Internal Marks | External Marks | Total |
|--------------|-------------|--|--------------|---|----|---------|----------------|----------------|-------|
| 1. | PI-C107 | MOOC Course 1 – Research Methodology | 3 | - | - | 3 | 60 | 40 | 100 |
| 2. | PI-C108 | MOOC Course2/ Self-study – Field relevant Elective | 3 | - | - | 3 | 60 | 40 | 100 |
| 3. | PI-C109 | Monitored Live Lab | - | - | 20 | 10 | 100 | 100 | 300 |
| Total | | | 26 | | | 16 | 220 | 180 | 400 |

Fourth Semester

| Sr. No. | Course Code | Course Title | Hours / Week | Credits | SEE Marks | CIE Marks | Total |
|--------------|-------------|--------------|--------------|---------|-----------|-----------|-------|
| 1. | PI-C110 | Thesis Work | - | 18 | 100 | 100 | 200 |
| Total | | | - | 18 | 100 | 100 | 200 |

Total: 76 Credits

Total Marks: 2000

L: Lecture, T: Tutorial, P: Practical

Elective Courses (**Interdisciplinary / Industry Oriented**)

Elective-1

| S. No. | Course Code | Course Title |
|--------|-------------|--|
| 1 | PI-E101 | Powder Metallurgy |
| 2 | PI-E102 | Materials, Energy Sources and Bonding Mechanisms |
| 3 | PI-E103 | Digital Manufacturing |
| 4 | PI-E104 | Polymer Engineering |

Elective-2

| S.No. | Course Code | Course Title |
|-------|-------------|---|
| 1 | PI-E105 | Rapid Tooling and Industrial Applications |
| 2 | PI-E106 | Rapid Manufacturing for medical application |
| 3 | PI-E107 | Metrology and Computer Aided Inspection |
| 4 | PI-E108 | Advanced composite technologies |

Elective-3

| S.No. | Course Code | Course Title |
|-------|-------------|--------------------------|
| 1 | PI-E109 | Mechatronics Systems |
| 2 | PI-E110 | Digital Logic & Circuits |
| 3 | PI-E111 | Industrial Robotics |
| 4 | PI-E112 | Reverse Engineering |

NITTTR, Chandigarh
DETAILED SYLLABUS
3D/4D Printing, Innovative Design and Production

| | | | | |
|---|-------------------------------------|----------|----------|----------|
| PI-C101 | Modelling for 3D/4D Printing | L | T | P |
| | | 4 | 0 | 0 |
| Pre-requisites/ knowledge/ Exposure | Machine Drawing, Auto CAD | | | |

COURSE OBJECTIVES

The objective of the course is to introduce the methodological basis of the 3 D modeling, geometric transformations, part orientation and its algorithm as well as the main theoretical and practical aspects of these topics.

COURSE OUTCOMES

On completion of this course, the students will be able to:

- Apply geometric transformation techniques in CAD.
- Develop mathematical models for 3D /4 D printing.
- Determine part orientation, apply suitable slicing algorithm and generate tool path for minimum build time, support material and part errors in 3D/4D printing.
- Design and analyze engineering components for 3D/4D applications.

TEXT BOOKS

T1. Zeid,Ibrahim. CAD/CAM Theory and Practice. TMH, 2019

T2. Saxena Anupam, Sahay Birendra. Computer Aided Engineering Design. Springer, 2005.

REFERENCE BOOKS

R1. Dieter, George. Engineering Design, 3rd Ed., McGraw Hill. 2001.

R2. Otto, Kevin; Wood, Kristin. Product Design, Pearson Education, 2004.

R3. Rogers, F; Adams, A. Mathematical Elements for Computer Graphics, TMH, 2008.

R4. Mortenson, M. Geometric Modeling, Wiley, NY, 1997.

R5. Saxena, A.;Sahay, B. Computer Aided Engineering Design, Springer, 2005.

R6. Venuvinod, P. and Weiyin Ma. Rapid Prototyping: Laser-based and Other Technologies, Springer, 2004.

R7. Lu, L.; Fuh J. and WongS. Laser-Induced Materials and Processes for Rapid Prototyping, Springer, 2001.

R8. Chua Chee Kai, Leong Kah Fai, “3D Printing and Additive Manufacturing: Principles & Applications”, 4th Edition, World Scientific, 2015.

COURSE CONTENT

Unit I: Introduction to Conceptual Design and CAD

15 Contact Hours

- (1) **Conceptual Design:** Introduction to Design Theories, develop a concept, implement a concept, creative methods for design, Introduction to CAD, CAD input devices, CAD output devices, CAD

Software, Display Visualization Aids, and Requirements of Geometric Modelling, Transformations of Geometry, Developing algorithms/computer codes for transformations.

- (2) **Design of Curves:** Hermite Cubic segments, Curve Trimming and Blending, Bezier segments, Bezier- subdivision, Degree elevation, Composite Bezier, B-spline, Properties of basic functions, Continuity, NURBS, Developing algorithms/computer codes for curves.

Unit II: Design of Surfaces and Solids

15 Contact Hours

- (1) **Design of Surfaces:** Surface entities, surface representation, surface analysis, design of analytical and synthetic surfaces, Developing algorithms/computer codes for surfaces.
- (2) **Design of Solids:** Solid entities, Boolean operations, B-rep of Solid Modeling, CSG approach of solid modelling, advanced modelling methods.
- (3)
- (4) **CAD Data Exchange Formats and Applications:** CAD Data exchange formats, Finite element analysis, 3D digitizing: Reengineering, Additive Manufacturing (AM).

Unit III: AM Data Formatting and Processing

15 Contact Hours

- (1) **AM Data Formats:** Tessellated Models, STL Format, STL File Problems, STL File Manipulation and Repair Algorithms, AMF files, 3MF, XML, Meta Data, PLY, STEP for AM Application Protocols (AP).
- (2) **AM Data Processing:** Part Orientation and Support Structure Generation, Model Slicing and Contour Data Organization, Direct and Adaptive Slicing, Hatching Strategies and Tool Path Generation.
- (3) **Modelling of AM Process:** Surface Roughness due to Staircase Effect, Part Build-time, Fabrication Cost, Optimal Orientation, Quantification of Building Inaccuracy and Part Stability.

| | | | | |
|---|---|----------|----------|----------|
| PI-C102 | 3D/4D Printing Processes | L | T | P |
| | | 4 | 0 | 0 |
| Pre-requisites/ knowledge/ Exposure | Manufacturing Processes, Casting, Welding and Forming | | | |

COURSE OBJECTIVES

To impart basic knowledge of 3D/4D printing techniques, material selection, equipment and applications of additive manufacturing.

COURSE OUTCOMES

On completion of this course, the students will be able to:

- differentiate between the different 3D/4D printing in manufacturing
- Select suitable materials for 3D/4D printing
- Select suitable 3D printing Technology for a given application.
- Select post-processing of 3D/4D parts
- Compare the conventional processes with 3D/4D printing in the field of automobile, aerospace, and bio-medical.

TEXT BOOKS

- T1. Kai, C; Fai L. Rapid Prototyping: Principles & Applications, World Scientific, 2003.
- T2. Gibson, I.; Rosen D.; Stucker, B. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010

REFERENCE BOOKS

- R1. Ian Gibson, David W Rosen, Brent Stucker., “Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing”, 2nd Edition, Springer, 2015.
- R2. Patri K. Venuvinod and Weiyin Ma, “Rapid Prototyping: Laser-based and Other Technologies”, Springer, 2004.
- R3. Chua Chee Kai, Leong Kah Fai, “3D Printing and Additive Manufacturing: Principles & Applications”, 4th Edition, World Scientific, 2015.
- R4. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer 2001.
- R5. Rafiq Noorani, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons, 2006.

COURSE CONTENT

Unit I: Introduction to 3D/4D printing 15 Contact Hours

- 1) **Introduction to Additive Manufacturing:** Introduction to 3D printing and AM, AM evolution, Distinction between AM & CNC machining, Steps in AM, Classification of AM processes, Advantages of AM and Types of materials for AM. Vat Photo polymerization, 4D printing

- 2) **AM Processes:** Stereo-lithography (SL), Materials, Process Modelling, SL resin curing process, SL scan patterns, Micro-stereo-lithography, Mask Projection Processes, Two-Photon vat photopolymerization, Process Benefits and Drawbacks, Applications of Vat Photopolymerization, Material Jetting and Binder Jetting AM Processes

Unit II: Types of AM processes

15 Contact Hours

- (1) **Extrusion-Based AM Processes:** Fused Deposition Modelling (FDM), Principles, Materials, Process Modelling, Plotting and path control, Bio-Extrusion, Contour Crafting, Process Benefits and Drawbacks, Applications of Extrusion-Based Processes.
- (2) **Sheet Lamination AM Processes:** Bonding Mechanisms, Materials, Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications.
- (3) **Powder Bed Fusion AM Processes:** Selective laser Sintering (SLS), Materials, Powder fusion mechanism and powder handling, Process Modelling, SLS Metal and ceramic part creation, Electron Beam melting (EBM), Process Benefits and Drawbacks, Applications of Powder Bed Fusion Processes.

Unit III: AM Data Formatting and Processing

15 Contact Hours

- (1) **Directed Energy Deposition AM Processes:** Process Description, Material Delivery, Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Electron Beam Based Metal Deposition, Processing-structure-properties, relationships, Benefits and drawbacks, Applications of Directed Energy Deposition Processes.
- (2) **Materials science for AM -** Multifunctional and graded materials in AM, Role of solidification rate, Evolution of non-equilibrium structure, microstructural studies, Structure property relationship.
- (3) **Post Processing of AM Parts:** Support Material Removal, Surface Texture Improvement, Accuracy Improvement, Aesthetic Improvement, Preparation for use as a Pattern, Property Enhancements using Non-thermal and Thermal Techniques.
- (4) **Guidelines for Process Selection:** Introduction, Selection Methods for a Part, Challenges of Selection, Example System for Preliminary Selection, Process Planning and Control.

| | | | | |
|--|---------------------------|----------|----------|----------|
| PI-C103 | 3D/4D Printing Lab | L | T | P |
| | | 0 | 0 | 2 |
| Pre-requisites knowledge/ Exposure | Material science | | | |

COURSE OBJECTIVES

To provide engineering aspects of different 3D/4D printing processes and to improve the surface finish of fabricated plastic components for the engineering applications.

COURSE OUTCOMES

On completion of this course, the students will be able to:

- Optimize the process parameters of FDM machine to improve the quality of the parts produced.
- Improve surface finish of fabricated plastic components for the engineering applications.
- Design and fabricate working models for the conceptual testing applications.
- Improve surface finish of fabricated plastic components for the engineering applications.

COURSE CONTENT

1. Introduction to 3D/4D printing
2. Generating STL files from the CAD Models & Working on STL files
3. Modelling Creative Designs in CAD Software
4. Processing the CAD data in Catalyst and CURA software
5. Simulation in Catalyst Software for optimizing build-time and material consumption
6. Sending the tool path data for fabricating the physical part on RP machine
7. Removing the supports & post processing (cleaning the surfaces)
8. Evaluating the quality of the fabricated part in terms of surface finish and dimensional accuracy.
9. Evaluating the fabricated part for its suitability to a given application

| | | | | |
|---|--|----------|----------|----------|
| PI-C104 | Mechanical Behavior and Material Characterization for 3D/4D Printing | L | T | P |
| | | 4 | 0 | 0 |
| Pre-requisites/ knowledge/ Exposure | Manufacturing Processes, CAD/CAM | | | |

COURSE OBJECTIVES

The objective of the course is to introduce the importance and methodology of the material characterization as well as principle and operation of characterization equipment's.

COURSE OUTCOMES

On completion of this course, the students will be able to :

- Interpret various materials characterization techniques.
- Explain the principle and operation of characterization equipment and the adjustment of operation variables to obtain good images / results.
- Select the characterization tool for specific application
- Compare the principle and operation of different characterization tools such as optical microscope, Scanning electron microscopes and transmission electron microscope
- Analyze the characterization results by various equipment.

TEXT BOOKS

T1. ASM Handbook: Materials Characterization, ASM International, 2008.

T2. Yang Leng: Materials Characterization-Introduction to Microscopic and Spectroscopic Methods, John Wiley & Sons (Asia) Pte Ltd., 2008.

REFERENCE BOOKS

R1. George E. Dieter, Mechanical Metallurgy, McGraw Hill, 2nd Edition, 2005.

R2. Hellan K, Introduction to Fracture Mechanics, McGraw Hill, 2002.

R3. J.E.Dorn, Mechanical Behavior of Materials at Elevated Temperatures, McGraw Hill, 2000.

R4. M.F Ashby and David R H Jones: Engineering Materials I: Introduction to Properties, Applications and Design, 2010.

R5. Richard W. Hertzberg, Richard P. Vinci, Jason L. Hertzberg, Deformation and Fracture Mechanics of Engineering Materials, 5th Edition, Wiley, 2012.

COURSE CONTENT

Unit I: Introduction to Fatigue and Fracture Mechanics

15 Contact Hours

- (1) **Fatigue:** High and low cycle fatigue, process of fatigue fracture, effect of mean stress, Cyclic stress/strain response of materials, establishment of cyclic stress/ strain curve, transition fatigue life, Coffin-Manson relationship, Evaluation of parameters, characterizing resistance against high cycle and Low cycle fatigue, Creep fatigue interaction, environmental effects, thermo chemical fatigue.

- (2) **Fracture Mechanics:** Brief review of the basic concepts of linear elastic and elastic-plastic fracture mechanics, stress intensity parameter, J- integral and crack tip opening displacement as fracture criteria, standard procedures for experimental determination of these parameters.

Unit II: Introduction to System Drives, Part Programming

15 Contact Hours

- (1) **Failure analysis:** Analyzing Fractures, Micro mechanisms of brittle and ductile fracture, fracture mechanism maps, fractography, Visual Examination & Management of Applied Failure Analysis, Manage Failure Analysis.
- (2) **Materials characterization techniques:** Optical microscopy techniques, Quantitative metallography, Scanning electron microscopy: Image formation methods in SEM. Applications.

Unit III: Basics of AM Machines

15 Contact Hours

- (1) **Atomic Force Microscopy (AFM)** - basic principles, instrumentation, operational modes, Applications, Limitations
- (2) **Electron Probe Micro Analyzer (EPMA)** - Introduction, Sample preparation, Working procedure, Applications, Limitations
- (3) **X-Ray Spectroscopy for Elemental Analysis** - Introduction, Characteristics of X-rays, X-ray Fluorescence Spectrometry, Wavelength Dispersive Spectroscopy-Instrumentation, Working procedure, Applications, Limitations, Energy Dispersive Spectroscopy - Instrumentation, Working procedure, Applications, Limitations. etc.

| | | | | |
|--|--|----------|----------|----------|
| PI-C105 | Finite Element Analysis for 3D/4D Printing | L | T | P |
| | | 4 | 0 | 0 |
| Pre-requisites knowledge/ Exposure | Manufacturing Processes, CAD/CAM | | | |
| Co-requisites | None | | | |

COURSE OBJECTIVES

1. Explain the theory and characteristics of finite elements method for engineering applications. .
2. Apply finite element solutions to structural, thermal, dynamic problem to develop the knowledge and skills needed to effectively evaluate finite element analyses.

COURSE OUTCOMES

On completion of this course, the students will be able to :

- Explain fundamentals of Finite Element Method
- Apply the concept of discretization and its mathematical basis for 1D problems
- Apply the concept of discretization and its mathematical basis for 2D problems.
- Solve structural problems using FEM.
- Solve transfer problems with the application of FEM.

COURSE DESCRIPTION

This course introduces finite element methods for the analysis of solid, structural, fluid, field, and heat transfer problems. Steady-state, transient, and dynamic conditions are considered. Applications include finite element analyses, modeling of problems, and interpretation of numerical results.

Text Books:

1. Finite Element Method for Engineers By Kenneth H. Huebner
2. Finite Element Analysis By S.S. Bhavikatti
3. Finite Element Modelling for Stress Analysis By Robert D. Cook

Reference Books

1. Introduction to Finite Element Method By J.N. Reddy
2. Introduction to Finite Elements in Engineering by T.R. Chandrupatla.
3. Finite Element Procedures in Engineering Analysis By K.J. Bathe

COURSE CONTENT

Unit I:

15 Contact Hours

1. Introduction to Finite Element Method

Introduction to FEM (Finite Element Method), Historical Background of FEM, Application Areas of FEM, Distinction between Continuous and Discrete Systems

2. Elasticity Review

Stress Tensor, Strain Tensor, Generalized Hook's Law, Plain Stress, Plane Strain, and Principal of Minimum Potential Energy

3. Basics of FEM

Discretizing Domain, Defining Nodes & Elements, Deriving Stiffness Matrix using Direct Method for Bar & Truss Element, Assembly Procedure for Global Stiffness Matrix, Solver Technology, Convergence

Unit II:

15 Contact Hours

4. Variation & Differential Approaches

Brief Overview of Variation Methods and Differential Methods, Ritz Method, Galerkin's Method

5. Functions

Basics of Interpolation Functions, Continuity and Serendipity Approach

6. Isoparametric Formulation

Concept of Isoparametric Formulation, Coordinate Transformation, Basic Theorems of Isoparametric Formulation, Assembling Stiffness Matrix, Numerical Integration (Gauss Quadrature)

Unit III:

15 Contact Hours

7. Application to Structural Problems

Application to Plane Truss, Application to Plane Stress and Plane Strain Problems, General Formulation for Three Dimensional Problems, Application Plane Beams and Plane Frames, Application to Axisymmetric Stress Analysis

8. Application to Heat Transfer Problems

One Dimensional & Two Dimensional Heat Conduction, Conduction with Convection, Conduction with Surface Radiation

9. Error Estimation

Convergence of Solution, Measures of Errors, Approximation of Error

| | | | | |
|--|--------------------------------------|----------|----------|----------|
| PI-C106 | Material characterization Laboratory | L | T | P |
| | | 0 | 0 | 4 |
| Pre-requisites knowledge/ Exposure | Material science | | | |

COURSE OBJECTIVES

To provide engineering aspects of material morphology and its metallurgical properties

COURSE OUTCOMES

On completion of this course, the students will be able to :

- Understand material morphology – Shape, size and distribution
- Understand physical properties of materials.
- Carry out tests related to Metallurgical properties – Microstructure, Micro-hardness, Phase & Elemental composition
- Surface roughness.
- Carry out dimensional and form error analysis. accuracy

COURSE CONTENT

The following Characterization carried out on cast, welded and formed components

- (1) Identify the phases in the microstructure
- (2) Phase/volume fraction
- (3) Grain size measurement using line intercept method / area method
- (4) EDX-analysis using SEM
- (5) Tensile behaviour of welded and additive manufactured components and analyze the data
- (6) Fractography of cast and welded samples
- (7) Micro-hardness analysis of welded and additive manufactured components
- (8) Non destructive testing of cast and welded components
- (9) Production and characterization of additive manufactured components
- (10) Analysis of additive manufactured components by using 3D-microscope
- (11) Dimensional and form error analysis of additive manufactured components using coordinate measuring machine (CMM)

| | | | | |
|--|-------------------|----------|----------|----------|
| PI-EC101 | Powder Metallurgy | L | T | P |
| | | 3 | 0 | 0 |
| Pre-requisites knowledge/ Exposure | Material science | | | |
| Co-requisites | None | | | |

COURSE OBJECTIVES

Students would learn about powder metallurgy processing technique and the related equipment.

COURSE OUTCOMES

On completion of this course, the students will be able to:

- Compare the basics of powder processing techniques and their applications
- Select suitable powder characterization technique.
- Explain the fabrication process of filters, self-lubricating, gears, friction parts, electrical materials through powder metallurgy.
- Compare and select different materials processing technique.
- Discuss the reasons for defects and mitigation methods in PM components.

TEXT BOOKS

T1. Powder Metallurgy Technology, Cambridge International Science Publishing, 2002.

T2. J. S. Hirschhorn: Introduction to Powder Metallurgy, American Powder Metallurgy Institute, Princeton, NJ, 1976.

REFERENCE BOOKS

R1. G. S. Upadhyaya, Powder Metallurgy Technology, Cambridge International Science Publishing, 1998.

R2. ASM Handbook, Vol-7, Powder Metallurgy, ASM International, 2010.

R3. P. C. Angelo and R. Subramaniam, Powder Metallurgy - Science, Technology and Application, PHI, New Delhi, 2008.

R4. R. M. German, Powder Metallurgy- Principles and Applications, MPIF, Princeton, 1994.

COURSE CONTENT

Unit I: Characterization of Powders

15 Contact Hours

- 1) **Production and Characterization of Powder** - Compaction of metal powder, die compaction, Isostatic compaction, Injection molding, Powder forging/ rolling/ extrusion, Pressureless Sintering, Hot pressing/ Isostatic Pressing, Post Sintering process, Application of Powder Metallurgy Parts
- 2) **Basic steps of powder metallurgy** -SWOT analysis of powder metallurgy, advanced powder fabrication and sintering techniques, Production of filters, self-lubricating bearings, gears,

friction parts, electrical materials, sintering of carbide tools, fabrication difficulty of tungsten filament, synthesis and sintering of hydroxyapatite(HAP) and other bioceramics, powder metallurgy of stainless steel, Application of powder metallurgy in Indian industries.

Unit II: Characterization and Compacting Techniques

15 Contact Hours

- (1) **Characterization:** Chemical composition, Structure, Morphology, Shape, Size, Distribution, Surface area, Powder flow, Apparent density, Tap density, Compressibility, Porosity.
- (2) **Consolidation:** Powder mixing and blending, Compaction techniques, Uniaxial, Isostatic compaction, Extrusion, Forging, Rolling, Injection molding, Tape forming, Slip casting, Sol-gel casting, Types of processes, Tooling and Die design.
- (3) **Sintering:** Solid state sintering, Liquid phase sintering, Reaction sintering, Hot pressing, Hot isostatic pressing, Self-propagating combustion sintering, Sintering atmosphere.

Unit III: Powder Metallurgy applications

15 Contact Hours

- (1) **Applications:** Application and uses of P/M products viz Filters, Contact materials, Bearing, Structural parts.
- (2) **Sintered Products** - Study of sintered bearings, cutting tools, metallic filters, friction and antifriction parts and electrical contact materials. Defects in Powder metallurgy processed materials and their processing to minimize defects : Friction stir processing etc.
- (3) **Powder Forming** - Powder rolling, powder forging, powder extrusion and explosive forming technique.

| | | | | |
|------------------------------------|--|----------|----------|----------|
| PI-EC102 | Materials, Energy Sources and Bonding Mechanisms | L | T | P |
| | | 3 | 0 | 0 |
| Pre-requisites knowledge/ Exposure | Manufacturing Processes, Non Traditional Manufacturing | | | |
| Co-requisites | None | | | |

COURSE OBJECTIVES

To provide engineering aspects of different materials, energy sources and bonding mechanisms and to identify the suitable manufacturing process for specific product fabrication

COURSE OUTCOMES

On completion of this course, the students will be able to:

- Explain essential characteristics of different materials.
- Understand the properties of lasers and identify their suitability for various applications
- Differentiate the lasers requirements for various material processes and manufacturing.
- Identify the process parameters and manufacturing characteristics of processes.

TEXT BOOKS

- T1. Li Yang • Keng Hsu • Brian Baughman Donald Godfrey • Francisco Medina Mamballykalathil Menon • Soeren Wiener, Additive Manufacturing of Metals: The Technology, Materials, Design and Production, Springer, 2017.
- T2. V.K. Jain, Advanced Machining Processes, Allied Publishers, Mumbai, 2002.

REFERENCE BOOKS

- R1. Patri K. Venuvinod and Weiyin Ma, Rapid Prototyping: Laser-based and Other Technologies, Springer, 2004.
- R2. Dongdong Gu, Laser Additive Manufacturing of High-Performance Materials, Springer, 2015.
- R3. K. Thyagarajan, Ajoy Ghatak, Lasers: Fundamentals and applications, 2nd Ed., Springer, 2010.
- R4. Ready, J.F, Industrial applications of Lasers, Academic Press, 2nd Ed., 1997.
- R5. William T Selfvast, Laser Fundamentals, Cambridge Univ. Press, 2008.
- R6. William M. Steen, Laser Material Processing, Springer, 1991.

COURSE CONTENT

Unit I: Introduction to Energy sources:

15 Contact Hours

- (1) **Introduction:** Energy Sources for Material Processing, and Classification of Energy Sources
- (2) **Materials for AM:** Atomic Structure and Bonding, Nature of Polymers, Thermoplastics and Thermosetting Polymers, Types of Polymerizations, Properties of Polymers, Degradation of Polymers, Metal and Ceramic Powders, Compaction and Sintering of Powders, Composites, Functionally Graded Materials (FGM's).
- (3) **Laser Beam:** Introduction, Electromagnetic Radiation, Energy Levels, Interaction of Radiation and Matter; Generation of Laser beam: Spontaneous and Stimulated Emission, Population

Inversion, Resonant Cavity; Properties of Laser Light: Line Width, Beam Divergence Angle, Coherence, Radiance, Focusing Properties of Laser Radiation, and Power. Types Of Lasers, Laser Optics: Light Beam Deflectors, Q-Switches, Optical Isolators, Beam Profilers, Beam Homogenizers; Laser Beam Interaction with Various forms of Materials; other Applications.

Unit II: Introduction to Laser and Electron Beam

15 Contact Hours

- (1) **Laser Additive Manufacturing (AM):** Classification, Processing Philosophy, and Metallurgical Mechanisms Classification of Laser AM Processes and Metallurgical Mechanisms, Laser Sintering (LS), Laser Melting (LM), Laser Metal Deposition (LMD), Classes of Materials for AM and Processing Mechanisms, For LM and LMD—Pure Metals Powder, For LM and LMD—Alloys Powder, For LS and LMD—Multi-Component Metals/Alloys Powder Mixture, Metal Matrix Composites (MMCs), Material/Process Considerations and Control Methods, General Physical Aspects and Design Strategies of Materials for AM, Microstructural Properties of AM-Processed Parts, Mechanical Properties and Performance Aspects of AM-Processed Parts, Structure/Property Stability of AM- Processed Parts.
- (2) **Electron Beam:** Introduction, Wave Properties, and Characteristics - Constructive Interference and Destructive Interference; Generation of Electron Beam: Free Electrons, Cathode, Anode, Control Electrode, Focusing Lens, Deflecting System, Beam Correction System, and Vacuum.
- (3) **Parameters:** Accelerating Voltage, Power Density, Beam Current, Lens Current, Focal Position, Beam Speed, Beam Deflection; Process Related Effects: Liquid and Vapour Phases, Effect of Vacuum, Solidification, and Heat Affected Zone, Internal Thermal Stresses; Electron beam Interaction with different forms of Material; other Applications.

Unit III: Basics of Electron Beam Technology and Plasma Arc processes
15 Contact Hours

- (1) **Electron Beam Technology:** EBT in Additive Manufacturing- Powder Bed Fusion- Electron Beam Melting - Materials - Powder Metallurgy Requirements for EBM - Powder Manufacturing - Gas Atomization - Induction Plasma Atomization - Armstrong Process - Hydride-Dehydride - Characterization - Parameter Development - Build Setup and Process - Latest literature
- (2) **Plasma Arc:** Introduction, Basic Properties, Characteristics, and Types; Plasma Production; Parameters; Plasma with Various Forms of Material Interaction; Applications.
- (3) **Other Sources:** Ultrasonic, Hybrid, and etc.

| | | | | |
|--|---|----------|----------|----------|
| PI-EC103 | Metrology and computer aided inspection | L | T | P |
| | | 3 | 0 | 0 |
| Pre-requisites knowledge/ Exposure | Metrology and Instrumentation, CAD/CAM | | | |
| Co-requisites | None | | | |

COURSE OBJECTIVES

The objective of the course is to introduce the basis of instrumentation, metrology and computer assisted inspection.

COURSE OUTCOMES

On completion of this course, the students will be able to:

- Explain need and applications of instrumentation, metrology & computer assisted inspection.
- Select appropriate techniques for given situations.
- Identify the errors of different measuring instruments.

TEXT BOOKS

T1. Fundamentals of dimensional Metrology T. Busch and R. Harlow Delmar, 3e.

T2. Engineering Metrology G. Thomas and G. Butter Worth PUB.

REFERENCE BOOKS

R1. Measurement systems: Applications & Design Doebelin International Student Edition.

R2. Optoelectronics for Technology and Engineering Robert G. Seippel Prentice Hall India.

R3. Interface Technology for Computer Controlled Ulrich-Rembold, Armbruster Marcel Dekker Publications, Manufacturing processes and Ulzmann NY.

R4. Study manual on tolerance stacks, vol.1 Second edition ASME. 1994 8. Dimensioning and tolerancing of mass Spotts Prentice Hall, 1983.

COURSE CONTENT

Unit I: Measurement and Instrumentation

15 Contact Hours

- (1) **Significance of Measurement and Instrumentation:** Introduction; generalized configuration and functional stages of measuring systems. The transducer and its environment; an overview; sensing process and physical laws. Types of measurement problems, Transducer classification and their modeling; Information, Energy and Incremental Models; Characteristics of instruments, design and selection of components of a measuring system.
- (2) **Dynamic Response of Instruments:** Mathematical model of a measuring system, response of general form of instruments to various test inputs; time-domain and frequency domain analysis. Elementary transfer functions and Bode plots of general transfer functions.
- (3) **Transducers and Transduction Principles:** Developments in sensors, detectors and transducer technology; displacement transducers; force, torque and motion sensors; piezoelectric transducers; capacitive type transducers; Strain gage transducers; accelerometers, pressure transducers based on elastic effect of volume and connecting tubing

Unit II: Instrumentation Errors and Analysis**15 Contact Hours**

- (1) **Errors in Measurement and its Analysis:** Causes and types of experimental errors; systematic and random errors. Uncertainty analysis; computation of overall uncertainty; estimation for design and selection for alternative test methods
- (2) **Data acquisition and Signal Processing:** Systems for data acquisition and processing; modules and computerized data system; digitization rate, time and frequency domain representation of signals, and Nyquist criterion
- (3) **Metrology and Techniques:** Standards in metrology-definition, Traceability, Characteristics Length & Angular measurements Review of standard instruments, GD and tolerance procedure- Review of dimension & form tolerance and methods of measurement, Tolerance analysis

Unit III: Calibration of various instruments**15 Contact Hours**

- (1) **Surface and form metrology :** flatness, roughness, waviness cylindricity, etc., Methods of improving accuracy & surface finish, Influence of forced vibration on accuracy, Dimensional wear of cutting tools and its influences on accuracy
- (2) **Standards for length measurement standards and their calibration:** Light interference - Method of coincidence - Measurement errors. Various tolerances and their specifications, gauging assembly, comparators. Angular measurements - principles and measuring instruments.
- (3) **Laser Applications in Metrology:** LASER light source, LASER interferometer, LASER alignment telescope, LASER micrometer, Online and in-process measurements of diameter, Roundness and surface roughness using LASER, Micro holes and topography measurements, straightness and flatness measurement.
- (4) **Computer Aided Metrology :** Principles and interfacing, soft metrology -Application of lasers in precision measurements- laser interface, laser scanners, Coordinate measurement machine (CMM), Type of CMM & applications. Non contact CMM, Electro optical sensors for dimension, contact sensors for surface finish measurements. Image processing and its Metrology.

| | | | | |
|--|--|----------|----------|----------|
| PI-EC104 | Polymer Engineering | L | T | P |
| Version 1.00 | | 3 | 0 | 0 |
| Pre-requisites knowledge/ Exposure | Manufacturing Techniques, Material Science | | | |
| Co-requisites | None | | | |

COURSE OBJECTIVES

The objective of the course is to introduce the basis of Polymer solutions, Relation between properties and structure, different crystallization and orientation, cross-linking of polymers and elastomers and polymer degradation.

COURSE OUTCOMES

On completion of this course, the students will be able to:

- Identify the importance of polymer industry
- Classify different polymers.
- Identify the errors during the polymer processing.
- Analysis the various factors for the polymer composites.

TEXT BOOKS

- T1. Textbooks/Sourcebooks: Nanomaterials: from research to applications by Hideo Hosono.
T2. Nanomaterials: an introduction to synthesis, properties and application by Dieter Vollath
T3. Nanomaterials: synthesis, properties, and applications by Alan S. Edelstein, Robert C. Cammarata.
T4. Nanomaterials handbook by YuryGogotsi

REFERENCE BOOKS

- R1.** Polymer Processing Fundamentals, Osswald, A.Tim, Hansar Publishers, 1998.
R2. Fundamentals of Reaction Injection Moulding, C.W. Macosko, Hanser Publisher, 1989.
R3. Encyclopedia of Polymer Science and Techology, John Woley and Sons, Inc 1965.

COURSE CONTENT

Unit I: General scenario of the Indian Plastics Processing Industry, and the plastics

15 Contact Hours

- (1) **Extrusion:** Type of single/twin screw extruders, controls, venting, compounding, reactive processing, extrusion of pipers/profiles, blown film, cast film/sheets, wire and cable coating, extrusion coating/Lamination, woven sacks, monofilament and non-woven articles and similar operations foam extrusion, coextrusion, multilayer coextrusion; flow models for extrusion processes, economic aspects of the process, trouble shooting and remedies. Aspects of product design.
- (2) **Calendaring:** Different machinery and the advantages/limitations. Various operations involved in calendaring, pre and post calendaring operations, new developments, flow analysis, economic aspects, trouble shooting and other aspects of calendaring. Aspects of product design.

Unit II: Polymer/ Rheology

15 Contact Hours

- (1) **Classification of polymers** - thermoplastic/ thermoset, addition/ condensation, natural /synthetic, crystalline/amorphous, step growth /chain growth, commodity specialty, homochain/ heterochain, confirmation: homo & copolymers (detailed graft,block alt, ladder etc. & nomenclature), configuration cis/trans; tacticity, branched/ cross-linked, Classification of polymers based on end use etc.
- (2) **Molecular Weight and its distribution:** Molecular weight and its distribution determination (M_n to M_z & MWD), Carothers equation, states of polymers, transition temperatures such as T_g , T_c , T_m , solubility parameter, solution properties, temperature, good/ bad solvent, Addition, condensation polymerization mechanism.
- (3) **Rheology of Nano composites-** Rheology of Multiphase Systems, Rheology of Polymer / clay Nano composites, Recent studies on Rheology, Measure Techniques, Steady shear Rheology, Dynamic Rheology, Non Linear Viscoelastic properties, Extensional Rheology, Rheological modeling of Nano-composites.

Unit III: Polymer Composites

15 Contact Hours

- (1) **Resins for composites** – polyester resins, epoxy resin, phenolic Resins, vinyl esterresins, alkyd resins. Reinforcements for composites – Natural fibers, jute, sisal, synthetic fibers, glass Fibers, carbon fibers, graphite fibers, polyethylene fibers, silicon carbide and boron fibers.
- (2) **Additives for composites** - catalysts, room temperature and elevated temperature, accelerators, coupling agents, fillers, flame retardants, toughening agents, UV, stabilizers. Processing of composites, Important processes like hand lay-up, spray-up, resin transfer moulding, vacuum bag, pressure bag moulding, centrifugal casting, pultrusion, filament winding, moulding compounds – SMC, DMC, BMC, TMC
- (3) **Testing Quality control & end use of plastics** – Testing for mechanical, electrical, thermal, optical and chemical properties, Determination of shelf life and gel time – Non-destructive testing 19 methods. Application of FRP products - in marine, chemical, railways, electrical and electronic industry, space structures – Robotics.

| | | | | |
|--|---|----------|----------|----------|
| PI-EC105 | RAPID TOOLING AND INDUSTRIAL APPLICATIONS | L | T | P |
| | | 3 | 0 | 0 |
| Pre-requisites knowledge/ Exposure | Manufacturing processes, CAD/CAM | | | |
| Co-requisites | None | | | |

COURSE OBJECTIVES

The objective of the course is to introduce the basis of rapid tooling and its applications in additive manufacturing

COURSE OUTCOMES

On completion of this course, the students will be able to:

- Identify suitable rapid tooling technique for rapid product development.
- Model the suitable tooling method for the given industrial application.
- Identify the errors during development of tool and minimize them.
- Design and fabricate the tool for the given medical application
- Design and fabricate the tool for the given automobile application.

TEXT BOOKS

- T1. D.T. Pham and S.S Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping & Rapid Tooling, Springer, 2001.
- T2. Peter Hilton and Paul F Jacobs, Rapid Tooling Technologies and Industrial Applications, Marcel Dekker Inc, New York, 2001.

REFERENCE BOOKS

- R1. D.T. Pham and S.S Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping & Rapid Tooling, Springer, 2001.
- R2. Peter Hilton and Paul F Jacobs, Rapid Tooling Technologies and Industrial Applications, Marcel Dekker Inc, New York, 2001.
- R3. Wanlong Wang, Henry W. Stoll and James G. Conley, Rapid Tooling Guidelines for Sand Casting, Springer, 2010.
- R4. Andreas Gebhardt, Understanding Additive Manufacture: Rapid Prototyping, Rapid Tooling and Rapid Manufacture, Hanser Publishers, 2013.

COURSE CONTENT

Unit I: Introduction to Rapid Tooling 15 Contact Hours

- (1) **FIntroduction:** Conventional Tooling, Rapid Tooling, Differences between Conventional and Rapid Tooling, Classification of Rapid Tooling: Direct and Indirect Tooling methods; Soft, Bridge (firm) and Hard Tooling methods.
- (2) **Indirect Methods for Rapid Tool Production and Rapid Bridge Tooling:** Introduction to Bridge tooling, CAFÉ Bridge tooling, Direct AIM Rapid Bridge tooling, Rapid Tool Rapid Bridge tooling, Shrinkage Variation, Random-noise Shrinkage.

- (3) **Rapid Tooling Process Modeling:** Introduction to modeling, Concurrent Rapid Product and Process Development, Finite Element Modeling and Simulation, Injection-moulding, Die-casting, Blow-moulding, Thermo-forming Processes modeling.
- (4) **The Express Tool Process:** Introduction, High-Thermal-Conductivity Materials, Conformal Cooling Channels, The Express Tool Process, Finite-Element Analysis of Express Tools, Express Tool Process Characteristics, Case studies of Express Tools.

Unit II: Introduction to Direct and Indirect Tooling Methods

15 Contact Hours

- (1) **Direct Soft Tooling/Firm Tooling Methods:** Role of direct soft tooling methods in tool production, SLS of Sand Casting & Copper PA Moulds, EOS Direct Croning™ Process, Direct AIM (Direct ACES™ Injection Moulds), SL Composite Tooling, 3DPTM Ceramic Shells, Topographic Shape Formation (TSF) tools.
- (2) **Indirect Soft Tooling/Firm Tooling Methods:** Role of indirect soft tooling methods in tool production, Metal Deposition Tools, Silicon rubber mould/RTV/Vacuum Casting, Epoxy tools, Spin casting with Vulcanized Rubber moulds, Castable Resin moulds, Castable Ceramic moulds, Plaster moulds, Casting (Investment/Die/Spin/Sand Castings).
- (3) **Direct Hard Tooling Methods:** Role of Direct Hard tooling methods in tool production, EOS DirectTool/ Direct Metal Laser Sintering, DTM RapidTool, LOM Tooling in Ceramic, ProMetal Rapid Tooling, Laser Engineered Net Shaping (LENS).

Unit III: Applications of Rapid Tooling

15 Contact Hours

- (1) **Indirect Hard Tooling Methods:** Role of indirect hard tooling methods in tool production, Fusible metallic cores, 3D Keltool, Cast Aluminum and Zinc Kirksite Tooling, EDM Electrodes, Ecotool.
- (2) **The Role of Rapid Tooling in Investment-Casting Applications:** Introduction, Rapid Tool Making for investment Casting, Rapid tooling for developing Casting Applications, BELL Helicopter 427 Program
- (3) **The Role of Rapid Tooling in Sand-Casting Applications:** Sand casting Process, Tool Design and Construction for Sand Casting, Sand Casting Dimensional Control, Tooling Alternative Selection Case Studies.
- (4) **Rapid Tooling in the Medical Device Industry:** Introduction, Investment Casting and Conventional Wax Pattern Tooling, Conventional Tooling Manufacture Vs. Rapid Tooling Manufacture, Medical Case studies like Hip Stem and Knee implants.
- (5) **Rapid Tooling in the Automotive Industry:** Approaching Niche Vehicle Markets, Accelerating Product Developments, Utilizing Rapid Prototyping and Manufacturing, Machining Laminates, Rapid Prototype Stages, Subsequent Casting Operations, Rapid Tooling Developments, Case Studies.
- (6) **Others:** The Future of Rapid Manufacturing and Case studies related to Rapid Tooling other Industrial Applications.

| | | | | |
|---|--|----------|----------|----------|
| PI-EC106 | RAPID MANUFACTURING FOR MEDICAL APPLICATIONS | L | T | P |
| | | 3 | 0 | 0 |
| Pre-requisites/ knowledge/ Exposure | Manufacturing processes, CAD/CAM | | | |

COURSE OUTCOMES: At the end of the course, the student shall be able to:

- Apply the concepts of medical imaging and 3D scanning for accurate 3D model reconstruction
- Identify the errors during processing of medical image data and minimize them.
- Select the suitable material for a given medical application.
- Analyze and select an additive manufacturing technology for a given medical application.
- Design and fabricate customized implant for the given medical application.

DETAILED SYLLABUS:

3 Dimensional Data Capture and Medical Scanning Technologies: Introduction to medical imaging, Human Anatomy, X-Ray technology, Computed Tomography (CT), Basic Components of CT, Different Types of CT Scanners, Magnetic Resonance Imaging (MRI), Ultrasound imaging, 3-D laser scanners, Industrial CT Scanners, 3D reconstruction and Reverse Engineering (RE), Image Reconstruction Procedure, Digital Communication in Medicine (DICOM) format, Types of Artifacts.

Medical Image Processing Software Systems: Processing of medical data from CT/MRI scan to 3D model in MIMICS, 3D-Doctor, Velocity2Pro, VoXim, Surgi Guide, SimPlant Software, MIMICS software modules, Importing data, thresholding, segmentation, Editing, region growing, volume reduction, 3D Visualization, surgical simulation, Meshing, Measurement tools, Smoothing tools, STL conversion, Morphological operations, Labelling, volume, RP file generation, Practice on Medical Modelling.

Biomaterials: Introduction to Biomaterials, Metallic Biomaterials, Ceramic Biomaterials, Polymeric Biomaterials, Composite Biomaterials, Biodegradable Polymeric Biomaterials, Tissue-derived Biomaterials.

Virtual and Diagnostic Models in Medicine: Surgical applications of virtual models in Cranio-maxillofacial bio-modelling, Oral and Maxillofacial surgery, customized cranio maxillofacial prosthetics, Biomodel-guided stereotaxy, Vascular biomodelling, Skull-based tumour surgery, Spinal surgery and Orthopaedic biomodelling.

Planning and Simulation of Complex Surgeries: Cranioplasty of large cranial defect, Congenital malformation of facial bones, Cosmetic facial reconstruction, Separation of conjoined twins, Tumor in the jaw, Cancerous brain, Dental precision planning and Spinal instrumentation.

Design and Fabrication of Customized Implants and Prosthesis: Cranium implants, Hip implants, Knee implants, Intervertebral spacers, Buccopharyngeal stent, Tracheobronchial stents, Obturator prosthesis and Tissue engineering scaffolds. A discussion on few benchmark case studies.

Design and Production of Medical Devices: Biopsy needle housing, Drug delivery devices, Masks for burnt victims, Functional prototypes help prove design value, Design and fabrication of non-implantable

devices, Tools, Guides, Templates, etc., Design and Fabrication of Medical Support Devices like Arm, Knee Braces, etc., Design and Fabrication of Health Monitoring Devices.

Additive Manufacturing Related Technology in Sports, Rehabilitation, Device for Elderly, Forensic Science and Anthropology, Tissue Engineering and Organ Printing.

READING:

1. Richard Bibb, Dominic Eggbeer and Abby Paterson, *Medical Modelling: The Application of Advanced Design and Rapid Prototyping Techniques in Medicine*, Woodhead Publishing, 2015.
2. Ian Gibson, *Advanced Manufacturing Technology for Medical Applications*, John Wiley, 2005.
3. Chua Chee Kai and Yeong Wai Yee, *Bio-Printing: Principles and Applications*, World Scientific Publishing, 2015.
4. Paulo Bartolo and Bopaya Bidanda, *Bio-materials and Prototyping Applications in Medicine*, Springer, 2008.
5. Joseph D. Bronzino, *The Biomedical Engineering Handbook*, 3rd Edition, CRC Press, 2006.

| | | | | |
|---|----------------------------------|----------|----------|----------|
| PI-EC107 | Digital Manufacturing | L | T | P |
| | | 3 | 0 | 0 |
| Pre-requisites/ knowledge/ Exposure | Manufacturing processes, CAD/CAM | | | |

OBJECTIVE

The objective of this course is to understand the transformation taking place, throughout the world, in design and manufacturing of products through digital manufacturing – a shift from paper-based processes to digital processes in the manufacturing industry.

LEARNING OUTCOMES

After the completion of this course, the students will be able to

- Understand product design and development process, along with the manufacturing aspects.
- Use parametric 3D CAD software tools in the correct manner for making geometric part models, assemblies and automated drawings of mechanical components and assemblies.
- Apply geometric transformations on the created wireframe, surface and solid models

DETAILED SYLLABUS

1. **Introduction:** Types of manufacturing systems and their characteristics, Computer aided Manufacturing (NC, CNC, DNC and adaptive control systems), Computer Network architectures and protocols, Computer Integrated Manufacturing Systems, What makes a manufacturing process “digital”
2. **CNC Machines:** Constructional details, Design features, Safety devices, Part programming
3. **Group Technology and Cellular Manufacturing:** Parts classification and part coding – approaches and systems, Benefits of group technology, Cellular manufacturing-basics, layout considerations
Cell formation approaches and evaluation of cell designs, Planning and control in cellular manufacturing, Applications in Manufacturing
4. **Computer Aided Process Planning:** Role of Computer in Planning function, CAPP Approaches
Benefits of CAPP, Machinability Data Systems, Computer – Generated Time Standards
5. **Computer Aided Quality Control:** Computers in quality control, Contact and non-contact inspection methods, Computer aided testing
6. **Flexible Manufacturing Systems:** FMS and its Components, Layout considerations in FMS, Material Handling in FMS
7. **Reverse Engineering:** Reverse Engineering – Principles and Technology, Contact type methods, Non-contact type methods, Applications in Product Manufacturing
8. **Additive Manufacturing:** Additive Manufacturing Processes, Steps in Additive Manufacturing, Materials used in Additive Manufacturing, Post processing, Challenges, Benefits and Applications
9. **Cloud Based Manufacturing:** Introduction to Cloud computing, Data Analytics in Manufacturing, Networked manufacturing, Industrial Internet of Things, Industry 4.0 Standard, Applications of Cloud based Manufacturing

BOOKS:

1. Groover M. P. and Zimmers E. W., “Computer Aided Design and Manufacturing”, Pearson Education, New Delhi, 2003
2. Groover M. P., “Automation, Production Systems and Computer Aided Manufacturing”, Pearson Education, New Delhi, 2015
3. P. Radhakrishnan, S. Subramanyan, V. Raju, “CAD/CAM/CIM”, New Age International, 2008
4. C.K. Chua, K.F. Leong, C.S. Lim, “Rapid Prototyping: Principles And Applications”, 3rd Edition, World Scientific Publishing Co Pte Ltd,2008
5. Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, Apress, 2016

REFERENCE BOOKS

6. Alp Ustundag,EmreCevikcan, “Industry 4.0: Managing The Digital Transformation”, Springer Series in Advanced Manufacturing, 2017
7. Zude Zhou, Shane ShengquanXie, Dejun Chen, Fundamentals of Digital Manufacturing Science”, Springer Series in Advanced Manufacturing, 2011

| | | | | |
|---|----------------------------------|----------|----------|----------|
| PI-EC108 | Advanced composite technologies | L | T | P |
| | | 3 | 0 | 0 |
| Pre-requisites/ knowledge/ Exposure | Manufacturing processes, CAD/CAM | | | |

COURSE OUTCOMES: At the end of the course the student will be able to:

- Understand composite material and their reinforcements
- Select constituent materials to develop appropriate composites
- Analyze interfaces of composites for predicting their mechanical properties.
- Develop metal matrix, ceramic matrix and polymer matrix composites with calculated values of constituents
- Analyze the performance of composites

DETAILED SYLLABUS

Introduction:

Overview of the course, history and basic concept of composites, Types and constituents, reinforcement and matrices, interface and mechanism of strengthening, definition and classification of composites, particulate and dispersion hardened composites, continuous and discontinuous fibre reinforced composites MMC, PMC, CMC.

Metal Matrix Composites Processing: Liquid state processes, solid state processes and in situ processes.

Interface: Role, reactions, bonding mechanisms and bond strength.

Properties and applications: Strength, stiffness, creep, fatigue and fracture; thermal, damping and tribological properties.

Polymer Matrix Composites Processing: Hand layup and spray technique, filament winding, pultrusion, resin transfer molding, bag and injection molding, sheet molding compound. Matrix resins-thermoplastics and thermosetting matrix resins, Reinforcing fibers- Natural fibers (cellulose, jute, coir etc.), carbon fiber, glass fiber, Kevlarfiber, etc. Particulate fillers-importance of particle shape and size, Coupling agents-surface treatment of fillers and fibers, significance of interface in composites, short and continuous fibre reinforced composites, critical fibre length, and anisotropic behavior.

Ceramic Matrix Composites Processing: Cold pressing & sintering, hot pressing reaction bonding processes, infiltration, in-situ chemical reaction, Sol-Gel and polymer pyrolysis, self propagating high temperature synthesis. Carbon-carbon composites, Interfaces rule of mixtures, Stress, strain transformations.

Nano-composites: introduction to Nano-composites, advantages disadvantages

Test methods: Quality assessment, physical and mechanical property characterization.

READING:

1. Chawla, Composite Materials Science and Engineering, Springer.
2. Hull, An introduction to composite materials, Cambridge.
3. Steven L. Donaldson, ASM Handbook Composites Volume 21, 2001.
4. Krishan K. Chawla, Composite Materials, Science and Engineering, Springer, 2001.

5. Suresh G. Advani, E. Murat Sozer, Process Modelling in Composites Manufacturing, 2nd Ed. CRC Press, 2009.

| | | | | |
|--|----------------------------------|----------|----------|----------|
| PI-EC109 | Mechatronics Systems | L | T | P |
| | | 3 | 0 | 0 |
| Pre-requisites knowledge/ Exposure | Manufacturing processes, CAD/CAM | | | |

OBJECTIVE

The objective of this course is to provide the student with basic skills useful in identifying the concepts of automated machines and equipment and describe the terms and phrases associated with mechatronics.

LEARNING OUTCOMES

After the completion of this course, the students will be able to

- Select & identify suitable mechatronics hardware for the given application.
- Describe & explain potential areas of mechatronics.
- Differentiate various control aspects of automation.
- Demonstrate the self-learning capability of Industrial Automation.

DETAILED SYLLABUS:

1. **Introduction:** Mechatronics & its Elements, Mechatronics Design Process, Integrated Design Issues in Mechatronics, Applications of Mechatronics
2. **Modeling & Simulation of Physical Systems:** Mathematical modeling of physical systems, Dynamic response of first and second order systems, System transfer functions, Block Diagram Approach, State Space Approach
3. **Actuators:** Fluid power control elements and standard graphical symbols, Directional, Pressure and Flow Control Valves – Construction and Working, Basic fluid power circuits, Mechanical & Solid state switches, AC and DC motors, Stepper motors
4. **Control Theory:** Introduction to Open Loop & Closed Loop Control, Transient & Steady state performance characteristics, Frequency response, PID Controllers & their Tuning, Adaptive Control
5. **Data Acquisition:** Sensors, Operational amplifier, Protection and filtering, Digital signals, Data acquisition systems
6. **Mechatronics System Design:** Traditional & Mechatronics Design, Possible Mechatronics Design Solutions, Digital logic, Programmable logic controllers, Microcontrollers, Simple Logic Circuits using PLC and microcontroller

BOOKS:

1. David G. Alciatore, Michael B. Hstand, “Introduction to Mechatronics and Measurement Systems”, Tata McGraw Hill, 4th Edition, 2014

2. W Bolton, "Mechatronics: A Multidisciplinary Approach", Pearson Education, 4th Edition, 2014
3. S R Majumdar, "Pneumatic Systems", Tata McGraw Hill, New Delhi, 2008.
4. S R Majumdar, "Oil Hydraulic Systems", Tata McGraw Hill, New Delhi, 2010
5. Groover M. P., "Automation, Production Systems and Computer Aided Manufacturing", Pearson Education, New Delhi, 2015

| | | | | |
|--|----------------------------------|----------|----------|----------|
| PI-EC110 | Digital Logic & Circuits | L | T | P |
| | | 3 | 0 | 0 |
| Pre-requisites knowledge/ Exposure | Manufacturing processes, CAD/CAM | | | |
| Co-requisites | None | | | |

OBJECTIVE

The knowledge of digital logic and circuits is required for designing a robotic control system. This subject will also enable the students to formulate Boolean expressions for programming the robot for performing given tasks.

COURSE OUTCOMES

After the completion of this course, the students will be able to :

- Formulate truth tables for different logic problems
- Derive Boolean expressions for implementing logic
- Identify components required for developing hardware for implementing logic

DETAILED SYLLABUS

1. **Number System and Codes:** Number System, Floating Point Representation of Numbers Arithmetic Operations, Binary Coded Decimal (BCD), Weighted Binary Codes, Non-Weighted Codes, Error Detecting & Correcting Codes, Alphanumeric Codes
2. **Boolean Algebra and Minimization Techniques:** Boolean Logic Operations, Basic Laws of Boolean Algebra, Demorgan's Theorems, Minimization Techniques, Sum of Products and Product of Sums Karnaugh map
3. **Logic Gates:** Different Logic gates, Mixed logic, Multilevel gating networks, Multiple output gate networks
4. **Logic families:** Digital integrated circuits, Current-sourcing and current-sinking logic, Resistor-transistor logic, Resistor-capacitor-transistor logic, Diode-transistor logic, Transistor-transistor logic
5. **Combinational Circuits:** Multiplexers and Demultiplexers, Decoders and Encoders, Parity generators/checkers' Code converters, Magnitude comparator
6. **Flip-Flops:** Latches, S-R flip flop, D flip-flop, J-K flip-flop, T flip-flop
7. **Counters and Registers:** Asynchronous counter, Synchronous counters, Counter ICs, Shift registers, Shift register counters, Sequence generator
8. **Sequential Circuits:** General sequential circuit model, Classification of sequential circuits, Synchronous sequential circuits, Fundamental mode Asynchronous sequential circuits, Pulse Mode Asynchronous sequential circuits
9. **D/A and A/D Converters:** Analog and digital data conversions, Characteristics of D/A converter, Types of D/A converters, Characteristics of A/D converter, Types of A/D converters
10. **Clock Generators:** Astable multivibrator, Monostable multivibrator, Schmitt trigger

BOOKS:

1. Digital Logic Design Principles by Norman Balabanian, Bradley Carlson, Wiley Student Edition
2. Digital Circuits & Design by D.P Kothari, J.S Dhillon, Pearson Education India
3. Digital Circuits and Design by Salivahanan and Arivazhagan, Vikas Publishing House, Noida

| | | | | |
|--|----------------------------------|----------|----------|----------|
| PI-EC111 | Industrial Robotics | L | T | P |
| | | 3 | 0 | 0 |
| Pre-requisites knowledge/ Exposure | Manufacturing processes, CAD/CAM | | | |
| Co-requisites | None | | | |

COURSE OUTCOMES: At the end of the course, the student shall be able to:

- Classify robots based on joints and arm configurations.
- Design application specific End Effectors for robots.
- Compute forward and inverse kinematics of robots and determine trajectory plan.
- Program robot to perform typical tasks including Pick and Place, Stacking and Welding.
- Design and select robots for Industrial and Non-Industrial applications.

DETAILED SYLLABUS

Robotics classification, Sensors-Position sensors, Velocity sensors, Proximity sensors, Touch and Slip Sensors, Force and Torque sensors.

Grippers and Manipulators-Gripper joints, Gripper force, Serial manipulator, Parallel Manipulator, selection of Robot-Selection based on the Application

Kinematics-Manipulators Kinematics, Rotation Matrix, Homogenous Transformation Matrix, Direct and Inverse Kinematics for industrial robots for Position and orientation.

Differential Kinematics and static- Dynamics-Lagrangian Formulation, Newton-EulerFormulation for RR & RP Manipulators,Trajectory planning-Motion Control- Interaction control, Rigid Body mechanics, Controlarchitecture- position, path velocity and force control systems, computed torque control,adaptive control, and Servo system for robot control.

Programming of Robots and Vision System- overview of various programming languages.

Application of Robots in production systems- Application of robot in welding, machinetools, material handling, and assembly operations parts sorting and parts inspection.

READINGS:

1. Fu, K.S., Gonzalez, R.C., and Lee, C.S.G., *Robotics control, Sensing, Vision andIntelligence*, McGraw-Hill Publishing company, New Delhi, 2003.
2. Klafter, R.D., Chmielewski, T.A., and Negin. M, *Robot Engineering-An IntegratedApproach*, Prentice Hall of India, New Delhi, 2002.
3. Craig, J.J., *Introduction to Robotics Mechanics and Control*, Addison Wesley, 1999.

| | | | | |
|--|----------------------------------|----------|----------|----------|
| PI-EC112 | Reverse Engineering | L | T | P |
| | | 3 | 0 | 0 |
| Pre-requisites knowledge/ Exposure | Manufacturing processes, CAD/CAM | | | |

COURSE OUTCOMES: At the end of the course, the student shall be able to:

- Identify the steps involved in re-engineering of a given component.
- Design and fabricate an existing component with suitable modifications as per customer's requirements.
- Select and configure a suitable re-engineering system for inspection and manufacturing.
- Apply the re-engineering techniques in aerospace, automobile and medical sectors.

DETAILED SYLLABUS

Introduction to reverse engineering, Re-Engineering–The Generic Process Geometric Modelling using Point Cloud Data: Point Cloud acquisition, Surface Modelling from a point clouds, Meshed or Faceted Models, Planar Contour Models, Points to Contour Models, Surface Models, Segmentation and Surface Fitting for Prismatic objects and Free Form Shapes.

Methodologies and Techniques for Re-Engineering: The Potential for Automation with 3-D Laser Scanners, What Is Not Re-Engineering, What is Computer-aided (Forward) Engineering, What Is Computer-aided Reverse Engineering, Computer Vision and Re-Engineering

Re-Engineering–Hardware and Software: Contact Methods Noncontact Methods, Destructive Method.

Selecting a Re-Engineering System: The Selection Process, Some Additional Complexities, Point Capture Devices, Triangulation Approaches, “Time-of-flight” or Ranging Systems, Structured-light and Stereoscopic Imaging Systems, issues with Light-based Approaches, Tracking Systems, Internal Measurement Systems, X-ray Tomography, Destructive Systems, Some Comments on Accuracy, Positioning the Probe, Post processing the Captured Data, Handling Data Points, Curve and Surface Creation, Inspection Applications, Manufacturing Approaches.

Integration Between Re-Engineering and Additive Manufacturing: Modeling Cloud Data in Re-Engineering, Data Processing for Rapid Prototyping, Integration of RE and RP for Layer based Model Generation, Adaptive Slicing Approach for Cloud Data Modeling, Planar Polygon Curve Construction for a Layer, Determination of Adaptive Layer Thickness.

Re-Engineering in Automotive, Aerospace, Medical sectors: Legal Aspects of Re-Engineering: Copyright Law, Re-Engineering, Recent Case Law, Barriers to Adopting Re-Engineering, discussion on a few benchmark case studies.

READING:

1. K. Otto and K. Wood, *Product Design: Techniques in Reverse Engineering and New Product Development*, Prentice Hall, 2001.
2. Reverse Engineering: An Industrial Perspective by Raja and Fernandes, Springer-Verlag 2008.
3. Anupam Saxena, Birendra Sahay, “Computer Aided Engineering Design”, Springer, 2005.
4. Ali K. Kamrani and Emad Abouel Nasr, “Engineering Design and Rapid Prototyping”, Springer, 2010.

M. TECH. IN COGNITIVE SYSTEMS

Title of the Programme: M.Tech. in Cognitive Systems

Rationale:

As human brains increasingly interact with technology that mimics their own capabilities, the need for students to understand both the science and engineering of cognition continues to grow as well. Addressing these challenges will require a deeper understanding of how the brain produces intelligent behaviour and how we may be able to replicate intelligence in machines. This programme on Cognitive Systems

- compliments emerging areas like AI and Big Data Analytics
- imparts knowledge about how purpose-built systems can be used to realize human-like behaviour.
- makes one learn how computing frameworks that can solve complicated problems without constant human intervention
- allows participants to improve the performance of business through human-machine interactions.

Total Credits: 76

Eligibility: Bachelor's degree in any branch of Engineering or its equivalent with First Division or 60% aggregate marks from a recognized institution.

Programming Outcomes: At the end of the programme, the student will be able to

- **PO1:** Understand the relationship between cognitive computing and artificial intelligence (AI)
- **PO2:** Understand inherently probabilistic nature of cognitive computing and how to use it as a business advantage
- **PO3:** Analyze cognitive computing systems that behave in unexpected ways
- **PO4:** Apply algorithms, techniques and software systems that offer the optimum cognitive computing solutions

Salient Features:

1. It is interdisciplinary program and admission is open to all engineering graduates.
2. Students will have the option to select some the courses offered through MOOCs.
3. Evaluation focuses more on formative evaluation to enable development of desired competencies.
4. In first and second semester, one of the electives being offered, is industry driven.
5. Project specific subject to be selected by the subject will be supervised and monitored by institute faculty.
6. In third semester, student will be attached to industry/NGO/Start up etc. for hands on training on relevant echo system.
7. The program is designed to allow the students to spend one full year in field and explore the possibility of developing prototype.

8. Effective implementation of NEP-2020 is ensured by offering a number of multidisciplinary
9. To have better industry relevance, industry experts will be engaged to run industry relevant subjects.
10. To ensure attainment of program outcomes, emerging pedagogical approaches will be inbuilt in the teaching learning methodology.
11. Since the program is of interdisciplinary nature, bridge courses will be offered to meet the pre requisites of the program.
12. The subjects will be reviewed in the duly constituted BOS after getting the University status.

Study and Evaluation Scheme

First Semester

| Sr. No. | Course Code | Course Title | Credits L-T-P | Hours / Week | Internal Marks | Internal Marks | Total |
|--|-------------|---|---------------|--------------|----------------|----------------|-------|
| Programme Specific Core | | | | | | | |
| 8. | CS-C-101 | Foundations of Cognitive Science | 4-- | 4 | 60 | 40 | 100 |
| 9. | CS-C-102 | Cognitive Computation | 4-- | 4 | 60 | 40 | 100 |
| Interdisciplinary / Industry Oriented Electives | | | | | | | |
| 10. | CS-I-103 | Visual Cognition | 3 -- | 3 | 60 | 40 | 100 |
| 11. | CS-E-104 | Elective 1 | 3 -- | 3 | 60 | 40 | 100 |
| 12. | CS-E-105 | Elective 2 | 3 -- | 3 | 60 | 40 | 100 |
| Laboratory Courses | | | | | | | |
| 13. | CS-P-105 | Internet of Things (Common to all M.TechProgrammes) | -- 2 | 4 | 50 | 50 | 100 |
| 14. | CS-P-106 | Cognitive Computation Laboratory | -- 2 | 4 | 50 | 50 | 100 |
| Total | | | 21 | 25 | 420 | 280 | 700 |

Second Semester

| Sr. No. | Course Code | Course Title | Credits L-T-P | Hours / Week | Internal Marks | External Marks | Total |
|--|-------------|--|---------------|--------------|----------------|----------------|-------|
| Programme Specific Core | | | | | | | |
| 8. | CS-C-201 | Neural Coding and Dynamics | 4-0-0 | 4 | 60 | 40 | 100 |
| 9. | CS-C-202 | Networks for Learning: Regression and Classification | 4-0-0 | 4 | 60 | 40 | 100 |
| Interdisciplinary / Industry Oriented Electives | | | | | | | |
| 10. | CS-I-203 | Computational Linguistics | 3 -- | 3 | 60 | 40 | 100 |
| 11. | CS-E-204 | Elective 3 | 3 -- | 3 | 60 | 40 | 100 |
| 12. | CS-E-205 | Elective 4 | 3 -- | 3 | 60 | 40 | 100 |
| Laboratory Courses | | | | | | | |
| 13. | CS-P-205 | Artificial Intelligence (Common to all M.TechProgrammes) | -- 2 | 4 | 50 | 50 | 100 |
| 14. | CS-P-206 | Language and Speech Laboratory | -- 2 | 4 | 50 | 50 | 100 |
| Total | | | 21 | 25 | 420 | 280 | 700 |

Third Semester

| Sr. No. | Course Code | Course Title | Credits | Hours / Week | Internal Marks | External Marks | Total |
|--------------|-------------|--|---------|--------------|----------------|----------------|-------|
| 2. | CS-M-301 | MOOC Course 1 – Research Methodology | 3 - - | 3 | 60 | 40 | 100 |
| 2. | CS-M-302 | MOOC Course 2 – Field Specific Subject | 3 - - | 3 | 60 | 40 | 100 |
| 3. | CS-P-303 | Live Lab | - - 10 | 20 | 100 | 100 | 200 |
| Total | | | 16 | 26 | 220 | 180 | 400 |

Fourth Semester

| Sr. No. | Course Code | Course Title | Credits | Hours / Week | SEE Marks | CIE Marks | Total |
|--------------|-------------|--------------|---------|--------------|-----------|-----------|-------|
| 1. | CS-D-401 | Thesis Work | 18 | - | 100 | 100 | 200 |
| Total | | | 18 | - | 100 | 100 | 200 |

Total: 76 Credits Total Marks: 2000

CS-E-205

Elective 1 (Select any one)

- CS-E-1041 : Human Memory and Learning
- CS-E-1042 : Cognitive Reasoning and Logic
- CS-E-1043 : Human Anatomy and Physiology

Elective 2 (Select any one)

- CS-E-1051 : Sensorimotor Systems and Human Performance Assessment
- CS-E-1052 : Machine Learning
- CS-E-1053 : Fundamentals of IoT

Elective 3 (Select any one)

- CS-E-2041 : Logic and Functional Programming
- CS-E-2042 : Big Data Analytics
- CS-E-2043 : Parallel and Distributed Computing

Elective 4 (Select any one)

- CS-E-2051 : Deep Learning
- CS-E-2052 : Biomedical Sensors
- CS-E-2053 : Multidisciplinary Product Development

CS-C-101: Foundations of Cognitive Science

Aim: Advances in cognitive science have resolved, clarified, and sometimes complicated some of the great questions of Western philosophy: what is the structure of the world and how do we come to know it; does everyone represent the world the same way; what is the best way for us to act in the world. Specific topics include color, objects, number, categories, similarity, inductive inference, space, time, causality, reasoning, decision-making, morality and consciousness. Readings and discussion include a brief philosophical history of each topic and focus on advances in cognitive and developmental psychology, computation, neuroscience, and related fields. At least one subject in cognitive science, psychology, philosophy, linguistics, or artificial intelligence is required.

Pre-requisite Knowledge: Foundation Biology

Learning Outcomes: At the end of this course, the student will be able to :

- Critically evaluate the conceptual and/or methodological foundations of cognitive science.
- Synthesise and analyse information about complex problems and issues in cognitive science research practice including experimental design and statistical methods.
- Exhibit analytical research skills and show intellectual independence.
- Demonstrate effective scientific communication in written and oral form for a variety of audiences.
- Demonstrate a high level of ethical conduct in research activities.

Course Contents

Cell biology of neurons, Human nervous system, with emphasis on the structure and function of the human brain. Neuron connections, neurotransmitters and synaptic transmission, sensory systems of the brain, the motor system, higher cortical functions. Behavioral and cellular analyses of learning and memory, Neural bases of sensory perception, visual pattern, color and depth perception, auditory responses and sound localization, and somatosensory perception.

Recommended Books:

- Fodor, J. A.. *Representations: Philosophical essays on the foundations of cognitive science* (pp. 225-257). Brighton: Harvester Press.
- Dawson, M. R. *Mind, body, world: Foundations of cognitive science*. Athabasca University Press.

CS-C-102: Cognitive Computation

Aim: In this course, students will be trained with tools and technologies for cognitive computing.

Pre-requisite Knowledge: Any Programming Language

Learning Outcomes: At the end of this course, the student will be able to :

- Describe the field of AI and its subfields machine learning, NLP and computer vision
- Understand the relationship between AI and NLP.
- Describe the main components that are involved when building a chatbot and explain their purpose.
- Identify some of the tools and services of Computer Vision.
- Understand Computer Vision components.

Course Contents

Basic tools for analyzing experimental data, interpreting statistical reports, reasoning under uncertain situations. Axioms of probability, discrete and continuous probability models, law of large numbers, Central Limit Theorem. Estimation, likelihood theory, Bayesian methods, bootstrap, Monte Carlo methods, hypothesis testing, confidence intervals, elementary design of experiments, goodness-of-fit. Simple regression model and the analysis of variance.

References:

- Pylyshyn, Z. W. *Computation and cognition* (p. 41). Cambridge, MA: MIT press.
- Bishop, J. M. A cognitive computation fallacy? *Cognition, computations and panpsychism. Cognitive Computation, 1(3), 221-233.*

CS-I-103: Visual Cognition

Aim: The course treats vision as information processing with a focus on computational challenges in artificial and biological visual systems. Particular emphasis is put on the underspecified nature of several visual problems as well as how artificial and biological systems attempt to solve those problems. The course treats basic image capturing methods, perceptual organization, depth and categorization. Furthermore, the course deals with visual perceptual learning, attention and gaze control.

Pre-requisite Knowledge: cognitive science or equivalent

Learning Outcomes: After the course, the student will be able to :

- Explain the human ability to perceive recognize, remember and imagine objects and scenes
- Describe different theories on perception and an understanding for applications of these theories on artificial systems.
- Use machine vision techniques to capture, analyze and use visual information.
- Apply and integrate this knowledge in a project.
- Communicate the project results in written and oral presentation.
- Understand cognitive science methods.
- Evaluate scientific studies on visual cognition.

Course Contents

Importance of general object recognition, object recognition in experimental, neural, computational, and applied domains. Problem of representation, encoding of 3-D objects, efficient recognition of 3-D objects from 2-D images. Face recognition, performance and recent attempts to mimic this ability in artificial computational systems.

Recommended Books:

- Summerfield, C., & Egner, T. Expectation (and attention) in visual cognition. *Trends in cognitive sciences*, 13(9), 403-409.
- Cavanagh, P. Visual cognition. *Vision research*, 51(13), 1538-1551.

CS-P-106: Cognitive Computation Laboratory

Applications of learning techniques in areas such as computer vision, computer graphics, database search and time-series analysis and prediction. implications of learning theories for how the brain may learn from experience, focusing on the neurobiology of object recognition.

References:

- Levine, D. S. (2018). *Introduction to neural and cognitive modeling*. Routledge.
- Fiorini, R. A. (2017). Towards advanced quantum cognitive computation. *International Journal of Software Science and Computational Intelligence (IJSSCI)*, 9(1), 1-19.

CS-C-201: Neural Coding and Dynamics

Aim: The course covers the fundamental theoretical principles and biological mechanisms underlying how brains acquire, assimilate, store and retrieve information, compute adaptive responses to external inputs, and how knowledge is extracted from experience to generate an internal model of the world leading to successful prediction of the outcome of events and actions: how brains become intelligent.

Pre-requisite Knowledge: cognitive science or equivalent

Learning Outcomes: At the end of this course, the student will be able to

- Understand about the human ability to perceive recognize, remember and imagine objects and scenes
- Understand about different theories on perception and an understanding for applications of these theories on artificial systems
- Understand about machine vision techniques to capture, analyze and use visual information
- apply and integrate this knowledge in a project.
- communicate the project results in written and oral presentation
- understand cognitive science methods
- evaluate scientific studies on visual cognition

Course Contents

Introduction to neural coding and dynamics. Convolution, correlation, linear systems, game theory, signal detection theory, probability theory, information theory, and reinforcement learning. Applications of neural coding in visual system, Hodgkin-Huxley and other related models of neural excitability, stochastic models of ion channels, cable theory, and models of synaptic transmission.

Recommended Books:

- Doya, K., Ishii, S., Pouget, A., & Rao, R. P. (Eds.). *Bayesian brain: Probabilistic approaches to neural coding*. MIT press.
- Cessac, B., Paugam-Moisy, H., & Viéville, T. Overview of facts and issues about neural coding by spikes. *Journal of Physiology-Paris*, 104(1-2), 5-18.

CS-C-202: Networks for Learning

Aim: During this course we will examine applications of several learning techniques in areas such as computer vision, computer graphics, database search and time-series analysis and prediction. Supervised learning with the use of regression and classification networks with sparse data sets will be explored.

Pre-requisite Knowledge: calculus

Learning Outcomes: At the end of the course, the student will be able to

- examine applications of several learning techniques in areas such as computer vision, computer graphics, database search and time-series analysis and prediction.
- Understand implications of learning theories for how the brain may learn from experience, focusing on the neurobiology of object recognition.
- Apply the networks in real-time applications and exercises

Course Contents

Supervised learning within the framework of Statistical Learning Theory. Classical statistical techniques, Regularization Theory in RKHS for multivariate function approximation from sparse data. VC theory, application in classification and regression techniques such as Regularization Networks and Support Vector Machines. Boosting, feature selection and multiclass classification.

Recommended Books:

- Razi, M. A., & Athappilly, K. A comparative predictive analysis of neural networks (NNs), nonlinear regression and classification and regression tree (CART) models. *Expert Systems with Applications*, 29(1), 65-74.
- Huang, G. B., Zhou, H., Ding, X., & Zhang, R. Extreme learning machine for regression and multiclass classification. *IEEE Transactions on Systems, Man, and Cybernetics, Part B (Cybernetics)*, 42(2), 513-529.

CS-I-203: Computational Linguistics

Aim: This course provides an introduction to the area of Computational Linguistics. It covers the major sub areas of the field such as speech recognition and synthesis, morph analyzers and spell checkers, POS tagging, parsing, Corpus Linguistics, Word Net, and machine translation. The course will introduce the participants to the basic key tools and applications in language technology.

Pre-requisite Knowledge: Any Programming Language

Learning Outcomes: At the end of the course, the student will be able to

- Extract and analyse text corpora.
- Understand foundational tasks in Computational Linguistics such as e-dictionary making, speech recognition and synthesis.

Course Contents

Introduction: Fundamentals, challenges, usage, classical problems.

Words-Structure: spellcheck, morphology using FSTs.

Words-Semantics: Basic ideas in Lexical Semantics, WordNet and WordNetbased similarity measures, Word Sense Disambiguation; supervised,unsupervised and semi-supervised approaches, HMM model for speech recognition.

Words-Parts of Speech: POST using Brill's Tagger and HMMs

Sentences: Basic ideas in compositional semantics, Classical Parsing (Bottom up,top down, Dynamic Programming: CYK parser), Parsing using ProbabilisticContext Free Grammars.

Language Modeling: Basic ideas, smoothing techniques.

Machine Translation: Rule based techniques, Statistical Machine Translation(SMT), parameter learning in SMT (IBM models) using EM.

Natural Language Generation: the potential of using ML for NLG

Recommended Books:

- Rabiner, L., & Schafer, R. *Theory and applications of digital speech processing*. Prentice Hall Press.
- Habash, N. Y. Introduction to Arabic natural language processing. *Synthesis Lectures on Human Language Technologies*, 3(1), 1-187.

CSP206: Language and Speech Laboratory

- Acquisition of syntax, morphology, lexicon, discourse and pragmatics
- Programs for Regular expressions, Spelling Correction, parts of speech tagging
- Speech perception and production
- Auditory modelling
- Bilingualism and multilingualism
- Language attitudes
- Robust automatic speech recognition
- Computer models of word recognition in noise

References:

- Nelson, N. W., Van Meter, A. M., Chamberlain, D., & Bahr, C. M. (2001). The speech-language pathologist's role in a writing lab approach. In *Seminars in speech and language* (Vol. 22, No. 03, pp. 209-220). Copyright by Thieme Medical Publishers, Inc., 333 Seventh Avenue, New York, NY 10001, USA. Tel.:+ 1 (212) 584-4662.
- Black, J. W. Speech science. *Quarterly Journal of Speech*, 37(4), 493-497.

CS-E-1041: Human Memory and Learning

Aim: The analysis of the anatomical and physical bases of learning and memory is one of the great successes of modern neuroscience. Thirty years ago little was known about how memory works, but now we know a great deal. This course will discuss four issues that are central to learning and memory. First, what are the different types of memory? Second, where in the brain is memory located? One possibility is that human memory is similar to the memory chip in a personal computer (PC), which stores all the memory in one location. A second possibility is that our memories are distributed and stored in different regions of the brain. Third, how does memory work? What types of changes occur in the nervous system when a memory is formed and stored, are there particular genes and proteins that are involved in memory, and how can a memory last for a lifetime? Fourth, is the issue of importance to many people, especially as we age: How can memory be maintained and improved, and how can it be fixed when it is broken?

Pre-requisite Knowledge: Human Brain System

Learning Outcomes: At the end of this course, the student will be able to :

- Understand different types of memory, brain theory and its location
- Analyse the structure of memory and its impact on learning
- Apply human learning models in real life engineering problems

Course Contents

Different types of memory, Brain memory and its location, distributed architecture of neural system, how memory works, Issue of importance of many people, Cognitive and neural organization of human memory and learning. Working memory and executive control, episodic and semantic memory, and implicit forms of memory. Integration of cognitive theory with recent insights from functional neuroimaging.

Recommended Books:

- Eichenbaum, H. *Learning & memory* (p. 494). New York: WW Norton & Company.
- Baddeley, A. D. *Essentials of human memory*. Psychology Press.

CS-E-1042: Cognitive Reasoning and Logic

Aim: Reasoning is one of the key aspects of human cognition. Traditionally logic was meant as a systematic theory of human reasoning, but in the 20th century the main developments in logic focused on mathematics and its foundations, and logic has been gradually replaced by more specific cognitive theories of reasoning. Still, these theories are mostly inspired by classical consideration of logic, probability, and computations. In this course we are going to particularly focus on the relationship between logical complexity and cognitive difficulty in reasoning.

Pre-requisite Knowledge: calculus

Learning Outcomes: At the end of the course, the student will be able to

- Understand the basics of logic, probability and computation.
- Apply critical thinking.
- Differentiate between deductive and inductive reasoning.
- Apply cognitive reasoning and logic in real time applications like robotics.

Course Contents

Critical thinking, meaning analysis, difference between literal meaning and implication, problems with the imprecision of ordinary language, identifying arguments, what makes an argument sound as opposed to unsound or merely valid, the difference between deductive and inductive reasoning, how to map arguments to reveal their structure. Symbolic logic, basic properties of a system of logic, turning phrases in ordinary language into well-formed formulas, draw truth-tables for formulas, evaluating arguments using truth-tables. basic principles of Venn diagrams, representing statements by Venn diagrams, evaluating arguments using Venn diagrams. Understanding arguments, avoiding fallacies.

Recommended Books:

- Magnani, L. (2015). Naturalizing logic: Errors of reasoning vindicated: Logic reapproaches cognitive science. *Journal of Applied Logic*, 13(1), 13-36.
 - Dennett, D. C. Cognitive wheels: The frame problem of AI.
-

CS-E-1043: Human Anatomy and Physiology

Aim: Anatomy and Physiology is a study of the structure and function of the human body including cells, tissues and organs of the following systems: integumentary, skeletal, muscular, nervous and special senses. Emphasis is on interrelationships among systems and regulation of physiological functions involved in maintaining homeostasis.

Learning Outcome: At the end of the course, the student will be able to:

- Use anatomical terminology to identify and describe locations of major organs of each system covered.
- Explain interrelationships among molecular, cellular, tissue and organ functions in each system.
- Describe the interdependency and interactions of the systems.
- Explain contributions of organs and systems to the maintenance of homeostasis.
- Identify causes and effects of homeostatic imbalances.
- Describe modern technology and tools used to study anatomy and physiology

Course Contents

♣ Main concepts concerning anatomy & physiology. ♣ The structural components of the cell and the genetic regulation of cells. ♣ The importance of membrane transport and membrane potentials to cell functions. ♣ The classification, structure and function of tissues. ♣ The structure, function and clinical considerations of the integumentary system, bone tissue including bone development, articulations, muscles and muscle tissue. ♣ The functional organization of the nervous system, central nervous system, peripheral nervous system, autonomic nervous system. ♣ The structure, function and clinical considerations of sensory organs.

Recommended Books:

- N Marieb, E. (1968). *Human anatomy & physiology*. Toronto.
- Shier, D., Butler, J., & Lewis, R. (2018). *Hole's essentials of human anatomy & physiology*. McGraw-Hill Education.
- Saladin, K. S., & Porth, C. (2010). *Anatomy & physiology: the unity of form and function* (Vol. 5). New York: McGraw-Hill.

CS-E-1051: Sensorimotor Systems and Human Performance Assessment

Aim: This course examines many dimensions of health and human performance. The major goal of the program is to enable students to make informed health decisions. The student will analyze the structure and function of the human body, apply physiological and biomechanical concepts to human movement, examine the acquisition of motor skills, explore the multi-dimensional nature of the health and human performance discipline, examine ethical issues related to the discipline and achieve the specific physical skills required to be healthy.

Learning Outcomes: At the end of the course, the student will be able to:

- Demonstrate the knowledge, skills, and abilities of a modern health fitness specialist;
- Demonstrate critical thinking and problem solving in health, physical activity, nutrition, sport, and exercise sciences;
- Demonstrate integrative learning and civic engagement in health, physical activity, nutrition, sport, and exercise sciences;
- Demonstrate ethical reasoning in health, physical activity, nutrition, sport, and exercise sciences;

Course Contents

Strength and Conditioning ♣ Human Performance testing and measurement ♣ Gait Analysis ♣
Tendon musculoskeletal adaptation ♣ Nutrition and performance ♣ Exercise psychophysiology

Recommended Books:

- Staal, M. A. (2004). Stress, cognition, and human performance: A literature review and conceptual framework.
- Paulus, M. P., Potterat, E. G., Taylor, M. K., Van Orden, K. F., Bauman, J., Momen, N., ... & Swain, J. L. (2009). A neuroscience approach to optimizing brain resources for human performance in extreme environments. *Neuroscience & Biobehavioral Reviews*, 33(7), 1080-1088.
- Carling, C., Reilly, T., & Williams, A. M. (2008). *Performance assessment for field sports*. Routledge.

CS-E-1052: Machine Learning

Aim: This course will serve as a comprehensive introduction to various topics in machine learning. The objective is to familiarize the audience with some basic learning algorithms and techniques and their applications, as well as general questions related to analyzing and handling large data sets. At the end of the course the students should be able to design and implement machine learning solutions to classification, regression, and clustering problems; and be able to evaluate and interpret the results of the algorithms.

Pre-requisite Knowledge: Probability and neural networks

Learning Outcomes: At the end of the course, the students will be able to:

- Understand the fundamental issues and challenges of machine learning.
- Understand the strengths and weaknesses of many popular machine learning approaches.
- Interpret the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.
- Design and implement various machine learning algorithms in a range of real-world applications.

Course Contents

Supervised Learning, Decision Trees & CART, Linear regression, Gradient Descent. Linear Classification: Logistic regression, Newton Raphson, Perceptron, Multilayer Perceptron, feedforward neural network, Error backpropagation method, Convolution Networks, Support Vector Machines (SVM)

Probabilistic Models: Bayes classifier, Naive Bayes classifier, Hidden Markov models (HMMs) for pattern classification. Design and Analysis of Experiments: Cross validation, Performance measures, CI Estimation, Hypothesis Testing

Unsupervised Learning: Criterion functions for clustering, Techniques for clustering -- K-means clustering, Gaussian Mixture Models, Hierarchical clustering, Density based clustering

Dimensionality Reduction Techniques: Principal component analysis, Fisher discriminant analysis, Multiple discriminant analysis.

Recommended Books:

1. Machine Learning by Tom Mitchell
2. Introduction to Machine Learning by Ethem Alpaydin
3. Introduction to Statistical Learning, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 2013.
4. Pattern Classification, 2nd Ed., Richard Duda, Peter Hart, David Stork, John Wiley & Sons, 2001.

CS-E-1053: Fundamentals of IoT

Aim: This course focuses on the latest microcontrollers with application development, product design and prototyping. This also focuses on interoperability in IoT along with various IoT Platforms for application development.

Pre-requisite Knowledge: Sensors and python programming

Learning Outcomes: At the end of the course, the students will be able to:

- Understand the various network protocols used in IoT
- Understand the role of Big Data, Cloud Computing and Data Analytics in a typical IoT system.
- Design a simple IoT system made up of sensors, wireless network connection, data analytics and display/actuators, and write the necessary control software.
- Build and test a complete IoT system.

Course Contents

Introduction to IoT, Sensing, Actuation, Basics of Networking, Communication Protocols. Sensor Networks, Machine to Machine Communications. Understanding of the IoT ecosystem, various layers in building an IoT application and interdependencies. INTEROPERABILITY IN IoT: Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino, Introduction to Python programming. Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi. Build use cases using Raspberry Pi. SDN FOR IoT: Introduction to SDN, SDN for IoT, Data Aggregation, Handling and Analytics, Cloud Computing, Sensors, Fog Computing Understanding of the various protocols being used in IoT like MQTT, AMQP, REST API. IoT Platforms and Applications: Understanding of the IoT platforms like PTC Thingworx and IoT frameworks like MS Azure, Understanding of the usage of these platforms to build applications like Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Case Study: Agriculture, Healthcare, Activity Monitoring.

Recommended Books:

1. David Etter, "IoT (Internet of Things) Programming: A Simple and Fast Way of Learning IoT," Kindle Edition.
2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, and David Boyle, "From Machine to Machine to the Internet of Things: Introduction to a New Age of Intelligence," Elsevier Science Publishing Co. Inc, 2014.
3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases," 1st Edition, Auerbach Publications, 2017.
4. Yasuura, H., Kyung C.M., Liu Y., and Lin Y.L., "Smart Sensors at the IoT Frontier," 1st Edition, Springer International Publishing, 2018.

CS-E-2041: Logic and Functional Programming

Aim:The objective of this course is to offer students a comprehensive knowledge and practical experience in functional and logic programming. The students will get basic information about theoretical basis of both paradigms and its implementation techniques.

Pre-requisite Knowledge: Basic programming knowledge

Learning Outcomes:After the completion of this course, the students will be able to:

- Understand the concepts of the Logic and Functional programming paradigms.
- Differentiate between functional programming and logic programming.
- Implement Lazy and Eager Evaluation Strategies.
- Implement functional and logic programs for cognitive systems.
- Apply functional and logic programming for solving a real world problem.

Course Contents:

Introduction of logic and Functional Paradigm, Propositional Concepts, Semantic Table, Problem Solving with Semantic Table. Rules of Natural Deduction, Sequent Calculus, Axiomatic Systems, Meta theorems, Important Properties of AL, Resolution, Resolving Arguments, Introduction to Predicate Logic Objects, Predicates and Quantifiers, Functions, First Order Language, Quantifiers, Scope and Binding, Substitution, An Axiomatic System for First Order Predicate Logic, Soundness and Completeness, Axiomatic Semantic and Programming.

Semantic Tableaux, Instantiation Rules, Problem-solving in Predicate Logic, Normal forms, Herbr and Universes and H-interpretation, Resolution, Unification, Resolution as a computing Tool, Nondeterministic Programming, Incomplete Data Structure, Second Order Programming in Prolog, Logic Grammars: Definite Clause Grammar, A Grammar Interpreter. Evaluation Strategies, Lazy Evaluation: Evaluation Order and strictness of function, Programming with lazy evaluation, Interactive functional program, Delay of unnecessary Computation, Infinite Data Structure, Eager Evaluation and Reasoning, Recent trends in logical and functional programming, predicate logics and various evaluation strategies.

Recommended Books:

1. John Kelly, "The Essence of Logic," Pearson Education, 1997.
2. Saroj Kaushik, "Logic and Prolog Programming", New Age International, 2002.
3. David S. Warren, "Programming in Tabled Prolog," Citeseer, 1995
4. W. F. Clocksin and C.S.Mellish, "Programming in Prolog," 4th Edition, Springer, 1994.
5. Ulf Nilsson and Jan Maluszynki, "Logic Programming and Prolog," 2nd Edition, John Wiley & Sons Ltd, 1995.

CS-E-2042: Big Data Analytics

Aim:The objective of this course is to teach the emerging concepts and case studies of Big Data with the real world case studies. In addition, the course focuses towards the coverage of data acquisition, storage, processing, querying and visualization with hands-on-practice using various big data analytics tools.

Pre-requisite Knowledge: DBMS

Learning Outcomes: After the completion of this course, the students will be able to:

- Understand the concepts of Big Data Analytics with real world case studies.
- Acquire, store and process Big Data from various sources.
- Analyse and visualize Big Data.
- Apply Big Data Analytics in various domains.

Course Contents:

Introduction to Big Data: Definition, various tools for Big Data, Possibilities of Big Data storage using RDBMS, Data Warehousing and Data Marts concept, Types of analytics - Descriptive, Diagnostic, Predictive, Prescriptive, Big Data characteristics - Volume, Velocity, Variety, Veracity, Value, Data analysis flow, Big data examples, applications & case studies.

Big Data Architectures & Patterns: MapReduce, Sharding, Bloom Filters, Lambda Architecture, Consistency, Availability & Partition Tolerance (CAP), Consensus in Distributed Systems, Leader Election and Other analytics patterns. Python Programming for Big Data Applications: Introduction to Python, Big Data stack setup and examples, Hortonworks Data Platform/Apache Ambari, Amazon EMR, Running Python MapReduce examples on big data stack.

Data Acquisition: Apache Flume; Apache Sqoop; Publish - Subscribe Messaging Frameworks; Big Data Collection Systems, Messaging queues, Custom connectors, Implementation examples

Big Data Storage: HDFS, HBase, Kudu. NoSQL Databases: Key-value databases, Document databases, Column Family databases, Graph databases.

Batch Data Analysis: Hadoop & YARN, MapReduce & Pig, Spark core, Batch data analysis examples & case studies. Real-time Analysis: Stream processing with Storm, In-memory processing with Spark Streaming, Real-time analysis examples & case studies. Interactive Querying: Hive, Spark SQL, Interactive querying examples & case studies. Cloud Computing Platforms: Amazon Web Services (AWS), Deploying Big Data applications in the cloud. Web Frameworks & Serving Databases: Django - Python web framework, Using different serving databases with Django. Data Visualization: Building visualizations with Lightning, pyGal&Seaborn

Recommended Books:

1. ArshdeepBahga, Vijay Madiseti, "Big Data Analytics: A Hands-On Approach", VPT Publishers, 2018
2. Big Data Black Book, D T editorial service, Dreamtech Press, Wiley India; 1st edition, 2016.
3. Baesens Bart, "Analytics in A Big Data World - The Essential Guide To Data Science and Its Applications", Wiley, 2014
4. RadhaShankarmani, M. Vijayalakshmi, "Big Data Analytics", Wiley, 2016

5. Acharya Seema, SubhashiniChellappan, "Big Data and Analytics", Wiley, 2015

CS-E-2043: Parallel and Distributed Computing

Aim:The course tells about programming paradigms used in parallel computation, about the organization of parallel systems, and about the application of programs and systems to solve interesting problems.

Pre-requisite Knowledge: nil

Learning Outcomes:At the end of the course, the students will be able to:

- Develop, test and debug RPC based client-server programs.
- Design and build application programs on distributed systems.
- Improve the performance and reliability of distributed programs.
- Design and build newer distributed file systems for any OS.

Course Contents

Introduction: Basic issues and model Asynchrony, delay, failure concurrency, Communication topology, load balancing, scaling. **Basic Approaches:** Agreement and consensus problems, transactions, Algorithms for reduction, scans (also non-parallel issues). Analysis: work/time complexity

Shared Memory: Models and primitives, PRAM, VRAM, semaphores, spin-locks, Barriers' implementations, NESL, Threads, distributed shared memory. **Parallel Architectures:** Survey of Architectures KSR, TMC, MasPar, workstation clusters

Algorithm Development and Analysis: Parallel algorithms, Connected components (dense and sparse case), Sorting, distributed algorithms, Clock synchronization

Recommended Books:

1. Kai, Hwang: Computer Architecture and parallel processing, Tata McGraw Hill Co.
2. F.T.Leighto: Introduction to Parallel Algorithms and Architectures: Arrays, Trees, Hypercubes, Morgan Kaufmann Publishers, San Mateo, California
3. Joseph JaJa: An Introduction to Parallel algorithms, Addison Wesley.
4. Patterson: Computer Architecture-Quantitative Analysis

CS-E-2051: Deep Learning

Aim: This course aims to present the mathematical, statistical and computational challenges of building stable representations for high-dimensional data, such as images, text and data. Course delves into selected topics of Deep Learning, discussing recent models from both supervised and unsupervised learning. Special emphasis will be on convolutional architectures, invariance learning, unsupervised learning and non-convex optimization.

Pre-requisite Knowledge: Neural Networks

Learning Outcomes: At the end of the course, the students will be able to :

- Explain the fundamental principles, theory and approaches for learning with deep neural networks
- Describe the main variants of deep learning (such convolutional and recurrent architectures), and their typical applications
- Explain the key concepts, issues and practices when training and modeling with deep architectures as well as hands-on experience in using deep learning frameworks for this purpose.
- Implement basic versions of some of the core deep network algorithms (such as backpropagation).
- Identify the learning tasks where deep learning is considered to be suitable.

Course Contents

History of Deep Learning, Deep Learning Success Stories, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm. Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent, Feedforward Neural Networks, Representation Power of Feedforward Neural Networks, Backpropagation. Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, Eigenvalues and eigenvectors, Eigenvalue Decomposition, Basis Principal Component Analysis and its interpretations, Singular Value Decomposition Autoencoders and relation to PCA, Regularization in auto encoders, Denoising auto encoders, Sparse auto encoders, Contractive autoencoders. **Regularization:** Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout Greedy Layerwise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization, Learning Vectorial Representations of Words. Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Backpropagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks.

Recommended Books:

1. Deep Learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville and Francis Bach.
2. Neural Networks and Deep Learning By Michael Nielsen
3. Deep Learning with Python by Francois Chollet, 1st Edition
4. Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems by Aurélien Géron, 1st Edition
5. Colab (Google)

CS-E-2052: Biomedical Sensors

Aim:Conventional computing based on Von Neumann architecture has been shown to be approaching its limits in scalability and power consumption. If solved with contemporary machines, today's applications in science and industry related to data analysis, pattern recognition and prediction would demand a huge computing power. In the era of ubiquitous sensing and data acquisition, a way to cheaply and power efficiently make sense of the collected 'big data' is of utmost importance. Here, human brain's efficiency becomes the ultimate standard and inspiration for any future technology. Such trend of understanding the brain behavior is currently gaining a huge attention worldwide. In the biomedical sensors course, students shall explore new computing technologies miming the way our brains process and store data.

Pre-requisite Knowledge: Nil

Learning Outcomes:At the end of the course, the students will be able to :

- Implement state of art biomedical sensors.
- Explore biomedical applications.
- Simulate various alternatives.

Module-1 Biopotential Electrodes

Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode-skin interface, half-cell potential, impedance, polarization effects of electrode – nonpolarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes.

Module-2 EEG, EMG & ECG

Bio signal characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. EEG- procedure, signal artefacts, signal analysis, evoked potential, EMG- procedure and signal analysis, Nerve conduction study.

Module-3 Bio Amplifiers

Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference.

Module-4 Physical Sensors in Biomedicine

Temperature measurement: core temperature-surface temperature- invasive. Blood flow measurement: skin blood- hot film anemometer- Doppler sonography- electromagnetic sensor - blood pressure measurement: noninvasive- hemodynamic invasive. Spirometry- sensors for pressure pulses and movement- ocular pressure sensor- acoustic sensors in hearing aid, in blood

flow measurement, sensors for bio-magnetism, tactile sensors for artificial limbs, sensors in ophthalmoscopy, artificial retina.

Module-5 Sensors for Chemical Quantities in Biomedicine

Blood gas and pH sensor, electrochemical sensor, transcutaneous, optical fiber sensor, mass spectrometer, optical oximetry, pulseoximetry, earoximetry. X ray imaging with sensors, detectors in nuclear radiology, magnetic field sensors for imaging, magnetic resonance imaging. Interaction of Ultrasound with matter; Cavitations, Reflection, Transmission- Scanning systems – Artefacts- Ultrasound- Doppler-Double Doppler shift-Clinical Applications.

Suggested Books:

1. J. G. Webster, J. G. Webster, “Medical Instrumentation; Application and Design”, John Wiley & Sons, Inc., New York, 4th Edition, 2015
2. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw-Hill, New Delhi, 3rd edition.
3. John Enderle, Joseph Bronzino, “Introduction to Biomedical Engineering”, Academic Press, 3rd Edition.
4. Myer Kutz, “Biomedical Engineering and Design Handbook, Volume 1: Volume I: Biomedical Engineering Fundamentals”, McGraw Hill Publisher, USA, 2nd Edition.

CS-E-2053: Multi-disciplinary Product Development

Aim: To expose the students to product design principles and market driven quality product design.

Pre-requisite Knowledge: Nil

Learning Outcomes: At the end of the course, the students will be able to :

- Appreciate the need to design as per customer needs and markets.
- Design products keeping in mind quality aspects.
- Design products as per design principles
- plan sourcing and e sourcing of materials.

Module-1 Customer Value and Market Segmentation

The way to measure value by what a customer is willing to pay. It is used as critical input for product function requirement development. No product can satisfy all the customers. Market Segmentation shows the methodology to target a specific customer group for product positioning.

Module-2 Voice of customer

Voice of customer: A disciplined approach to directly collecting feedback and input from customers. Used throughout the Engineering and Marketing process.

Module-3 Quality Function deployment

Critical to Quality and Quality Function Deployment: Specify and quantify customer needs. Flow down those customer needs in each step of product development.

Module-4 Design of Six Sigma

Integrate statistics into quality continuous improvement operation model. Design for Six Sigma used throughout the product development process in order to improve the correction of the first design delivery.

Module-5 Design Principles

Sample design Principles: As little design as possible to satisfy customer expectations and eliminating any unnecessary complexity helps maximize business benefit.

Module-6 Strategic sourcing and e-sourcing

Strategic Sourcing and Standardized Parts: Leverage the expertise of external source is one of the key strategies to success. Parts standardization improves the manufacturing flexibility and reduces the quality issue. e-sourcing: Leverage web-based applications to deliver savings and productivity gains while conducting the strategic sourcing.

Suggested Books:

1. Tempelman, Shercliff, Van Eyben, "Manufacturing and Design, Elsevier, 1st edition.
2. Art Weinstein, "Handbook of Market Segmentation: Strategic Targeting for Business and Technology Firms, Third Edition (Haworth Series in Segmented, Targeted, and Customized Market), 3rd ed. Routledge, Taylor and Francis group.
3. Michael Lamoureux, "The e-Sourcing Handbook: A Modern Guide to Supply and Spend Management Success, Lasta publishing.

M.TECH.IN AUGMENTED REALITY, VIRTUAL REALITY AND DIGITAL GAME DESIGN

Title of the Programme

M Tech in Augmented Reality, Virtual Reality and Digital Game Design

Department: Information Management and Engineering/Media Engineering

Rationale

This course is interdisciplinary in nature where Augmented Reality and Virtual Reality will be explained to experience AR and VR as Medium. The students will be able to design AR and VR applications, test, and implement their own AR and VR experiences/games using Unity by the end of the specialization. In this course, the students will learn the basics of 3D graphics, how to create objects and how to lay them out to create an environment. This programme covers the theoretical and practical foundations of video game production using the Unity 3D game engine. The students will learn to develop a game concept; prototype, test, and iterate on ideas; and navigate licensing, marketing, and other business considerations.

Total Credits: 76

Eligibility: BE/B.Tech in any branch of Engineering

Salient Features:

13. It is interdisciplinary program and admission is open to all engineering graduates.
14. Students will have the option to select some the courses offered through MOOCs.
15. Evaluation focuses more on formative evaluation to enable development of desired competencies.
16. In first and second semester, one of the electives being offered , is industry driven.
17. Project specific subject to be selected by the subject will be supervised and monitored by institute faculty.
18. In third semester , student will be attached to industry/NGO/Start up etc for hands on training on relevant echo system.
19. The program is designed to allow the students to spend one full year in field and explore the possibility of developing prototype.
20. Effective implementation of NEP-2020 is ensured by offering a number of multidisciplinary
21. To have better industry relevance, industry experts will be engaged to run industry relevant subjects.
22. To ensure attainment of program outcomes, emerging pedagogical approaches will be inbuilt in the teaching learning methodology.
23. Since the program is of interdisciplinary nature, bridge courses will be offered to meet the pre requisites of the program.

Program Outcomes (POs):

- **PO1:** An ability to apply advances in Artificial Intelligence, Augmented Reality and Virtual Reality with innovative and creative ideas in designing smarter games for infotainment facilitating life long learning.
- **PO2:** An ability to build intelligent games that makes participating players to involve in **activities** to learn **problem-solving**, strategy, **trust**, calculated **risk-taking**, to adapt to unforeseen issues and to share.

Study and Evaluation Scheme**First Semester**

| Sr. No. | Course Code | Course Title | Hours /Week | | | Credits | Internal Marks | External Marks | Total |
|------------------------------------|-------------|--|-------------|---|---|---------|----------------|----------------|-------|
| | | | L | T | P | | | | |
| Programme Specific Core | | | | | | | | | |
| 15. | DGD-C-101 | Augmented Reality and Virtual Reality | 4 | - | - | 4 | 60 | 40 | 100 |
| 16. | DGD-C-102 | Human Computer Interface | 4 | | | 4 | 60 | 40 | 100 |
| Interdisciplinary Electives | | | | | | | | | |
| 17. | DGD-E-xxx | Elective 1 | 3 | - | - | 3 | 60 | 40 | 100 |
| 18. | DGD-E-xxx | Elective 2 | 3 | - | - | 3 | 60 | 40 | 100 |
| Industry Oriented Elective | | | | | | | | | |
| 19. | DGD-I-xxx | Elective 3 | 3 | - | - | 3 | 60 | 40 | 100 |
| Laboratory Courses | | | | | | | | | |
| 20. | DGD-P-106 | Internet of Things (Common to all M.Tech Programmes) | - | - | 4 | 2 | 60 | 40 | 100 |
| 21. | DGD-P-107 | Unity Game Development | - | - | 4 | 2 | 60 | 40 | 100 |
| Total | | | 25 | | | 21 | 420 | 280 | 700 |

Second Semester

| Sr. No. | Course Code | Course Title | Hours/ Week | | | Credits | Internal Marks | External Marks | Total |
|------------------------------------|-------------|---|-------------|---|---|---------|----------------|----------------|-------|
| | | | L | T | P | | | | |
| Programme Specific Core | | | | | | | | | |
| 15. | DGD-C-201 | Game Physics | 4 | - | - | 4 | 60 | 40 | 100 |
| 16. | DGD-C-202 | Artificial Intelligence for Game Design | 4 | - | - | 4 | 60 | 40 | 100 |
| Interdisciplinary Electives | | | | | | | | | |

| | | | | | | | | | |
|-----------------------------------|-----------|---|----|---|---|----|-----|-----|-----|
| 17. | DGD-E-xxx | Elective 1 | 3 | - | - | 3 | 60 | 70 | 100 |
| 18. | DGD-E-xxx | Elective 2 | 3 | - | - | 3 | 60 | 70 | 100 |
| Industry Oriented Elective | | | | | | | | | |
| 19. | DGD-I-xxx | Elective 3 | 3 | - | - | 3 | 60 | 70 | 100 |
| Laboratory Courses | | | | | | | | | |
| 20. | DGD-P-206 | Artificial Intelligence (Common to all M.Tech Programmes) | - | - | 4 | 2 | 60 | 50 | 100 |
| 21. | DGD-P-207 | ARVR Lab | - | - | 4 | 2 | 60 | 50 | 100 |
| Total | | | 25 | | | 21 | 420 | 280 | 700 |

Third Semester

| Sr. No. | Course Code | Course Title | Hours / Week | | | Credits | Internal Marks | External Marks | Total |
|--------------|-------------|---|--------------|---|---|---------|----------------|----------------|-------|
| | | | L | T | P | | | | |
| 3. | DGD-M-301 | MOOC Course 1 – Research Methodology | 3 | - | - | 3 | 60 | 40 | 100 |
| 2. | DGD-M-302 | MOOC Course 2 / Self Study – Project Specific Subject | 3 | - | - | 3 | 60 | 40 | 100 |
| 3. | DGD-P-303 | Live Lab | 20 | | | 10 | 100 | 100 | 200 |
| Total | | | 26 | | | 16 | 110 | 180 | 400 |

Fourth Semester

| Sr. No. | Course Code | Course Title | Hours / Week | Credits | SEE Marks | CIE Marks | Total |
|--------------|-------------|--------------|--------------|---------|-----------|-----------|-------|
| 1. | DGD-D-401 | Thesis Work | - | 18 | 100 | 100 | 200 |
| Total | | | - | 18 | 100 | 100 | 200 |

Total: 76 Credits

Elective 1

1. Game Play and Prototyping
2. Game Programming
3. GPU Programming
4. Machine Learning

Elective 2

1. Immersive Technologies
2. Virtual Instrumentation and CAD Tools

3. Deep Learning
4. Computational linguistic

Elective 3

1. Mobile Game Development
2. Augmented Reality for Business Applications
3. Game Design and Development
4. Robotic system design

Detailed Syllabus

| Sr. No. | Course Code | Course Title | L | T | P | Credits | Internal Marks | External Marks | Total |
|---------|-------------|---------------------------------------|---|---|---|---------|----------------|----------------|-------|
| 1 | DGD-C-101 | Augmented Reality and Virtual Reality | 4 | | | 4 | 60 | 40 | 100 |

Aim: this course will help to understand various models of AR and VR and various techniques to design AR and VR environments

Learning Outcomes : At the end of the course, the students will be able to :

- Provide opportunity to explore the research issues in Augmented Reality and Virtual Reality (AR &VR).
- Use the basic concepts and framework of virtual reality.

Detailed Contents:

Unit 1: Introduction of Virtual Reality: Fundamental Concept and Components of Virtual Reality. Primary Features and Present Development on Virtual Reality.

Unit 2: Multiple Models of Input and Output Interface in Virtual Reality: Input -- Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input, 3D Menus & 3DScanner etc. Output -- Visual /Auditory / Haptic Devices.

Unit 3: Visual Computation in Virtual Reality: Fundamentals of Computer Graphics. Software and Hardware Technology on Stereoscopic Display. Advanced Techniques in CG: Management of Large Scale Environments & Real Time Rendering.

Unit 4: Interactive Techniques in Virtual Reality: Body Track, Hand Gesture, 3D Manus, Object Grasp. Development Tools and Frameworks in Virtual Reality: Frameworks of Software Development Tools in VR. X3D Standard; Vega, MultiGen, Virtools etc.

Unit 5: Application of VR in Digital Entertainment: VR Technology in Film & TV Production. VR Technology in Physical Exercises and Games. Demonstration of Digital Entertainment by VR. Augmented and Mixed Reality, Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational

augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.

SUGGESTED BOOKS:

- 1) Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press, 2003/2006.
- 2) Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.
- 3) Alan Craig, William Sherman and Jeffrey Will, Developing Virtual Reality Applications, Foundations of Effective Design, Morgan Kaufmann, 2009.

| Sr. No. | Course Code | Course Title | L | T | P | Credits | Internal Marks | External Marks | Total |
|---------|-------------|--------------------------|---|---|---|---------|----------------|----------------|-------|
| 2. | DGD-C-102 | Human Computer Interface | 4 | | | 4 | 60 | 40 | 100 |

Aim: The goals of HCI are to produce usable and safe systems, as well as functional systems. It focuses on the interfaces between people and computers.

Learning Outcomes: At the end of the course, the students will be able to :

- carry out user inquiry to understand human needs in particular contexts;
- construct design sketches and prototypes to manifest design ideas;
- construct narratives of use so as to envision designs in use;
- reflect on the design process to make learning visible;
- carry out usability studies to get feedback on the user experience.

Detailed Contents

Unit 1: Introduction to Human Computer Interface - Importance of User Interface, History of Human Computer Interface, Importance of Good Design, Benefits of Good Design, Principles of User Interface Design. Interaction Devices - Keyboard Keys, Function Keys, Pointing Devices, Speech Recognition, Handwriting Recognition, Speech Generation, Image Display, Video Display, Device Drivers.

Unit 2: Color and Content - Why Colors, Color Uses, Choosing Colors, Possible Problems With Colors, Page Title, Headings, Text, Messages, Error Messages, Icons. User Interface Design

Process-I - Understanding How User Interact With Computers, User Interface Models, Design Methodologies, Designing an Interface, Process of Interaction Design.

Unit 3: User Interface Design Process-II - Human Interaction with Computers, Human Interaction Speeds, Human Characteristics in Design, Human Consideration in Design. Graphical User Interface - Popularity of Graphics, Characteristics of Graphical User Interface, Concepts of Direct Manipulation, Graphical System Advantages and Disadvantages, Web User Interface Characteristics and Popularity.

Unit 4: Device and Screen-Based Control - Device Based Controls, Operable Controls, Text Entry/Read-Only Controls, Selection Controls, Combining Entry/Selection Controls, Other Operable Controls, Presentation Controls and Selecting Proper Controls. Screen Design - Design Goals, Test for a Good Design, Screen and Web Page Meaning and Purpose, Organizing Screen Elements Clearly, Ordering of Screen Data and Content, Screen Navigation and Flow.

Unit 5: Windows - Window characteristics, Components of Window, Window Presentation Styles, Types of Windows, Window Management. Understanding Business Functions - Business Definitions and Requirement analysis, Determining Business Functions, Design Standards or Style Guides, System Training and Documentation. Software Tools Specification Methods, Interface Building Tools-Interface Mock Up Tools, Software Engineering Tools, Windowing System Layer, GUI Tool Kit Layer.

Unit 6: Information Search and Visualization - Database Query, Phrase Search in Documents, Multimedia Document Searches, Information Visualization, Advanced Filtering, Hypertext, Web Technology, Static Web Content and Dynamic Web Content. Time - Response Time, Dealing With Time Delays, Echo Delay, File Delay, Blinking for Attention, Use of Sound, Preventing Errors. Usability and Prototypes - Usability: Purpose of Usability, Importance of Usability, Usability Testing. Prototypes: Hand Sketches and Scenarios, Interactive Paper Prototypes, ProgrammFacades, Prototype-Oriented Languages, Comparisons of Prototypes.

SUGGESTED BOOKS

1. Beyer, Hugh and Karen Holtzblatt. "Principles of contextual inquiry" (Chapter 3), from Contextual design: defining customer-centered systems, Morgan Kaufmann, 1998.
2. Beyer, Hugh and Karen Holtzblatt. "Work models" (Chapter 6), from Contextual design: defining customer-centered systems, Morgan Kaufmann, 1998.
3. Buchenau, Marion and Suri, Jane. "Experience prototyping". In Proceedings of the 3rd Conference on Designing Interactive Systems: Processes, Practices, Methods, and Techniques, 2000.
4. Buxton, Bill. pp105-114, pp234-251, and pp330-359 from Sketching user experiences, Morgan Kaufmann, 2007.
5. Clark, Andy. "Natural born cyborgs?", from M. Beynon, C.L. Nehaniv, and K. Dautenhahn (Eds.): Cognitive Technology 2001, Lecture Notes in Artificial Intelligence 2117, pp. 17-24, Springer-Verlag, 2001.

| Sr. No. | Course Code | Course Title | L | T | P | Credits | Internal Marks | External Marks | Total |
|---------|-------------|--------------|---|---|---|---------|----------------|----------------|-------|
| 3. | DGD-C-201 | Game Physics | 4 | - | - | 4 | 60 | 40 | 100 |

Aim: Game physics deals with the introductory knowledge to making objects in games and media move, deform, collide, break, unite, and fly. The course equips the student with the relevant mathematical and physical background to understand the rules which govern such actions in nature. Moreover, it teaches the essence of stable, convergent, and realistic simulation of these actions. The course will have two interleaved narratives: the continuous and the discrete. In the continuous, we will learn the essential physics that governs the interactions of objects in the worlds. In the discrete, we will learn how to quantify and simulate objects with a computer, concerning space and time.

Learning Outcomes: At the end of the course, the student will be able to :

- Explain the concepts related to Classical Newtonian physics: Newton laws, friction, rigid body physics, dynamics, and kinematics
- Carry out discretization of space and time.
- Explain the Soft body physics, stress & strain, body deformation.
- Describe the Collision detection & resolution.
- Illustrate the Constraints & controllers.

DETAILED CONTENTS

Unit 1: Basic Physics, Basic and Vector Calculus, Rigid-Body Physics

Unit 2: Collisions, The game-engine loop and Time Integration, Constraints and Controllers

Unit 3: Soft-Body Physics, Finite-Element Simulation, Mass-Spring Systems and Position-Based Dynamics

Unit 4: Fluid Physics, Fluid Simulation

Unit 5: Physics engine design and implementation

SUGGESTED BOOKS:

- Physics for Game Developers, 2nd Edition, By David Bourg, Bryan Bywalec
- Physically Based Modeling: Principles and Practice (Online Siggraph '97 Course notes)
- Game Physics Engine Development by Ian Millington.
- Game Physics by David H. Eberly.

| Sr. No. | Course Code | Course Title | L | T | P | Credits | Internal Marks | External Marks | Total |
|---------|-------------|---|---|---|---|---------|----------------|----------------|-------|
| 4. | DGD-C-202 | Artificial Intelligence for Game Design | 4 | - | - | 4 | 60 | 40 | 100 |

Aim: This course will focus on design, program, and analyze artificial intelligence methods appropriate to a game's design and have fun doing so.

Prerequisite: Programming capability in a language / platform that allows simple graphic animations (see below). Python tkinter is the recommended choice for its reasonable quality with limited programming effort, but serious gamers might want to use a graphics package such as Open GL. The instructor will provide a basic GUI animation.

Learning Outcomes: At the end of the course, the student will be able to :

- Understand the issues and role of AI in the design of games
- Undertake programming autonomous movement of avatars
- design and use path planning
- design and implement decision making and coordinating action based on finite states, fuzzy sets, Markov sets, or rules.
- understand tactical and strategic AI.

Detailed Contents

Unit 1: Introduction, Nature of Game AI, Game AI Design, Analytical Geometry 1, Simple State Machines, Computational Geometry

Unit 2: Kinetic and Dynamic Movement, Analytical Geometry 2, Steering and combining steering

Unit 3: Interaction with Physics engine, Jumping, Coordinated movement, Motor Control, Path finding methods

Unit 4: Decision Making: Decision trees, State Machines, Fuzzy Logic, Markov Systems, Goal-oriented behavior, Rule-based systems, blackboard architectures

Unit 5: Decision Making, Tactics, Learning, Execution Management

SUGGESTED BOOKS:

1. Artificial Intelligence for Games, Second Edition by Ian Millington and John Funge, Morgan-Kaufman

ELECTIVE I

1. Game Play and Prototyping

Aim: This is an advanced course covering the process of Game Prototyping. Computer Science students will learn modern skills (Design/Engineering/Production) for developing sophisticated games rapidly from concept to finished prototype.

Learning Outcomes: At the end of the course, the student will be able to :

- Demonstrate mastery of class material via in-class exercises, prototyping, playtesting, and quizzes
- Deliver game prototype that compels users and complies with a range of constraints and shows promise for full production as a next step. Prototype using non-digital materials as well as Unity 3D.
- Conduct playtest sessions which elicit formal feedback from play testers that can be used to improve the quality of the play experience (no emphasis on production values).
- Iterate on prototype to improve player experience as measured by play tester feedback and instructor judgment with proficiency
- Present interactive game concepts with clarity.

Unit 1: Overview and Introduction: rapid design, quick step engineering, and highly focused production, and how they interrelate to modern rapid Prototyping. Game Design and Prototyping I - Exploring the Core principles of game design and how modern, rapid prototyping has changed the process. Learn to define the core experience, using verbs to describe the player's actions, the player compulsion loop. Develop ways to demonstrate key aspects of game design features. Game Design and Prototyping II - Learnings from past projects - Crash Bandicoot, Uncharted, Overwatch, Pokemon GO. Understanding core principles of "fun" - compulsion loops, play engines, choices that make "simple, hot, and deep" gameplay. Further defining the specialized elements and different approaches for prototyping mobile, console, web, and PC games.

Unit 2: From Paper to Digital - Prototyping Production: Continue to explore the various tools used for prototyping, including Spreadsheet Prototyping and the Unity 3D environment. Iteration steps of paper prototyping. How do the paper prototypes feel so far? Questions? Concerns? The Vertical Slice: in-depth game production processes and ideologies for reaching a quick vertical slice for proof of concept. Agile/Waterfall. Rapid Iteration. Quick steps from concept, to code, to screen. Min Viable Spec approach, An in depth introduction to, and analysis of, the elements that make up a 3D game, and how the development process is different from making a 2D game, particularly when prototyping.

Unit 3: Developing Game Worlds for Rapid Prototyping: Learn how to create simple yet effective systems to immerse players in the world and experience you are selling them. How community is the glue, and games are a social phenomenon. The engineering view of how to develop game worlds in Unity 3D. Use the game base created earlier in the term. Develop game world as an object/environment but also as an agent acting upon itself and its inhabitants. Focused Playtesting

Techniques to Iterate for Success: Learn how to create and execute test plans that reveal core aspects of your players experiences and the key “fun factors” as well as the dangerous “friction” that turns players off. Game Development is first and foremost an iterative process, but before you can take steps to improve a play experience, you need to know what’s wrong and what’s right at a very fundamental level. Playtest Observation, How to create insightful Player.

Unit 4: Alpha Apocalypse: Now that the teams are deep into their prototyping development and have some test data, hidden problems not seen in the early paper designs are beginning to reveal themselves. Now is the time to act, not later! All games have problems in development. It’s how you respond that makes a game go from bad, to good, to great. Iterate with extreme prejudice. The user experience is supreme, so how do you respond to the data and how do you measure “fun” over and over? Integrating Premise and Narrative as Rocket Fuel This class will examine means and mechanisms where the game’s premise and interactive narrative help frame and flesh out your prototype setup and play experience. Sometimes a narrative conceit will put the players in a certain “frame of mind” which encourages certain behaviors and attitudes that help drive the gameplay experience. Game designers learn to manipulate the player’s state of mind, tone, or attitude for maximum emotional and play effect.

Unit 5: Honing the Core Loops Gameplay is all about compulsion and player satisfaction, which leads to stickiness and retention. Learn how the core loops of the game keep your players coming back for more and why. From last week’s feedback, how can the core loops of your prototype be refined? Using Data Analysis to Make a Better Game Data, especially big data, can reveal hidden patterns driving complex systems, including games. We will cover some examples of best practices for using data to help shape and improve gameplay, both before launch and after. Examples include Heat Mapping in Halo by Bungie, World of Warcraft Life/Death data analysis from past projects, A/B Testing, Pokemon GO statistical encounters, and others.

Unit 6: Future Trends: A glimpse into the future of the game prototyping, crowd funding, and state-of-the-art game development. What is trending in development? What new emerging technologies might change how games are built, distributed, and played? How can the students be prepared in upcoming job interviews about what is coming for game tech in the future?

SUGGESTED BOOKS:

Bond, J. G. (2014). Introduction to Game Design, Prototyping, and Development: From Concept to Playable Game with Unity and C. Addison-Wesley Professional.

Macklin, C., Sharp, J., & Gibson, J. (2015). Introduction to Game Design, Prototyping, and Development (Book) and Introduction to Game Design LiveLessons (VideoTraining) Bundle.

2. Game Programming

Learning Outcomes: At the end of the course, the student will be able to :

- implement choreographed AI
- implement chasing/evade and targeting algorithms and understand the mechanisms behind them
- utilize finite state machines to implement game object behavior
- use path finding algorithms such as A*
- perform perspective transformations in order to display 3D scenes
- implement billboard and understand the mechanisms behind it
- implement backface removal and understand the mathematics behind it
- use the painter's algorithms to ensure correct occlusion
- perform texture mapping.
- partition the game world for efficient processing of events

Course Contents

Unit 1: Building a Game System Framework - Real-Time Systems, The basic Game Loop, Using a KeyListener on a Frame and requesting the focus, Pseudo asynchronous input via the keyboard, Player Controlled Actions, Static Image based Sprites, Circle versus Circle Collision Detection in 2D space, Axis Aligned Rectangle versus Axis Aligned Rectangle Collision Detection in 2D space, Circle versus Line Collision Detection in 2D space, Responding to Collision

Unit 2: Game Object Movement - Playing Sound, Avoiding Screen Flicker and Tearing via Double Buffering, Page Flipping, and Synching to the Vertical Blank, 2D Scene Building, Building an Animation Object for Frame based Animation, Building Animated Sprites, Translation in 2D space for Sprites, User and Computer control of Sprites, 2D Polygon Models

Unit 3: Building an Object to encapsulate 2D Polygon Models, Translation in 2D space revisited for 2D Polygon Models, Rotation in 2D space for 2D Polygon Models, User and Computer control of 2D Polygon Models, Backgrounds, Scrolling and Parallax Scrolling

Unit 4: Game A.I - Choreographed A.I., Following Waypoints, Simple Targeting, Chasing, and Evading Algorithms for 2D Space, Predictive Targeting, Chasing, and Evading, Algorithms for 2D Space, Finite State Machines, The A* algorithm, Using Genetic Algorithms to build your A.I., Using Neural Networks to build your're A.I., 3D Scene Building Perspective Transformation.

Unit 5: Billboard - Adding the 3rd spacial dimension to Sprites, Building 3D Animated Sprites, 3D Polygon Models, Building an Object to encapsulate 3D Polygon Models, The Painter's Algorithm, Backface Removal and Occlusion, Rotation about the x, y, and z axis in 3D space for 3D Polygon Models, Portal Based Rendering, Binary Space Partitioning and Quad-Trees, Texture Mapping of Polygon Surfaces in 3D, Stepping back to 2.5 D

Unit 6: Texture Mapping of Vertical Rectangular Surfaces in 3D, Limiting movement to 4 degrees of freedom, Building a map for 3D scenes using a 2D Bird's Eye View, Populating the map with Billboard based objects.

SUGGESTED BOOKS

1. Sanchez-Crespo, D., & Dalmau, D. S. C. (2004). Core techniques and algorithms in game programming. New Riders.
2. Luna, F. (2012). Introduction to 3D game programming with DirectX 11. Stylus Publishing, LLC.
3. LaMothe, A. (2002). Tricks of the Windows game programming gurus. Sams Publishing.

3. GPU Programming

Aim: To learn parallel programming with graphics processing units (GPUs)

Learning Outcomes: At the end of the course, the student will be able to :

- Use the concepts of parallel programming,
- implement programs on GPUs,
- undertake debugging and profiling parallel programs.

Detailed Contents:

Unit 1: Introduction - History, graphics processors, graphics processing units, GPGPUs. Clock speeds, CPU / GPU comparisons, heterogeneity. Accelerators, parallel programming, CUDA / OpenCL / OpenACC, Hello World Computation, Kernels, launch parameters, thread hierarchy, warps / wavefronts, thread blocks / workgroups, streaming multiprocessors, 1D / 2D / 3D thread mapping, device properties, simple programs

Unit 2: Memory - Memory hierarchy, DRAM / global, local / shared, private / local, textures, constant memory. Pointers, parameter passing, arrays and dynamic memory, multi-dimensional arrays. Memory allocation, memory copying across devices. Programs with matrices, performance evaluation with different memories

Unit 3: Synchronization: Memory consistency. Barriers (local versus global), atomics, memory fence. Prefix sum, reduction. Programs for concurrent data structures such as worklists, linked-lists. Synchronization across CPU and GPU, Functions : Device functions, host functions, kernels, functors. Using libraries (such as Thrust), developing libraries.

Unit 4: Debugging GPU programs. Profiling, profile tools, performance aspects, Streams: Asynchronous processing, tasks, task-dependence. Overlapped data transfers, default stream, synchronization with streams. Events, event-based-synchronization - overlapping data transfer and kernel execution, pitfalls.

Unit 5: Case studies: Image processing. Graph algorithms. Simulations. Deep learning. Advanced topics: Dynamic parallelism. Unified virtual memory. Multi-GPU processing. Peer access. Heterogeneous processing

SUGGESTED BOOKS:

1. Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wenmei Hwu; Morgan Kaufman; 2010 (ISBN: 978-0123814722)
2. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman; 2012 (ISBN: 978-0124159334)

4. Machine Learning

Aim: This course will serve as a comprehensive introduction to various topics in machine learning. The objective is to familiarize the audience with some basic learning algorithms and techniques and their applications, as well as general questions related to analyzing and handling large data sets. At the end of the course the students should be able to design and implement machine learning solutions to classification, regression, and clustering problems; and be able to evaluate and interpret the results of the algorithms.

Course Outcomes:

At the end of the course, the students will be able to:

- Understand the fundamental issues and challenges of machine learning.
- Understand the strengths and weaknesses of many popular machine learning approaches.
- Interpret the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.
- Design and implement various machine learning algorithms in a range of real-world applications.

Detailed Contents:

Supervised Learning, Decision Trees & CART, Linear regression, Gradient Descent.

Linear Classification: Logistic regression, Newton Raphson, Perceptron, Multilayer Perceptron, feedforward neural network, Error backpropagation method, Convolution Networks, Support Vector Machines (SVM)

Probabilistic Models: Bayes classifier, Naive Bayes classifier, Hidden Markov models (HMMs) for pattern classification

Design and Analysis of Experiments: Cross validation, Performance measures, CI Estimation, Hypothesis Testing

Unsupervised Learning: Criterion functions for clustering, Techniques for clustering -- K-means clustering, Gaussian Mixture Models, Hierarchical clustering, Density based clustering.

Dimensionality Reduction Techniques: Principal component analysis, Fisher discriminant analysis, Multiple discriminant analysis

SUGGESTED BOOKS:

1. Machine Learning by Tom Mitchell
2. Introduction to Machine Learning by Ethem Alpaydin
3. Introduction to Statistical Learning, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 2013.
4. Pattern Classification, 2nd Ed., Richard Duda, Peter Hart, David Stork, John Wiley & Sons, 2001.

ELECTIVE 2

1. Immersive Technologies

Learning Outcomes: At the end of the course, the student will be able to :

- create a lesson plan that uses virtual reality as a resource.
- use the hardware and software that is necessary to use virtual reality in the classroom.
- understand the strengths and limitations of virtual reality.
- participate in using virtual reality resources.

Detailed Contents

Unit 1: Understanding Immersive Technology and Mixed Reality

Unit 2: The Hardware and Software of Immersive Technology - Equipment You'll Need, Current Hardware Options, Overcoming a Significant Obstacle - Cost, Samsung Gear VR, Lenovo Mirage Solo

Unit 3: Creating Lesson Plans that Use Immersive Technology - Tips for Using VR in the classroom, List of VR apps, A Brief Introduction to Google Expeditions, How to use Google Expeditions

Unit 4: Grading and Evaluation - AI based Grading and Evaluation

Unit 5: Case Studies

SUGGESTED BOOKS

1. Cai, Y. (Ed.). (2013). 3D immersive and interactive learning. New York: Springer.
2. Code, J., Clarke-Midura, J., Zap, N., & Dede, C. (2012). Virtual performance assessment in immersive virtual environments. In *Interactivity in e-learning: Case studies and frameworks* (pp. 230-252). IGI Global.
3. Gregory, S., Reiners, T., & Tynan, B. (2010). Alternative realities: Immersive learning for and with students. In *Distance learning technology, current instruction, and the future of education: Applications of today, practices of tomorrow* (pp. 245-272). IGI Global.
4. Zheng, R. Z., & Greenberg, K. (2020). Immersive Technology: Past, Present, and Future in Education. In *Cognitive and Affective Perspectives on Immersive Technology in Education* (pp. 107-126). IGI Global.
5. Metcalf, S. J., Kamarainen, A. M., Grotzer, T., & Dede, C. (2013). Teacher perceptions of the practicality and effectiveness of immersive ecological simulations as classroom curricula. *International Journal of Virtual and Personal Learning Environments (IJVPLE)*, 4(3), 66-77.

2. Virtual Instrumentation and CAD Tools

Unit-1 Review of Virtual Instrumentation

Historical perspective, Block diagram and Architecture of Virtual Instruments.

Unit-2 Data-flow Techniques

Graphical programming in data flow, Comparison with conventional programming.

Unit-3 VI Programming Techniques

VIs and sub-VIs, Loops and Charts, Arrays, Clusters and graphs, Case and sequence structures, Formula nodes, Local and global variables, Strings and file I/O.

Unit-4 Data Acquisition Basics

ADC, DAC, DIO, Counters and timers

Unit-5 Common Instrumentation Interfaces

RS232C/ RS485, GPIB, PC Hardware structure, DMA software and hardware installation.

Unit-6 Use of Analysis Tools

Advanced analysis tools such as Fourier transforms, Power spectrum, Correlation methods, Windowing and filtering and their applications in signal and image processing, Motion Control, System buses, Interface buses: PCMCIA, VXI, SCXI, PXI, etc.

Unit-7 CAD Tools

LabVIEW

SUGGESTED BOOKS:

1. Johnson, G., LabVIEW Graphical Programming, McGraw-Hill.
2. Sokoloff, L., Basic Concepts of LabVIEW 4, Prentice Hall Inc..
3. Wells, L.K. and Travis, J., LabVIEW for Everyone, Prentice Hall Inc.
4. Gupta, S. and Gupta, J.P., PC Interfacing for Data Acquisition and Process Control, Instrument Society of America.

3. Deep Learning

Unit-1 Introduction

Introduction to Deep Learning: history of deep learning, deep learning success stories, mcculloch pitts neuron, thresholding logic, perceptron's, perceptron learning algorithm.

Unit-2 Multi-Layer Network and Optimization Technique

Multilayer perceptron's (mlps), representation power of mlps, sigmoid neurons, gradient descent, feed forward neural networks, representation power of feed forward neural networks feed forward neural networks, back propagation gradient descent (gd), momentum based gd, nesterov accelerated gd, stochastic gd, adagrad, rmsprop, adam, eigenvalues and eigenvectors, eigenvalue decomposition, basis.

Unit-3 Dimension Reduction and Regularization

Principal component analysis and its interpretations, singular value decomposition auto encoders and relation to pca, regularization in auto encoders, denoising auto encoders, sparse auto encoders, contractive auto encoders regularization: bias variance tradeoff, l2 regularization, early stopping, dataset augmentation, parameter sharing and tying, injecting noise at input, ensemble methods, dropout greedy layer wise pre-training, better activation functions, better weight initialization methods, batch normalization learning vectorial representations of words.

Unit-4 Convolutional Neural Networks

Lenet, alexnet, zf-net, vggnet, googlenet, resnet, visualizing convolutional neural networks, guided back propagation, deep dream, deep art, fooling convolutional neural networks.

Unit-5 Recurrent Neural Networks

Back propagation through time (bptt), vanishing and exploding gradients, truncated bptt, gru, lstms encoder decoder models, attention mechanism, attention over images.

SUGGESTED BOOKS:

1. J.Patterson, A.Gibson, Deep Learning, (1e), O'Reilly Publication, 2018.
2. Goodfellow I., Bengio Y, Deep Learning (Adaptive Computation and Machine Learning series), (1e), MIT Press, 2017.
3. Shai Shalev-Shwartz , Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, (3e), Cambridge University Press, 2015.

4. Computational Linguistic

Aim: This course provides an introduction to the area of Computational Linguistics. It covers the major sub areas of the field such as speech recognition and synthesis, morph analyzers and spell checkers, POS tagging, parsing, Corpus Linguistics, Word Net, and machine translation. The course will introduce the participants to the basic key tools and applications in language technology.

Pre-requisite Knowledge: Any Programming Language

Learning Outcomes: At the end of the course, the student will be able to

- Extract and analyse text corpora.
- Understand foundational tasks in Computational Linguistics such as e-dictionary making, speech recognition and synthesis.

Detailed Contents

Introduction: Fundamentals, challenges, usage, classical problems.

Words-Structure: spellcheck, morphology using FSTs.

Words-Semantics: Basic ideas in Lexical Semantics, WordNet and WordNetbased similarity measures, Word Sense Disambiguation; supervised,unsupervised and semi-supervised approaches, HMM model for speech recognition.

Words-Parts of Speech: POST using Brill's Tagger and HMMs

Sentences: Basic ideas in compositional semantics, Classical Parsing (Bottom up,top down, Dynamic Programming: CYK parser), Parsing using ProbabilisticContext Free Grammars.

Language Modeling: Basic ideas, smoothing techniques.

Machine Translation: Rule based techniques, Statistical Machine Translation(SMT), parameter learning in SMT (IBM models) using EM.

Natural Language Generation: the potential of using ML for NLG

SUGGESTED BOOKS:

- Rabiner, L., & Schafer, R. Theory and applications of digital speech processing. Prentice Hall Press.
- Habash, N. Y. Introduction to Arabic natural language processing. Synthesis Lectures on Human Language Technologies, 3(1), 1-187.

Elective 3

1. Mobile Game Development

Aim: This course provides students with an in-depth introduction to technologies and techniques used to create successful cross-platform mobile games.

Learning Outcomes:

At end of the course, students will be able to :

- Develop a solid foundation in software engineering for mobile games.
- Gain an understanding of Unity & C# and popular tools & plugins.
- Familiarize with mobile usability and design concerns.
- Implement individual game project prototypes.
- Implement a larger, demo-able game project in a team environment.

Detailed Contents

Unit 1: Introduction - Why Mobile? Unity & C#: Game Dev Basics, Scenes, Game Objects, Components, etc. Working with Unity & C#: 2D Graphics, Unity & C# Camera, Sprites and Texture Atlases - Animation – Scrolling. Math and Physics; 3D Introduction, Quick overview of vector math, Physics principles, 3D math primer, Basics of the 3D world, 3D rendering essentials, Using Unity for 3D development

Unit 2: Mobile Game Input; Designing for Mobile, - Basic Touch and Multi-Touch Gestures, - Accelerometer, - Virtual joypads, - Usability and Game case studies, Designing for the impatient gamer, Particle Effects; Alternate Game Development Solutions, Particle Effects, Cross-platform game engines, Platform specific game creation tools, Tilemaps; Artificial Intelligence, Tilemaps, AI behavior, Pathfinding

Unit 3: Augmented/Virtual Reality Games, Augmented/Virtual reality games design principles and case studies, Connecting (and selling) to the World; Data Networking, Multiplayer principles, Game Center and competitors, “Social” mobile gaming, Analytics - Monetization - Localization - Remote Data and Data persistence, Playtesting and Tutorials - Playtesting, - Tutorials

Unit 4: Software Engineering for Games: - Game Architecture and Implementation Patterns, - Optimization, - Pipelines and Tools, Profiling, Build Systems, Testing

Unit 5: Advanced Graphics; Native Development, - Shaders on mobile, Advanced 3D effects, Plugins, Publishing Deploying on the App Store, Thin line between success and failure, Future of mobile games

SUGGESTED BOOKS:

- Introduction to Game Design, Prototyping, and Development: From Concept to Playable Game with Unity and C#. Jeremy Gibson. ISBN-10: 0321933168.
- Game Programming Algorithms and Techniques. Sanjay Madhav. ISBN-10: 0321940156.

2. Augmented Reality for Business Applications

Aim: The objective of this course is to Learn how to make your competition irrelevant, Create your own blue ocean with Augmented Reality, Start your own new business or integrate AR with your current business with step by step process and projects, Increase your sales with strategic marketing plan, Gain more customer engagement and increase your sales, Build more brand value

Learning Outcomes: At the end of this course, students will be able to :

- Understand AR Business Management and Operations
- Design and Develop of AR content and Marketing Strategies
- Undertake Business Launch planning, Business Set up and Integrations

- Carry out AR Marketing Campaign
- Understand Consumer Psychology and Behavior

Detail Contents

Unit 1: INTRODUCTION: Create your own blue ocean with AR/ VR - How to create your own blue ocean, Figure out what you selling, Strategies to find out your own blue ocean, How to plan your business launch, How to find your right audience, What is AR, What is the difference between VR, AR, MR and XR, Who are the key players in AR technology, Who is AR for? What is the current and future state of market trends? What is the consumer behavior with AR? What industries can AR be used for? Benefits and use cases of AR? What is the potential and benefit of using AR? How does AR work? And what are different types of AR? Careers related to immersive technologies

Unit 2: AR MARKETING AND DESIGNING - What is consumer sales psychology, What is marketing and types of marketing overview, What are different types of content marketing, List of keywords used for Marketing and immersive technologies, Ethics, principles and guidelines for business marketing & immersive technologies, Principles of Designing and Developing content, What is UX and UI, user experiences, Introduction and history to VR, AR and MR technologies, How does VR and AR technologies work, Skills needed for advanced VR/AR Development,

Unit 3: AR MARKETING PLANNING - Platforms for creating VR and AR experiences without technical skills, Unique ideas on how AR can be integrated for various business industries to provide better solutions, Types of AR and VR content, Learn basics of designing Funnels with AR and VR, Strategic approach and integrated marketing planning, Learn how to integrate AR with Story-Telling, Info graphics, Images, Videos, business stationary designs, marketing promotional designs, Digital and Social Media Marketing with AR, Elements of AR marketing project planning, How to create a integrated AR marketing plan, How to create a AR business plan,

Unit 4: AR TOOLS AND PLATFORMS FOR DEVELOPMENT - Software that can be used for developing AR content, Readily available AR software's and platform without technical skills, Create AR Designs for Business Stationary, Create AR print ads, Integrate AR designs with your business and marketing strategies, Create Social Media AR Banners, Create integrated AR Email Sequences, Create integrated AR info graphic and images, Create integrated AR presentation on PPT, Create AR funnels, Create AR 3D Animated products, Create AR animated explainer video, Integration with marketing strategies and business, How to integrate AR games for product packaging

Unit 5: What, Why, How and Where to Outsource - What needs to be outsourced for greater productivity, What skills are required in an employee for AR, Where can we find skills professionals for AR, What type of development can be outsourced and what you can create, AR Business Launch: Implement business plan with strategic marketing integrating AR, Reach out to your audience, Final AR business integrations and management

SUGGESTED BOOKS:

- Scholz, J., & Smith, A. N. (2016). Augmented reality: Designing immersive experiences that maximize consumer engagement. *Business Horizons*, 59(2), 149-161.
- Dias, A. (2009). Technology Enhanced Learning and Augmented Reality: An Application on Multimedia Interactive Books.
- Arnaldi, B., Guitton, P., & Moreau, G. (Eds.). (2018). Virtual reality and augmented reality: Myths and realities. John Wiley & Sons.

3. Game Design and Development

Aim:

1. Utilize fundamental practices of contemporary software development, such as object-oriented programming and the purpose and implementation of various design patterns.
2. Discuss the theory of developing a realtime application such as a game.
3. Independently develop 2D arcade titles of the approximate complexity of Space Invaders, Pac-Man, or similar.
4. Through an overview of contemporary development practices within the games industry, determine an appropriate career path (Art, Design, Engineering, Production, and Quality Assurance).

Learning outcomes: Upon completion of the course, students will be able to:

- Discuss the history of computer programming languages, in particular the trend of managed code as a safer alternative to native code.
- Practice the rudiments of Linear Algebra, using vectors and matrices to solve numerous analytical/scientific problems.
- Create 2D arcade-style game simulations such as Space Invaders or PacMan.
- Identify best practices for memory-constrained devices such as gaming consoles and discuss the particular issues of developing software for a console as opposed to a personal computer.

Detailed Contents

Unit 1: Intro to game design and production, Unity production basics: Lighting, materials, effects, etc. Creating a simple game, C# in game development, Working with 3D, games Rigidbody physics, User input and UI, Mathematics: Cartesian Coordinate Systems, World space, object space, camera space, Vectors, Matrices

Unit 2: JavaScript Language Fundamentals: Introduction to JavaScript and HTML5, Project design and organization, Programming language fundamentals, Data types, Object-oriented programming (review), Containers, Exceptions, Delegates and Events, String manipulation

Unit 3: Game Design and Development: Cultural and function definition of games, Rudiments of game design, Development processes, Documentation. Game Design: Balancing games, analyzing games, the MDA framework, CubeShip Game, Game Programming, Working with Animations, Game Programming, Game Design - Choice, agency, aesthetics, and more UI Development, Unity Editor Intermediate Topics, Raycasting

Unit 4: Game Development Technical Aspects: User input, Graphics, Audio, Game Engine Architecture, Collision Detection, Publication, Lessons from the Underground: DIY/Indie techniques, XNA, Content Pipeline

Unit 5: 3D Characters: Animation & control, Intermediate Game Production, Event Systems & Delegates, Game Programming: Useful code libraries, Data Structures, Global Illumination, 2D Game Jam, Level Design & Tutorials, Start on Last major game design, 3D Models, Debugging

Unit 6: Intro to AI, FSMs, Beyond Game Design: Programming applications Algorithms & Trees, Affordances & User Experience Design Patterns

SUGGESTED BOOKS:

1. An Introduction to HTML5 Game Development with Phaser.JS Travis Faas, CRC Press, 2016
2. Learn Unity3D Programming with UnityScript Janine Suvak, Apress, 2014

4. Robotic system design

PRE REQUISITES

- Engineering Mathematics
- Engineering Mechanics
- Basic Electronics
- Basic Programming

Aim: The objective of this course is to impart knowledge about industrial robots for their design, modeling and simulation.

Learning Outcomes: After the completion of this course, the students will be able to

- Perform kinematic and dynamic analyses with simulation
- Design control laws for a robot
- Integrate mechanical and electrical hardware for prototyping a robotic manipulator.

- Select a robotic system for given application.

Detailed Contents

Unit 1: Introduction to Robotics & MATLAB

Robot Subsystems & Configurations, Joints & Links, Robot End-Effectors, Sensors & Actuators, Functional Requirements of Robots, Industrial Applications of Robots, MATLAB Basics, Matrix Creation & Manipulation in MATLAB, Programming in MATLAB, Plotting in MATLAB

Unit 2: Robot Kinematics

Pose of a Rigid Body, Homogeneous Transformations Matrices, Denavit and Hartenberg (DH) Parameters, Forward Position Analysis, Inverse Position Analysis, Velocity Analysis: The Jacobian Matrix, Jacobian Computations, Forward and Inverse Velocity Analysis, Acceleration Analysis, Design Project: Modeling of 3-DOF Robot Kinematics in MATLAB

Unit 3: Robot Dynamics

Force and Moments Balance, Equivalent Joint Torques, Role of Jacobian in Statics, Inertia Properties
Euler-Lagrange Formulation, Newton-Euler Formulation, Recursive Newton-Euler Algorithm, Dynamic Equations for Multiple-DOF Robots, Solving Differential Equations in MATLAB, Design Project: Modeling & Simulation of 3-DOF Robot Manipulator in MATLAB

Unit 4: Robot Trajectory Planning

Path versus Trajectory, Basics of Trajectory Planning, Joint Space Trajectory Planning, Cartesian Space Trajectory Planning, Point-to-Point vs. Continuous Path Planning, Design Project: Trajectory Planning of 3-DOF Robot in MATLAB

Unit 5: Robot Sensors

Role of Sensors in Robotic system, Internal and External Sensors, Proximity Sensors of various types
Displacement, Velocity & Acceleration Sensors, Force and Touch Sensors, Range Sensors, Vision Systems, Image Processing

Unit 6: End-Effectors

End Effectors and Types-Mechanical, Magnetic, Vacuum, Various types of mechanical grippers
Design of mechanical grippers, End-Effector Selection Criteria, End Effector design case studies

Unit 7: Robot Actuators

Characteristics of Robot Actuating Systems, Electric Motors, Hydraulic actuators, Pneumatic actuators
Magnetostrictive actuators, Shape-memory type actuators, Electroactive polymer actuators, Selection of actuators

Unit 8: Finite Element Analysis

Introduction to FEA, Steps of Finite Element Modeling & Analysis, Structural Analysis of mechanisms
Modal Analysis of mechanisms, Optimization using FEA Technique, Design Project: Structural and modal analysis of a robot manipulator

SUGGESTED BOOKS:

1. Introduction to Robotics, S. K. Saha, McGraw Hill Education (India) Pvt. Ltd.
2. Introduction to Robotics – Analysis, Control, Applications, Saeed B. Niku, Wiley India Pvt. Ltd.
3. Introduction to Robotics – Mechanics and Control, John J. Craig, Pearson Education Inc.
4. Robotics & Control – R.K. Mittal & I.J. Nagrath – TMH Publications
5. Industrial Robotics – Technology, Programming and Applications - M.P.Groover, M.Weiss, R.N.Nagel, N.G.Odrey
6. Design of Machinery: An Introduction to the Synthesis and Analysis of Mechanisms and Machines, Robert L.Norton, Tata McGraw-Hill, 3rd Edition
7. Dally and Riley, “Experimental stress analysis”, McGraw-Hill International Student Edition, McGraw-Hill Book Company.
8. Fundamentals of Finite Element Analysis, David V. Hutton, Tata McGraw Hill

M.TECH. IN SENSOR, DATA AND IOT SYSTEM MANAGEMENT

Rationale

Sensor, Data and IoT System Management is conceptualized as an interdisciplinary course wherein the three cutting edge technology areas viz. sensor technology, data science, and IoT Systems are combined together to propose technological solutions to myriad problems in the social landscape.

Internet of Things (IoT) is used in intelligent homes, smart buildings, factory automation systems, intelligent transportation systems, and autonomous car management systems. An IoT system consists of a number of sensors, actuators, and computing nodes. The data generated by the system is accessed by one or more remote OM (Operations & Management) servers through internet which must undertake the processing, storing, and classifying of the data.

This course shall explore the technological aspects of the Sensing and Data-Driven Control for various applications.

Total Credits: 76

Eligibility: Bachelor's in any branch of engineering or its equivalent with first division or 60% aggregate marks from a recognized institute.

Programme Outcomes of PG Program in Sensor, Data and IoT System Management

At the end of the program, a student is expected to have:

- PO1: An ability to demonstrate understanding over the emerging field of Sensor, Data and IoT System Management as an integrated area of study.
- PO2: To apply, analyze, evaluate and synthesize existing and new knowledge related to Sensor, Data and IoT System Management at system level.
- PO3: An ability to independently carry out research and development work to solve practical problems using these technologies specially in socially relevant areas like biomedical engineering, agricultural sciences etc.
- PO4: An ability to write and present a substantial technical report / document.

Salient Features :

- 24. It is interdisciplinary program and admission is open to all engineering graduates.
- 25. Students will have the option to select some the courses offered through MOOCs.
- 26. Evaluation focuses more on formative evaluation to enable development of desired competencies.
- 27. In first and second semester, one of the electives being offered, is industry driven.

28. Project specific subject to be selected by the subject will be supervised and monitored by institute faculty.
29. In third semester , student will be attached to industry/NGO/Start up etc for hands on training on relevant echo system.
30. The program is designed to allow the students to spend one full year in field and explore the possibility of developing prototype.
31. Effective implementation of NEP-2020 is ensured by offering a number of multidisciplinary
32. To have better industry relevance, industry experts will be engaged to run industry relevant subjects.
33. To ensure attainment of program outcomes, emerging pedagogical approaches will be inbuilt in the teaching learning methodology.
34. Since the program is of interdisciplinary nature, bridge courses will be offered to meet the pre requisites of the program.

Title of the program: Masters Programme in Sensor, Data and IoT System Management

Study and Evaluation Scheme:

First Semester

| Sr. No. | Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|--|-------------|--------------------------------------|--------------------|---------|----------------|----------------|-------|
| Programme Specific Core | | | | | | | |
| 22. | SDI-C-101 | Data Analytics and Signal Processing | 4 - - | 4 | 60 | 40 | 100 |
| 23. | SDI-C-102 | Smart Sensors and Actuators | 4 - - | 4 | 60 | 40 | 100 |
| Interdisciplinary / Industry Oriented Electives | | | | | | | |
| 24. | SDI-E-XXX | Elective 1 | 3 - - | 3 | 60 | 40 | 100 |
| 25. | SDI-E-XXX | Elective 2 | 3 - - | 3 | 60 | 40 | 100 |
| 26. | SDI-E-XXX | Elective 3 | 3 - - | 3 | 60 | 40 | 100 |
| Laboratory Courses | | | | | | | |
| 27. | SDI-P-151 | Internet of Things | - - 4 | 2 | 60 | 40 | 100 |
| 28. | SDI-P-152 | Sensors and Data Acquisition | - - 4 | 2 | 60 | 40 | 100 |
| Total | | | 25 | 21 | 420 | 280 | 700 |

Second Semester

| Sr. No. | Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|--|-------------|------------------------|--------------------|---------|----------------|----------------|-------|
| Programme Specific Core | | | | | | | |
| 22. | SDI-C-201 | IoT Security and Trust | 4 - - | 4 | 60 | 40 | 100 |
| 23. | SDI-C-202 | Advanced IoT Systems | 4 - - | 4 | 60 | 40 | 100 |
| Interdisciplinary / Industry Oriented Electives | | | | | | | |

| | | | | | | | | | |
|---------------------------|-----------|--|----|---|---|----|-----|-----|-----|
| 24. | SDI-E-XXX | Elective 4 | 3 | - | - | 3 | 60 | 40 | 100 |
| 25. | SDI-E-XXX | Elective 5 | 3 | - | - | 3 | 60 | 40 | 100 |
| 26. | SDI-E-XXX | Elective 6 | 3 | - | - | 3 | 60 | 40 | 100 |
| Laboratory Courses | | | | | | | | | |
| 27. | SDI-P-251 | Artificial Intelligence Lab (Common to all M.Tech Programmes) | - | - | 4 | 2 | 60 | 40 | 100 |
| 28. | SDI-P-252 | Advanced IoT Laboratory | - | - | 4 | 2 | 60 | 40 | 100 |
| Total | | | 25 | | | 21 | 420 | 280 | 700 |

Third Semester

| Sr. No. | Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|--------------|-------------|--|-----------------------|---------|----------------|----------------|-------|
| 4. | SDI-M-301 | MOOC Course 1 – Research Methodology | 3 - - | 3 | 60 | 40 | 100 |
| 2. | SDI-M-302 | MOOC Course 2 – Field Specific Subject | 3 - - | 3 | 60 | 40 | 100 |
| 3. | SDI-P-351 | Live Lab | 20 - - | 10 | 100 | 100 | 200 |
| Total | | | 26 | 16 | 280 | 180 | 400 |

Fourth Semester

| Sr. No. | Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|--------------|-------------|--------------|-----------------------|---------|----------------|----------------|-------|
| 1. | SDI-D-401 | Thesis Work | - | 18 | 100 | 100 | 200 |
| Total | | | - | 18 | 100 | 100 | 200 |

Total: 76 Credits

Elective 1 (Select any one)

- SDI-E-103 : Advanced Statistical Methods
- SDI-E-104 : Data Warehousing and Mining
- SDI-E-105 : Virtualization and Cloud Computing

Elective 2 (Select any one)

- SDI-E-106 : Automotive Sensors & In-vehicle Networking
- SDI-E-107 : RF and Microwave Sensors
- SDI-E-108 : Biomedical Sensors

Elective 3 (Select any one)

- SDI-E-109 : IoT Applications Development
- SDI-E-1010 : Fibre Optic Sensors and Photonics
- SDI-E-1011 : Virtual Instrumentation and CAD Tools

Elective 4 (Select any one)

- SDI-E-203 : Power Management for IoT Devices
- SDI-E-204 : 3D Printing for IoT System Design
- SDI-E-205 : Data Access Control and Security

Elective 5 (Select any one)

- SDI-E-206 : Multi-disciplinary Product Development
- SDI-E-207 : Data Science
- SDI-E-208 : Deep Learning

Elective 6 (Select any one)

- SDI-I-201 : Industrial Internet of Things
- SDI-I-202 : Instrumentation for Special Agricultural Applications
- SDI-I-203 : Artificial Intelligence for IoT Applications

SDI-C-101 Data Analytics and Signal Processing

Aim: This course aims to introduce students to all the basic and advanced concepts in Linear Algebra with a strong focus on applications. Linear Algebra is one of the fundamental tools that has applications in diverse fields such as Machine Learning, Data Analytics, Signal Processing, Wireless Communication, Operations Research, Control and Finance.

Pre-requisite Knowledge: Statistics

Learning Outcomes: At the end of the course, the student will be able to

- demonstrate proficiency with statistical analysis of data.

- develop the ability to build and assess data-based models.
- execute statistical analyses with professional statistical software.
- demonstrate skill in data management.

Module-1 Discrete Random Signal Processing

Random Processes, Ensemble Average, Gaussian Process, Multi variate Gaussian Process, Stationary process, Autocorrelation, Auto Covariance, Ergodicity, White noise, Power Spectrum, Filtering of Random Process.

Module-2 Signal Modeling

ARMA, AR, MA Models. Wiener filter, Linear prediction, Kalman Filter.

Module-3 Feature extraction

FFT, Power spectrum, DCT, filter banks, Wavelet, Wavelet Packets, Cepstrum.

Module-4 Time series analysis

Basic analysis, Univariate time series analysis, Multivariate time series analysis, non stationary time series.

Module-5 Reduction of dimensionality

Bayesian decision, Linear discrimination, Principal Component analysis, SVD, Independent Component Analysis.

Module-6 Machine learning

Supervised learning, generative algorithms, Support Vector machines, Unsupervised learning, K means clustering, Neural network (SOM, ART), Expectation maximization.

Module-7 Big Data Analytics

Introduction Big data analytics, visualization and data exploration, basic and intermediate analysis, linear and logistic regression, decision tree.

Suggested Books:

1. J. G. Proakis, DG. Manolakis and D. Sharma, “Digital signal processing principles, algorithms and applications”, 4th ed., Person education, USA
2. Sophocles J. Orfanidis, “Introduction to signal Processing” 2nd ed., Prentice Hall, New Delhi India.
3. Oppenheim V. A.V and Schaffer R. W, “Discrete- time signal Processing”, 3rd ed., Prentice Hall,. New Delhi, India
4. Thomas A. Runkler, "Data Analytics: Models and Algorithms for Intelligent Data Analysis", 2016, 2nd ed., Springer Verlag, UK

5. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective" 1st ed., MIT Press, USA.

SDI-C-102 Smart Sensors and Actuators

Aim

This course aims to illustrate the concepts of various smart sensor technology and their applications in the area of smart grid data acquisition.

Pre-requisite Knowledge: Transducers

Learning Outcomes: At the end of the course, the student will be able to

- Implement smart sensor systems and integrate with sensing and actuation in an IoT system.
- Explain the concepts behind converting physical phenomena into measurable electrical signals in different types of sensors.
- Explain the concepts behind converting electrical power into a mechanical output (actuators).
- Apply appropriate mathematical equations to describe sensor operation
- Design, build and test an integrated system involving sensors and/or actuators, and demonstrate system operation.

DETAILED CONTENTS

1. Sensor Technology

Physics of Sensors, Sensor Characteristics, Sensor Function, Measuring Chain for Sensing, Sensing Modules, Sensor Types, Sensors for Dimensional Metrology- Tactile and Contactless Sensors, Fiber-Optic Sensors, Strain Gages.

2. Smart Sensors

Smart Temperature Sensors, Smart Wind Sensors, Smart Hall effect Sensors, HV Sensors, Smart Capacitor Control Sensors.

3. Mechatronic Sensors

MEMS/Micro-sensors and Embedded Sensors, their construction and applications as smart sensing devices, Cyber Physical Systems, Sensors for Cyber-Physical Systems.

4. Calibration and Self-Calibration of Smart Sensors

Calibration of Smart Sensors: Calibration Terminology, Specifics of Smart Sensor Calibration and trimming, Case Study: Smart Magnetic Field Sensor and Smart Wind Sensor.

5. Wireless Sensor Networks-Principles and Applications

Introduction to Wireless Sensor Networks, Individual Wireless Sensor Node Architecture, Wireless Sensor Networks Architecture, Radio Options for the Physical Layer in Wireless Sensor Networks, Power Consideration in Wireless Sensor Networks, Application of Wireless Sensor Networks.

6. Data Acquisition System for Smart Grid

Data Acquisition for dynamic sensors: Introduction, DAQ boards, Data acquisition subsystem-Supervisory control subsystem-Real-time software environment-Data base management system.

SUGGESTED TEXT BOOKS

1. Horst Czichos: Measurement, Testing and Sensor Technology Fundamentals and Application to Materials and Technical Systems, Springer International Publishing AG, part of Springer Nature 2018, ISBN 978-3-319-76384-2 ISBN 978-3-319-76385-9 (eBook)
2. Jon S. Wilson: Sensor Technology Handbook, Elsevier Inc, 2005, ISBN: 0-7506-7729-5.

RECOMMENDED REFERENCE MATERIAL

1. Gerard Meijer MichielPertjjs and Kofi Makinwa: Smart Sensor Systems: Emerging Trends and Applications, John Wiley & Sons Ltd, 2014, ISBN: 9780470686003

SDI-C-201

IoT Security and Trust

Aim: This course will give students a theoretical and practical grounding in Internet of Things (IoT), covering IoT systems architecture, hardware platforms, embedded programming and debugging, networking paradigms for IoT, and security.

Pre-requisite Knowledge: Fundamentals of IoT

Learning Outcomes: At the end of the course, the student will be able to :

- Understand the fundamentals of encryption for cyber security.
- Design elementary blocks for threat modelling.
- Deal with security and digital identity issues in cloud computing.
- Understand issues related to cyber crime, hacking and forensics.

Module-1 Fundamentals of encryption for cyber security

Cryptography – Need and the Mathematical basics- History of cryptography, symmetric ciphers, block ciphers, DES – AES. Public-key cryptography: RSA, Diffie-Hellman Algorithm, Elliptic Curve Cryptosystems, Algebraic structure, Triple Data Encryption Algorithm (TDEA) Block cipher.

Module-2 IoT security framework

IOT security frame work, Security in hardware,Bootprocess, OS & Kernel, application, run time environment and containers. Need and methods of Edge Security, Network Security: Internet, Intranet, LAN, Wireless Networks, Wireless cellular networks, Cellular Networks and VOIP.

Module-3 Elementary blocks of IoT Security & Models for Identity Management

Vulnerability of IoT and elementary blocks of IoT Security, Threat modeling – Key elements. Identity management Models and Identity management in IoT, Approaches using User-centric, Device-centric and Hybrid.

Module-4 Identity Management and Trust Establishment

Trust management lifecycle, Identity and Trust, Web of trust models. Establishment: Cryptosystems – Mutual establishment phases – Comparison on security analysis. Identity management framework.

Module-5 Access Control in IoT and light weight cryptography

Capability-based access control schemes, Concepts, identity-based and identity-driven, Light weight cryptography, need and methods , IoT use cases.

Module-6 Security and Digital Identity in Cloud Computing

Cloud security , Digital identity management in cloud, Classical solutions, alternative solutions, Management of privacy and personal data in Cloud.

Module-7 Cyber Crimes, Hackers and Forensics

Cyber Crimes and Laws – Hackers – Dealing with the rise tide of Cyber Crimes – Cyber Forensics and incident Response – Network Forensics.

Suggested Books:

1. John R. Vacca, “Computer and Information Security Handbook”, Elsevier.
Parikshit Narendra Mahalle , Poonam N. Railkar, “Identity Management for Internet of Things”, River Publishers, 2015.
2. William Stallings, “Cryptography and Network security: Principles and Practice”, 5th Edition, Pearson Education, India.
3. Maryline Laurent, Samia Bouzefrane, “Digital Identity Management”, Elsevier, 2015.
4. Joseph Migga Kizza, “Computer Network Security”, Springer.
5. Christof Paar and Jan Pelzl, “Understanding Cryptography – A Textbook for Students and Practitioners”, Springer.
6. Behrouz A. Forouzan : Cryptography & Network Security – The McGraw Hill Company.
7. Charlie Kaufman, Radia Perlman, Mike Speciner, Network Security: “Private Communication in a public World”, PTR Prentice Hall, Second Edition.
8. Alasdair Gilchrist, “IoT security Issues”, Oreilly publications, 2017.

Aim: The concepts of Networking, Set theory and Relation. 2 The concepts of Functions and define the recursive functions. 3 The concept of IoT platforms. 3. The concept of Connected Vehicles. 4. The concept of variable and also identify the mapping.

Pre-requisite Knowledge: IoT Devices

Learning Outcomes: At the end of the course, the student will be able to

- Apply the Set theory and Relation concepts.
- Apply the Functions.
- Identify the permutations and combinations.
- Identify the mapping.

Module-1 Introduction

Introduction to IoT, Sensing, Actuation, Basics of Networking, Communication Protocols, Sensor Networks, Machine to Machine Communications. Understanding of the IoT ecosystem, various layers in building an IoT application and interdependencies.

Module-2 Interoperability in IoT

Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino, Introduction to Python programming. Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi. Build use cases using Raspberry Pi.

Module-3 SDN for IoT

Introduction to SDN, SDN for IoT, Data Aggregation, Handling and Analytics, Cloud Computing, Sensors, Fog Computing, Understanding of the various protocols being used in IoT like MQTT, AMQP, REST API.

Module-4 IoT Platforms and Applications

Understanding of the IoT platforms like PTC Thingworx and IoT frameworks like MS Azure, Understanding of the usage of these platforms to build applications like Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Case Study: Agriculture, Healthcare, Activity Monitoring.

Suggested Books:

1. David Etter, “IoT (Internet of Things) Programming: A Simple and Fast Way of Learning IoT,” Kindle Edition.
2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, and David Boyle, “From Machine to Machine to the Internet of Things: with specialisation in Internet of Things Introduction to a New Age of Intelligence,” Elsevier Science Publishing Co. Inc.,
3. Pethuru Raj and Anupama C. Raman, “The Internet of Things: Enabling Technologies, Platforms, and Use Cases,” 1st Edition, Auerbach Publications, 2017.
4. asuura, H., Kyung C.M., Liu Y., and Lin Y.L., “Smart Sensors at the IoT Frontier,” 1st Edition, Springer International Publishing, 2018.

Aim: 1. To develop the students ability to deal with numerical and quantitative issues. To enable the use of statistical, graphical and algebraic techniques wherever relevant. 3. To have a proper understanding of Statistical applications in engineering.

Pre-requisite Knowledge: Basic Mathematics

Learning Outcomes: At the end of the course, the student will be able to :

- Critically evaluate the underlying assumptions of statistical analysis tools.
- Discuss critically the issues surrounding sampling and significance.
- Discuss critically the uses and limitations of statistical analysis.
- Solve a range of problems using the techniques covered.

Module-1 Basic Statistical Tools for Analysis

Summary Statistics, Correlation and Regression, Concept of R^2 and Adjusted R^2 and and Partial and Multiple Correlation, Fitting of simple and Multiple Linear regression, Explanation and Assumptions of Regression Diagnostics.

Module-2 Statistical inference

Basic Concepts, Normal distribution-Area properties, Steps in tests of significance –large sample tests-Z tests for Means and Proportions, Small sample tests –t-test for Means, F test for Equality of Variances, Chi-square test for independence of Attributes.

Module-3 Modelling and Forecasting Methods

Introduction: Concept of Linear and Non Liner Forecasting model ,Concepts of Trend, Exponential Smoothing, Linear and Compound Growth model, Fitting of Logistic curve and their Applications, Moving Averages, Forecasting accuracy tests.

Probability models for time series: Concepts of AR, ARMA and ARIMA models.

Module-4 Design of Experiments

Analysis of variance – one and two way classifications – Principle of design of experiments, CRD

–

RBD – LSD, Concepts of 2^2 and 2^3 factorial experiments.

Suggested Books:

1. Applied Statistics and Probability for Engineers, 6ed, (2016), Douglas C. Montgomery
George C. Runger, John Wiley & Sons.
2. Time Series Analysis and Its Applications With R Examples (2017), by Shumway, Robert
H.,
Stoffer, David S. Springer publications.
3. The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Second
Edition
(Springer Series in Statistics)(2017), by Trevor Hastie and Robert Tibshirani.
4. Introduction to Probability and Statistics: Principles and Applications for Engineering and
the
Computing Sciences(2017), Mc.Grawhill education by J. Susan Milton and Jesse Arnold.

Aim: To identify the scope and essentiality of Data Warehousing and Mining. Analyze data, choose relevant models and algorithms for respective applications. Study spatial and web data mining. Develop research interest towards advances in data mining.

Pre-requisite Knowledge: Data Science

Learning Outcomes: At the end of the course, the student will be able to :

- Understand Data Warehouse fundamentals, Data Mining Principles.
- Design data warehouse with dimensional modelling and apply OLAP operations.
- Identify appropriate data mining algorithms to solve real world problems.
- Evaluate different data mining techniques like classification, prediction, clustering and association rule mining.

Module-1 Data Warehousing

Data types, Data modelling and DBMS Schemas for Decision Support , Data mart, Data ETL operations, Metadata; OLAP operations, Bitmap and Join Indexing, Data Cubing, Star tree construction, inverted index.

Module-2 Data mining

Data, Pre-processing and KDD Process, Association rule mining and Interestingness of Patterns, Frequent Pattern and frequent itemset Mining, A-priori algorithm, Correlation Analysis, Constraint Based Association Mining.

Module-3 Classification and Prediction

Basic Concepts , entropy, Dimensionality reduction, PCA, Decision Tree, Naïve Bayes algorithm, Neural networks, Back propagation, SVM, Associative Classification, Lazy Learners, Ensemble learning, Ada-Boosting, Bagging, Accuracy and Error Measures, Performance evaluation, ROC.

Module-4 Clustering

Types of Data in Cluster Analysis – A Categorization of Major Clustering methods, Partitioning Methods, Hierarchical clustering, Expectation-Maximization Algorithm, Density Based clustering, Constraint-Based Cluster Analysis – Outlier Analysis and Data mining for intrusion detection, mining sequence and time series data.

Module-5 Case study

Case study on Data mining with data sets.

Suggested Books:

1. Han, J and Kambher, M, Data Mining Concepts and Techniques, (3e), Morgan Kaufmann Publishers- Elsevier, ISBN-12: 9780123814791, ISBN-13: 978-9380931913
2. Tan, P N, Steinbach, M and Kumar, V, Introduction to Data Mining, (1e), Person Education India, ISBN-10: 0321321367, ISBN-13: 978-0321321367.
3. A. Berson and S. J. Smith, Data Warehousing, Data Mining & OLAP, (10e), Tata McGraw – Hill, ISBN-10: 0070587418, ISBN-13: 978-0070587410, 2017.

Aim: The aim of this course is to provide comprehensive and in-depth knowledge of Cloud Computing concepts, technologies, architecture and applications by introducing and researching state-of-the-art in Cloud Computing issues, technologies, applications and implementations.

Pre-requisite Knowledge: Internet Protocols

Learning Outcomes: At the end of the course, the student will be able to :

- Understand the main concepts, issues, and direction of cloud computing.
- Deal with Virtualization Technologies
- Use Optimization techniques for scheduling

Module-1 Overview of Computing Paradigms

Recent Trends in Computing: Distributed Computing, Cluster Computing, Grid Computing, Utility Computing, Cloud Computing. Evolution of Cloud Computing: Migrating into a Cloud.

Module-2 Cloud Computing Basics

Cloud Computing Overview; Characteristics; Applications; Benefits; Limitations; Challenges, SOA; Cloud Computing Service Models: Infrastructure as a Service; Platform as a Service; Software as a Service. Cloud Computing Deployment Models: Private Cloud; Public Cloud; Community Cloud; Hybrid Cloud, Major Cloud Service providers.

Module-3 Virtualization Concepts

Overview of Virtualization Technologies, Types of Virtualization, Benefits of Virtualization, Hypervisors; VM Provisioning & Migration: VM Lifecycle, VM Provisioning Process, VM Migration Techniques.

Module-4 Scheduling in Cloud

Overview of Scheduling problem, Different types of scheduling, Scheduling for independent and dependent tasks, Static vs. Dynamic scheduling, Optimization techniques for scheduling.

Module-5 Cloud Storage

Overview; Storage as a Service, Benefits and Challenges, Storage Area Networks(SANs), Case Study of Amazon S3.

Module-6 Cloud Security

Infrastructure Security: Network Level Security, Host Level Security and Application Level Security, Data Security: Data Security & Privacy Issues; Identity & Access Management; Legal Issues in Cloud Computing.

Module-7 Mobile Cloud Computing

Overview of Mobile Cloud Computing, Advantages, Challenges, Using Smartphones with the Cloud, Offloading techniques - their pros and cons, Mobile Cloud Security.

Module-8 SLA Management

Overview of SLA, Types of SLA, SLA Life Cycle, SLA Management Process.

Suggested Books:

1. Raj kumar Buyya, James Broberg, Andrzej Goscinski (Editors): Cloud Computing: Principles and Paradigms, Wiley.
2. Barrie Sosinsky: Cloud Computing Bible, Wiley.
3. Anthony T. Velte, Toby J. Velte, and Robert Elsenpeter: Cloud Computing: A Practical Approach, McGraw Hill, 2010.
4. Judith Hurwitz, Robin Bloor, Marcia Kaufman, Fern Halper: Cloud Computing for Dummies, Wiley.
5. Borko Furht, Armando Escalante (Editors): Handbook of Cloud Computing, Springer.

Aim: Aim of the course is to provide the knowledge of sensors application areas of automobiles

Pre-requisite Knowledge: Sensor Design

Learning Outcomes: At the end of the course, the student will be able to

- Explain batteries, Differential Gear, Braking Systems, lighting and other electrical systems inside an automobile.
- Understand all the sensors and actuators used in automotive systems.
- Explain Anti-collision techniques using ultrasonic Doppler sensors.

Module-1 Introduction to Automotive Engineering, Automotive Management systems

Power-train, Combustion Engines, Transmission, Differential Gear, Braking Systems, Introduction to Modern Automotive Systems and need for electronics in Automobiles, Application areas of electronics in the automobiles, Possibilities and challenges in the automotive industry, Enabling technologies and Industry trends.

Module-2 Power train Sensors

λ sensors, exhaust temperature sensor, NO_x sensor, PM sensor, fuel quality sensor, level sensor, torque sensor, speed sensor, mass flow sensor, manifold pressure sensor.

Module-3 Sensors for Chassis management

Wheel speed sensors/direction sensors, steering position sensor (multi turn), acceleration sensor (inertia measurement), brake pneumatic pressure sensor, ABS sensor, electronic stability sensor.

Module-4 Sensors for vehicle body management, Sensors for automotive vehicle convenience and security systems

Gas sensors (CO₂), Temperature/humidity sensor, air bag sensor, key less entering sensor, radar sensors. Tire pressure monitoring systems, Two wheeler and Four wheeler security systems, parking guide systems, anti-lock braking system, future safety technologies, Vehicle diagnostics and health monitoring, Safety and Reliability, Traction Control, Vehicle dynamics control, Accelerators and tilt sensors for sensing skidding and anti-collision, Anti-collision techniques using ultrasonic Doppler sensors.

Module-5 Air Bag and Seat Belt Pre tensioner Systems

Principal Sensor Functions, Distributed Front Air Bag sensing systems, Single-Point Sensing systems, Side-Impact Sensing, and Future Occupant Protection systems.

Module-6 Passenger Convenience Systems

Electromechanical Seat, Seat Belt Height, Steering Wheel, and Mirror Adjustments, Central Locking Systems, Tire Pressure Control Systems, Electromechanical Window Drives, etc.

Module-7 Healthcare applications

Enabling Connectivity by Networking:-In vehicle communication standards (CAN & LIN), Telematic solutions, Portable or embedded connectivity- Endorsing Dependability in Drive-by wire systems:- Terminology and concepts , Why by-wire, FLEXRAY, Requirements on cost and dependability, Drive-by-wire case studies- prototype development-future of In vehicle communication.

Suggested Books:

1. Automotive Electrics, Automotive Electronics: Systems & Components, 5th Edition, BOSCH.
2. John Turner, Automotive Sensors, 1st Edition, Momentum Press, New York.
3. Automotive Sensors Handbook, 8th Edition, BOSCH.
4. Jiri Marek, Hans-Peter Trah, Yasutoshi Suzuki, Iwao Yokomori, Sensors for Automotive Technology, 4th Edition, Wiley, New York.
5. Ernest O. Doebelin, “Measurement Systems – Application and Design”, 2017, 6th Edition, McGraw-Hill, New Delhi.

Aim: The main aim is to provide students knowledge of different types Antenna for sensing, radiometer and radar.

Pre-requisite Knowledge: Microwave Engineering

Learning Outcomes: At the end of the course, the student will be able to :

- Understand Concepts of Printed Antennas and Broadband Microstrip Patch Antennas
- Deal with Characterization of Wearable Antennas
- Use Applications in automotive, agriculture, medicine, weather forecasting.

Module-1 RF Sensors

Microwave Antenna-Introduction, types of Antenna, fundamental parameters of antennas, radiation mechanism, Fresnel and Fraunhofer regions. Antenna for communication and Antenna for sensing, radiometer and radar.

Module-2 Antenna for personal area communication

Concepts of Printed Antennas, Broadband Microstrip Patch Antennas, Antennas for Wearable Devices, Design Requirements, Modeling and Characterization of Wearable Antennas, WBAN Radio Channel Characterization and Effect of Wearable Antennas, Domains of Operation, Sources on the Human Body, Compact Wearable Antenna for different applications.

Module-3 Radar

Introduction to RADAR, RADAR range equation, MTI and pulse Doppler RADAR, Tracking RADAR, SAR pulse RADAR, CW RADAR.

Module-4 Applications of Radar

Automotive, remote sensing, agriculture, medicine, detection of buried objects, NDT, defense factors affecting the performance of RADAR, RADAR transmitters, Receivers.

Module-5 Radiometers

Radiative transfer theory, SMMR, Types of radiometers - and Bolometers, Applications in automotive, agriculture, medicine, weather forecasting.

Module-6 Microwave power Sensors

Diode Sensors: Diode detector principles, dynamic range average power sensors, signal waveform effects on the measurement uncertainty of diode sensors. Thermocouple Sensors: Principles of Thermocouple sensor, power meters for thermocouple sensors.

Module-7 RFID Sensors

Introduction, Components of RFID systems, hardware and software components, RFID standards, RFID applications.

Suggested Books:

1. Finkenzeuer Klaus, “RFID Handbook”, 3rd edition, John Wiley and Sons, New Jersey.
2. Constantine A. Balanis, “Antenna Theory Analysis and Design”, 2016, 4th edition, John Wiley and Sons, New Jersey.
3. B. Hoffman - Wellenhof, H.Lichtenegger and J.Collins, "GPS: Theory and Practice ", 5th edition, Springer, New York.
4. Lillesand & Kiefer, “Remote Sensing and Image Interpretation”, 6th edition, John Wiley and Sons, New Jersey.

Aim: Introduce the students to different types of electrodes used in bio potential recording and facilitate the students in recognizing electrode configuration and issues related with the electrode relative motions.

Pre-requisite Knowledge: Biomedical Engineering

Learning Outcomes: At the end of the course, the student will be able to :

- Realize the need for reusable electrodes and understands the method of implementation.
- Familiarize with electrode placements for various biopotential recording as per the voltage range.
- Understand design principles of bio-amplifiers and drawback related with noises.
- Implement different types of physiological parameter measurement using appropriate sensors.

Module-1 Biopotential Electrodes

Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode–skin interface, half-cell potential, impedance, polarization effects of electrode – nonpolarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes.

Module-2 EEG, EMG & ECG

Bio signal characteristics – frequency and amplitude ranges. ECG – Einthoven’s triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. EEG- procedure, signal artefacts, signal analysis, evoked potential, EMG- procedure and signal analysis, Nerve conduction study.

Module-3 Bio Amplifiers

Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference.

Module-4 Physical Sensors in Biomedicine

Temperature measurement: core temperature,-surface temperature- invasive. Blood flow measurement: skin blood- hot film anemometer- Doppler sonography- electromagnetic sensor - blood pressure measurement: noninvasive- hemodynamic invasive. Spirometry- sensors for pressure pulses and movement- ocular pressure sensor- acoustic sensors in hearing aid, in blood flow measurement, sensors for bio-magnetism, tactile sensors for artificial limbs, sensors in ophthalmoscopy, artificial retina.

Module-5 Sensors for Chemical Quantities in Biomedicine

Blood gas and pH sensor, electrochemical sensor, transcutaneous, optical fiber sensor, mass spectrometer, optical oximetry, pulseoximetry, earoximetry.

Module-6 Detectors in Radiology

X ray imaging with sensors, detectors in nuclear radiology, magnetic field sensors for imaging, magnetic resonance imaging.

Module-7 Sound in Medicine

Interaction of Ultrasound with matter; Cavitations, Reflection, Transmission- Scanning systems – Artefacts- Ultrasound- Doppler-Double Doppler shift-Clinical Applications.

Suggested Books:

5. J. G. Webster, J. G. Webster ,“Medical Instrumentation; Application and Design”, John Wiley & Sons, Inc., New York, 4th Edition, 2015
6. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw-Hill, New Delhi, 3rd edition.
7. John Enderle, Joseph Bronzino, “Introduction to Biomedical Engineering”, Academic Press, 3rd Edition.
8. Myer Kutz, “Biomedical Engineering and Design Handbook, Volume 1: Volume I: Biomedical Engineering Fundamentals”, McGraw Hill Publisher, USA, 2nd Edition.

Aim: To acquire specific scripting knowledge to develop interactive applications and understand the basics of android application development along with programming skills in developing application pertaining to Industrial, medical, agricultural, etc.

Pre-requisite Knowledge: Fundamentals of IoT

Learning Outcomes: At the end of the course, the student will be able to :

- Design dynamic web forms to acquire and process user & sensor data..
- Interactive forms using Java Script with a focus on internet of things.
- Implement mobile application using android SDK.
- Solve the need for smart systems in a distributed environment.

Module-1 Markup Language

Introduction to Markup language, HTML document structure, HTML forms, Style (CSS), Multiple CSS stylesheets, DHTML, Tools for image creation and manipulation, User experience design, IoT development using charts.

Module-2 Scripting Language

Introduction to JavaScript, Functions, DOM, Forms, and Event Handlers, Object Handlers, Input validation, J2ME, application design using J2ME , IoT development using Real time rules, platforms, alerts.

Module-3 Android Programing Framework

Mobile app development: Android Development environment, Simple UI Layouts and layout properties, GUI objects, Event Driven Programming, opening and closing a Database.

Module-4 Industrial Internet Application

IIoT Fundamentals and Components, Industrial Manufacturing, Monitoring, Control, Optimization and Autonomy, Introduction to Hadoop and big data analytics.

Module-5 Applications in agriculture

Smart Farming: Weather monitoring, Precision farming, Smart Greenhouse, Drones for pesticides.

Module-6 Applications in IoT enabled Smart Cities

Energy Consumption Monitoring, Smart Energy Meters, Home automation, Smart Grid and Solar Energy Harvesting, Intelligent Parking, Data lake services scenarios.

Module-7 Healthcare applications

Architecture of IoT for Healthcare, Multiple views coalescence, SBC-ADL to construct the system architecture. Use Cases : Wearable devices for Remote monitoring of Physiological parameter, ECG, EEG, Diabetes and Blood Pressure.

Suggested Books:

1. John Dean, Web Programming with HTML5, CSS and JavaScript, 2018, Jones and Bartlett Publishers Inc., ISBN-10: 9781284091793.
2. DiMarzio J. F., Beginning Android Programming with Android Studio, 2016, 4th ed., Wiley, ISBN-10: 9788126565580.
3. Fadi Al-Turjman, Intelligence in IoT- enabled Smart Cities, 2019, 1st edition, CRC Press, ISBN-10: 1138316849.
4. Giacomo Veneri, and Antonio Capasso, Hands-on Industrial Internet of Things: Create a powerful industrial IoT infrastructure using Industry 4.0, 2018, Packt Publishing.
5. Subhas Chandra Mukhopadhyay, Smart Sensing Technology for Agriculture and Environmental Monitoring, Springer, ISBN-10: 3642276377.

Aim: To introduce the theory and technology of fiber optics sensing to improve their understanding in rapidly growing field and predict the optical parameters in optical devices to understand the phenomena induced due to intensity based effects.

Learning Outcomes: At the end of the course, the student will be able to :

- Use knowledge of optical waveguides and optical devices employed in optical sensors.
- Explain optical parameters involved in active and passive components.
- Entrust the characteristics of a suitable optical materials for the sensing device in a given application.
- Apply the knowledge in designing interferometric devices which is more effectively used in sensing.

Module-1 Theory of Optical Waveguides

Wave theory of optical waveguides, formation of guided modes, Slab waveguide, Rectangular waveguide, Radiation fields from waveguide, Effective index method, Marcatili's method, Beam propagation method. Basic characteristic of Optical Fiber Waveguides, Acceptance angle, Numerical aperture, skewrays- Electromagnetic Modes in Cylindrical Waveguides.

Module-2 Active and Passive Optical Components

Electro-optic and acousto optic wave guide devices, directional couplers, optical switch, phase and amplitude

modulators, filters etc, Y junction, power splitters, arrayed waveguide devices, fiber pig tailing, end-fiber prism coupling, FBG and fabrication of FBG, Tapered couplers.

Module-3 Intensity and Polarization Sensors

Intensity sensor: Transmissive concept – Reflective concept – Micro bending concept – Transmission and Reflection with other optic effect – Interferometers – Mach Zehnder – Michelson – Fabry-Perot and Sagnac – Phase sensor: Phase detection – Polarization maintaining fibers. Displacement and temperature sensors: reflective and Micro bending Technology- Applications of displacement and temperature sensors.

Module-4 Interferometric Sensors

Pressure sensors: Transmissive concepts, Microbending – Intrinsic concepts – Interferometric concepts, Applications. Flow sensors: Turbine flowmeters- Differential pressure flow sensors – Laser Doppler velocity sensors- Applications- Sagnac Interferometer for rotation sensing. Magnetic and electric field sensors: Intensity and phase modulation types – applications.

Module-5 Polymer based waveguide in sensing

Polymer based waveguide, materials, properties, fabrication process of polymer based waveguide, Polymer based optical components - Passive, Active polymer devices, Ring Resonator, structure, theory, Filter using Ring Resonator-application in sensing.

Module-6 Fiber based Chemical Sensors

Fiber based Chemical Sensing : Absorption, Fluorescence, Chemi-luminescence, Vibrational Spectroscopic, SPR.

Module-7 Fiber based Bio-Sensors

Fiber based Bio-molecules sensing: High Index, SPR, Hollow core fiber probes, Label Free bio-molecules.

Suggested Books:

1. David A. Krohn, Trevor W. MacDougall, Alexis Mendez, "Fiber Optic Sensors: Fundamentals and Applications" SPIE Press, 4th ed. 2015. ISBN: 1628411805.
2. Eric Udd , William B. Spillman Jr., "Fiber Optic Sensors: An Introduction for Engineers and Scientists", Wiley, 2nd Ed., ISBN: 0470126841.
3. Zujie Fang & et. al., "Fundamentals of Optical Fiber Sensors" Wiley, 1st Ed., 2012.ISBN: 0470575409.
4. Shizhuo Yin, Paul B. Ruffin, and Francis T.S. Yu, "Fiber Optic Sensors",CRC Press, 2 Ed, 2017. ASIN: B078JN75QW.
5. F.Baldini&et.al.,“Optical Chemical Sensors”, NATO Science Series II: Mathematics, Physics and Chemistry, Springer, ISBN: 1402046103.

Aim: To provide the knowledge of Virtual Instruments along with programming and CAD tools for instruments design and analysis.

Pre-requisite Knowledge: Measuring Instruments

Learning Outcomes: At the end of the course, the student will be able to :

- Understand Virtual Instruments, Local and global variables.
- Use the knowledge of Loops and Charts, Arrays, Clusters and graphs, Case and sequence structures.
- Deal with Data Acquisition and interfacing.

Module-1 Review of Virtual Instrumentation

Historical perspective, Block diagram and Architecture of Virtual Instruments.

Module-2 Data-flow Techniques

Graphical programming in data flow, Comparison with conventional programming.

Module-3 VI Programming Techniques

VIs and sub-VIs, Loops and Charts, Arrays, Clusters and graphs, Case and sequence structures, Formula nodes, Local and global variables, Strings and file I/O.

Module-4 Data Acquisition Basics

ADC, DAC, DIO, Counters and timers

Module-5 Common Instrumentation Interfaces

RS232C/ RS485, GPIB, PC Hardware structure, DMA software and hardware installation.

Module-6 Use of Analysis Tools

Advanced analysis tools such as Fourier transforms, Power spectrum, Correlation methods, Windowing and filtering and their applications in signal and image processing, Motion Control, System buses, Interface buses: PCMCIA, VXI, SCXI, PXI, etc.

Module-7 CAD Tools

LabVIEW

Suggested Books:

1. Johnson, G., LabVIEW Graphical Programming, McGraw-Hill.
2. Sokoloff, L., Basic Concepts of LabVIEW 4, Prentice Hall Inc..
3. Wells, L.K. and Travis, J., LabVIEW for Everyone, Prentice Hall Inc.

4. Gupta, S. and Gupta, J.P., PC Interfacing for Data Acquisition and Process Control, Instrument Society of America.

SDI-E-203

Power Management for IoT Devices

Aim: To provide the knowledge of energy harvesting based sensor networks for IoT devices.

Pre-requisite Knowledge: Fundamentals of IoT

Learning Outcomes: At the end of the course, the student will be able to :

- Understand Lumped parameter model and coupled distributed parameter models.
- Deal with Non-linear techniques – vibration control & steady state cases.
- Use the knowledge of harvesting for RF sensors and ID tags – powering wireless SHM sensor nodes.

Module-1 Energy Harvesting Systems

Introduction – Energy sources – energy harvesting based sensor networks – photovoltaic cell technologies – generation of electric power in semiconductor PV cells – types.

Module-2 Piezo-Electric Energy Harvesting and Electromechanical Modeling

Piezoelectric materials – transducers – harvesters – micro generators – strategies for enhancing the performance of energy harvesters. Electromechanical modelling of Lumped parameter model and coupled distributed parameter models and closed-form solutions.

Module-3 Electromagnetic Energy Harvesting and Non-Linear Techniques

Basic principles – micro fabricated coils and magnetic materials – scaling – power maximizations – micro and macro scale implementations. Non-linear techniques – vibration control & steady state cases.

Module-4 Energy Harvesting Wireless Sensors

Power sources for WSN – Power generation – conversion – examples – case studies. Harvesting microelectronic circuits – power conditioning and losses.

Module-5 Selected Applications of Energy Harvesting Systems

Case studies for Implanted medical devices – Bio-MEMS based applications – harvesting for RF sensors and ID tags – powering wireless SHM sensor nodes.

Suggested Books:

1. Carlos Manuel Ferreira Carvalho, Nuno Filipe Silva VeríssimoPaulino, “CMOS Indoor Light Energy Harvesting System for Wireless Sensing Applications”, springer.
2. Danick Briand, Eric Yeatman, Shad Roundy ,“Micro Energy Harvesting”.

SDI-E-204 3D Printing for IoT System Design

Aim: To provide the knowledge of energy harvesting based sensor networks for IoT devices.

Pre-requisite Knowledge: manufacturing

Learning Outcomes: At the end of the course, the student will be able to

- Understand 3D printing approaches for IoT.
- Use knowledge of 3D structures and its applications.
- Deal with Additive manufacturing.

1. Device fabrication techniques for IoT devices
2. 3D Printing Approaches
3. Additive manufacturing of 3D electronic applications
4. Fictionalization of 3D surfaces
5. IoT Systems and applications
6. 3D printing for PCBs

Aim: To provide the knowledge of Policies of Access Control, Models of Access Control and Mechanisms.

Pre-requisite Knowledge: Information Technology

Learning Outcomes: At the end of the course, the student will be able to :

- Understand Non-Discretionary Access Control (NDAC) and Mandatory Access Control (MAC).
- Deal with Dynamically Constrained RBAC, Limitations of RBAC, Comparing RBAC to DAC and MAC Access Control Policy.
- Make use of knowledge of Smart Card Data Transmission ATR, PPS Security Techniques, User Identification, and Smart Card Security.

Module-1 Introduction to Access Control

Purpose and Fundamentals of Access Control, Brief History, Policies of Access Control, Models of Access Control and Mechanisms, Discretionary Access Control (DAC), Non-Discretionary Access Control (NDAC), Mandatory Access Control (MAC).

Module-2 Capabilities and Limitations of Access Control Mechanisms

Access Control List (ACL) and Limitations, Capability List and Limitations.

Module-3 Role-Based Access Control (RBAC) and Limitations

Core RBAC, Hierarchical RBAC, Statically Constrained RBAC, Dynamically Constrained RBAC, Limitations of RBAC, Comparing RBAC to DAC and MAC Access Control Policy, Biba's Integrity Model, Clark-Wilson Model, Domain Type Enforcement Model, Mapping the Enterprise View to the System View, Role Hierarchies, Inheritance Schemes, Hierarchy Structures and Inheritance Forms, SOD in Real System Temporal Constraints in RBAC, MAC and DAC.

Module-4 Smart Card Based Information Security

Smart Card Operating System-Fundamentals, Design and Implantation Principles, Memory Organization, Smart Card Files, File Management, Atomic Operation, Smart Card Data Transmission ATR, PPS Security Techniques, User Identification, Smart Card Security, Quality Assurance and Testing, Smart Card Life Cycle-5 Phases, Smart Card Terminals.

Module-5 Recent Trends in Database Security and Access Control Mechanisms

Case Study of RBAC Systems, Recent Trends Related to Data Security Management, Vulnerabilities in Different DBMS.

Suggested Books:

1. David F, Ferraiolo D, Richard K, and Chandramouli R, Role Based Access Control, (1e), Artech House, ISBN: 1-58053-370-1.
2. Gerardus B, Role-Based Access Control a Complete Guide, (1e), Emereo Pty Limited, 2019.
3. <http://www.smartcard.co.uk/tutorials/sct-itsc.pdf> : Smart Card Tutorial.

SDI-E-206 Multi-disciplinary Product Development

Aim: To develop the students for integrative thinking on good engineering practices and emphasis the students from shifting their mindset from theoretical to practical work.

Pre-requisite Knowledge: Nil

Learning Outcomes: At the end of the course, the student will be able to :

- demonstrate an understanding of the overview of all the product development processes and knowledge of concept generation and selection tools.
- value the voice of the customer in getting the feedback.
- demonstrate an understanding of quality in a product or service through tools.
- improve the design of the product in accordance with the quality standards.

Module-1 Customer Value and Market Segmentation

The way to measure value by what a customer is willing to pay. It is used as critical input for product function requirement development. No product can satisfy all the customers. Market Segmentation shows the methodology to target a specific customer group for product positioning.

Module-2 Voice of customer

Voice of customer: A disciplined approach to directly collecting feedback and input from customers. Used throughout the Engineering and Marketing process.

Module-3 Quality Function deployment

Critical to Quality and Quality function Deployment: Specify and quantify customer needs. Flow down those customer needs in each step of product development.

Module-4 Design of Six Sigma

Integrate statistics into quality continuous improvement operation model. Design for Six Sigma used throughout the product development process in order to improve the correction of the first design delivery.

Module-5 Design Principles

Sample design Principles: As little design as possible to satisfy customer expectations and eliminating any unnecessary complexity helps maximize business benefit.

Module-6 Design of Manufacturing

Design of Manufacturing: Consider product manufacturability during design phase. Manufacture product efficiently increases the organization competitive power.

Module-7 Strategic sourcing and e-sourcing

Strategic Sourcing and Standardized Parts: Leverage the expertise of external source is one of the key strategies to success. Parts standardization improves the manufacturing flexibility and reduces the quality issue. e-sourcing: Leverage web-based applications to deliver savings and productivity gains while conducting the strategic sourcing.

Suggested Books:

4. Tempelman, Shercliff, Van Eyben, “Manufacturing and Design, Elsevier, 1st edition.
5. Art Weinstein, “Handbook of Market Segmentation: Strategic Targeting for Business and Technology Firms, Third Edition (Haworth Series in Segmented, Targeted, and Customized Market), 3rd ed. Routledge, Taylor and Francis group.
6. Michael Lamoureux, “The e-Sourcing Handbook: A Modern Guide to Supply and Spend Management Success, Lasta publishing.

Aim: To provide the knowledge of statistics and optimization from a data science perspective.

Pre-requisite Knowledge: DBMS

Learning Outcomes: At the end of the course, the student will be able to :

- Understand structured thinking for solving data science problems.
- Deals with distance measures, projections, notion of hyper planes and half-planes.
- Understand variances and correlations.

Module-1 Basics of Data Science

Introduction, typology of problems, importance of linear algebra, statistics and optimization from a data science perspective, structured thinking for solving data science problems.

Module-2 Linear Algebra

Matrices and their properties (determinants, traces, rank, nullity, etc.), eigenvalues and eigenvectors, Matrix factorizations, inner products, distance measures, projections, notion of hyper planes, half-planes.

Module-3 Probability, Statistics and Random Processes

Probability theory and axioms, random variables, probability distributions and density functions (Uni-variate and multivariate), expectations and moments, covariance and correlation, statistics and sampling distributions, hypothesis testing of means, proportions, variances and correlations, confidence (statistical) intervals, correlation functions, white-noise process.

Module-4 Optimization

Unconstrained optimization, necessary and sufficiency conditions for optima, gradient descent methods, constrained optimization, KKT conditions, introduction to non-gradient techniques, introduction to least squares optimization, optimization view of machine learning.

Module-5 Introduction to Data Science Methods

Linear regression as an exemplar function approximation problem, linear classification problems.

Suggested Books:

1. G. Strang Introduction to Linear Algebra, (5e), Wellesley-Cambridge Press,2016.
2. Bendat, J. S. and A. G. Piersol, Random Data: Analysis and Measurement Procedures, (4e), John Wiley & Sons.
3. Montgomery, D. C. and G. C. Runger, Applied Statistics and Probability for Engineers, (5e), John Wiley & Sons.

4. Cathy O’Neil and Rachel Schutt, Doing Data Science, (4e), O’Reilly Media, Fourth Edition, 2016.

SDI-E-208

Deep Learning

Aim: To introduce the fundamental theory and concepts of machine learning and artificial intelligence along with a comprehensive foundation to artificial neural networks, neuro-modeling, and their applications to pattern recognition.

Pre-requisite Knowledge: Neural Networks

Learning Outcomes: At the end of the course, the student will be able to :

- Explain the basic concepts of machine learning algorithms.
- Identify machine learning techniques suitable for given problem.
- Understand the differences between shallow neural networks and deep neural networks for supervised and unsupervised learning.
- Develop and train neural networks for classification, regression and clustering.
- Understand the foundations of neural networks, how to build neural networks and learn how to lead successful machine learning projects

Module-1 Introduction

Introduction to Deep Learning: history of deep learning, deep learning success stories, mcculloch pitts neuron, thresholding logic, perceptron’s, perceptron learning algorithm.

Module-2 Multi-Layer Network and Optimization Technique

Multilayer perceptron’s (mlps), representation power of mlps, sigmoid neurons, gradient descent, feed forward neural networks, representation power of feed forward neural networks feed forward neural networks, back propagation gradient descent (gd), momentum based gd, nesterov accelerated gd, stochastic gd, adagrad, rmsprop, adam, eigenvalues and eigenvectors, eigenvalue decomposition, basis.

Module-3 Dimension Reduction and Regularization

Principal component analysis and its interpretations, singular value decomposition auto encoders and relation to pca, regularization in auto encoders, denoising auto encoders, sparse auto encoders, contractive auto encoders regularization: bias variance tradeoff, l2 regularization, early stopping,

dataset augmentation, parameter sharing and tying, injecting noise at input, ensemble methods, dropout greedy layer wise pre-training, better activation functions, better weight initialization methods, batch normalization learning vectorial representations of words.

Module-4 Convolutional Neural Networks

Lenet, alexnet, zf-net, vggnet, googlenet, resnet, visualizing convolutional neural networks, guided back propagation, deep dream, deep art, fooling convolutional neural networks.

Module-5 Recurrent Neural Networks

Back propagation through time (bptt), vanishing and exploding gradients, truncated bptt, gru, lstms encoder decoder models, attention mechanism, attention over images.

Suggested Books:

5. J.Patterson, A.Gibson, Deep Learning, (1e), O'Reilly Publication, 2018.
6. Goodfellow I., Bengio Y, Deep Learning (Adaptive Computation and Machine Learning series), (1e), MIT Press, 2017.
7. Shai Shalev-Shwartz , Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, (3e), Cambridge University Press, 2015.

Aim: To provide the knowledge of industry 4.0, Collaborative Platform and Product.

Pre-requisite Knowledge: Basic IoT

Learning Outcomes: At the end of the course, the student will be able to :

- Understand Smart Factories, Cyber Physical Systems and Next Generation Sensors.
- Deal with industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication and IIoT Networking.
- Make use of knowledge of Factories and Assembly Line, Food Industry, Healthcare and Power Plants.

Module-1 Industry 4.0

Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories, Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product.

Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis. Cybersecurity in Industry 4.0.

Module-2 Basics of Industrial IoT

Industrial Processes, Industrial Sensing & Actuation, Industrial Internet Systems, IIoT- Introduction, Industrial IoT: Business Model and Reference Architecture: IIoT Business Models-Part I, Part II, IIoT Reference Architecture, Industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking.

Module-3 IIoT Analytics

Industrial IoT: Big Data Analytics and Software Defined Networks.

IIoT Analytics - Introduction, Machine Learning and Data Science, and Julia Programming, Data Management with Hadoop. Data Center Networks, Security and Fog Computing: Cloud Computing in IIoT.

Industrial IoT: Security and Fog Computing, Application Domains: Factories and Assembly Line, Food Industry, Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.

Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies.

Suggested Books:

1. Enterprise IoT Strategies and Best Practice for Connected Products and Services.
– Dirk Slama, Frank Puhmann, Jim Mirrish, Rishi M Bhatnagar
2. The Internet of Things: Key Applications and Protocols - David Boswarthick.
3. The Silent Intelligence, The Internet of Things. By – Daniel Kellmerit, Daniel Obodovski
4. “Industry 4.0: The Industrial Internet of Things”, by Alasdair Gilchrist (Apress)
5. “Industrial Internet of Things: CybermanufacturingSystems”by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer).

SDI-I-202 Instrumentation for Special Agriculture Applications

Aim: To acquire specific scripting knowledge to develop interactive applications, understand the basics of android application development and apply the programming skills in developing application pertaining to Industrial, medical, agricultural, etc.

Pre-requisite Knowledge: Measuring Instruments

Learning Outcomes: At the end of the course, the student will be able to :

- Implement mobile application using android SDK.
- Solve the need for smart systems in a distributed environment.
- Understand the IoT architecture and building blocks for various domains.
- Devise multidisciplinary case to case modelling and execute wide range of application.

Module-1 Review of Instrumentation

Historical perspective, Need of Instrumentation for Agriculture, Advantages of Instrumentation (Virtual), Define Virtual Instrumentation, block diagram & architecture of VI, data flow techniques, graphical programming in data flow, comparison with conventional programming.

Module-2 Programming Techniques

VIS & Sub VIS, loops & charts, arrays, clusters, graphs, case & sequence structures, formula modes, local and global variable, string & file input.

Module-3 Data Acquisition Basics for Agriculture

ADC, DAC, DIO, Counters & timers, PC Hardware structure, timing, interrupts, DMA, Software and Hardware Installation.

Module-4 Common Instrument Interfaces

Current loop, Rs 232C/Rs 485, GPIB, System basics, interface basics : USB, PCMCIA, VXI, SCXI, PXI etc, networking basics for office & industrial application VISA & IVI, image acquisition & processing, Motion control.ADC,DAC,D10,DMM,Waveform generator.

Module-5 Application in process control for Agriculture

Flow, Pressure, Temperature, Level control case study, Condition monitoring of pumps, data acquisition.

Suggested Books:

1. Gary Johnson, Labview Graphical Programming second edition, MC GrawHill,Newyork.
2. Lisa K. Wells &Jettrey Travis, Labview for everyone, Prentice Hall, New Jersey.
3. Sokoloff, Basic Concepts of Labview 4, Prentice Hall, New Jercy.
4. S. Gupta, J.P.Gupta, PC interfacing for Data Acquisition & process control, secondEdition, Instrument Society of America.

5. Technical manuals for DAS modules of national instruments L .T.amy Automation system for control & data acquisition

SDI-I-203 Artificial Intelligence for IoT Applications

Aim: To provide the knowledge of machine learning, artificial intelligence and development of applications for IoT

Pre-requisite Knowledge: IoT

Learning Outcomes: At the end of the course, the student will be able to :

- Understand Maximum margin hyperplan Kernel trick and Classifying wine using SVM, Naive Bayes.
- Use knowledge of RL and Deep reinforcement learning.
- Deal with Heart monitor, Digital assistants, IoT and smart homes.

Chapter 1: Machine Learning for IoT

ML and IoT, Learning paradigms, Prediction using linear regression, Electrical power output prediction using regression, Logistic regression for classification, Cross-entropy loss function, Classifying wine using logistic regressor, Classification using support vector machines, Maximum margin hyperplane

Kernel trick, Classifying wine using SVM, Naive Bayes, Gaussian Naive Bayes for wine quality

Decision trees, Decision trees in scikit, Decision trees in action

Chapter 2: Genetic Algorithms for IoT

Deterministic and analytic methods, Gradient descent method, Newton-Raphson method, Natural optimization methods, Simulated annealing, Particle Swarm Optimization, Genetic algorithms

Introduction to genetic algorithms, The genetic algorithm, Crossover, Mutation, Pros and cons, Advantages, Disadvantages, Coding genetic algorithms using Distributed Evolutionary, Algorithms in Python

Chapter 3: Reinforcement Learning for IoT

Introduction, RL terminology, Deep reinforcement learning, Some successful applications

Simulated environments, OpenAI gym, Q-learning, Taxi drop-off using Q-tables, Q-Network

Taxi drop-off using Q-Network, DQN to play an Atari game, Double DQN, Duelling DQN

Chapter 3: Generative Models for IoT

Introduction, Generating images using VAEs, VAEs in TensorFlow

GANs, Implementing vanilla GAN in Tensor Flow, Deep Convolutional GANs, Variants of GAN and its cool applications, Cycle GAN, Applications of GANs

Chapter 4: Distributed AI for IoT

Introduction, Spark components and its working, Apache MLlib, Regression in MLlib,

Classification in MLlib, Transfer learning using SparkDL, Introducing H2O.ai, H2O AutoML
Regression in H2O, Classification in H2O

Chapter 5: Personal and Home IoT

Personal IoT, SuperShoes by MIT, Continuous glucose monitoring, Hypoglycemia prediction using CGM data, Heart monitor, Digital assistants, IoT and smart homes, Human activity recognition, HAR using wearable sensors, HAR from videos

Chapter 6: AI for the Industrial IoT

Introduction to AI-powered Industrial IoT, Some interesting use cases, Predictive maintenance using AI, Predictive maintenance using Long Short-Term Memory, Predictive maintenance advantages and disadvantages

Chapter 7: AI for Smart Cities IoT

Components of a smart city, Smart traffic management, Smart parking, Smart waste management
Smart policing, Smart lighting, Smart governance, Adapting IoT for smart cities and the necessary steps, Challenges and benefits

Chapter 8: Combining It All Together

Processing different types of data, Time series modeling, Preprocessing textual data, Data augmentation for images, Handling videos files, Audio files as input data, Computing in cloud
AWS, Google Cloud platform, Microsoft Azure

M.TECH. IN DRONE AND UNMANNED AIRBORNE SYSTEM TECHNOLOGY

| | |
|----------------------|--|
| Programme: | M. Tech |
| Title: | Drone and Unmanned Airborne System Technology |
| Offered by: | Electronics and Communication Engineering Department |
| Supported by: | Mechanical Engineering Department |

Rationale:

Drone and Unmanned Airborne Systems (UAS) program is to prepare students for design, operations and development in the emerging unmanned systems field. As one of its kind programs in this growing field it focuses on the growth, innovative development, and effective use of unmanned system technology for real world applications. This program will provide students the knowledge and skills required to operate and design the drone and unmanned airborne systems (UAS). The students will be introduced to the various aspects of unmanned aviation operations, which include UAS system types and components, communication, networking and navigations, regulations and operational approvals of UAS. The students will gain knowledge in related topics such as industry trends, ground and flight systems, remote sensing, aerodynamics, human factors, safety and resource management. The emphasis will be on modelling, design, construction, 3-D prototyping, data analysis and evaluation of UAS. The program will provide the opportunity to the students to have industry exposure in the related field and develop industry oriented projects using advanced simulators and prototyping.

| | |
|-------------------------|---|
| Total credits: | 76 credits |
| Course Duration: | Two years |
| Eligibility: | B.E./B.Tech in ECE, CSE, Electrical, and Mechanical Engineering |

Salient features:

35. It is interdisciplinary program and admission is open to all engineering graduates.
36. Students will have the option to select some the courses offered through MOOCs.
37. Evaluation focuses more on formative evaluation to enable development of desired competencies.
38. In first and second semester, one of the electives being offered , is industry driven.

39. Project specific subject to be selected by the subject will be supervised and monitored by institute faculty.
40. In third semester, student will be attached to industry/NGO/Start up etc for hands on training on relevant echo system.
41. The program is designed to allow the students to spend one full year in field and explore the possibility of developing prototype.
42. Effective implementation of NEP-2020 is ensured by offering a number of multidisciplinary
43. To have better industry relevance, industry experts will be engaged to run industry relevant subjects.
44. To ensure attainment of program outcomes, emerging pedagogical approaches will be inbuilt in the teaching learning methodology.
45. Since the program is of interdisciplinary nature, bridge courses will be offered to meet the pre requisites of the program.

Program Outcomes:

At the end of the program, the students will be able to:

- Carryout independent research/investigation and development to solve complex engineering problems related to drone and unmanned airborne systems
- Apply engineering knowledge, techniques and modern tools to analyze problems in unmanned airborne systems
- Demonstrate excellence in prototyping technologies related to airborne vehicles and unmanned systems.
- Engage in lifelong learning adhering to professional, ethical, legal, safety, environmental and societal aspects for career excellence

Study and Evaluation Scheme

First Semester

| S No. | Course Code | Course Title | Contact hours per week | | | Credits | Evaluation Scheme | | Total |
|-------------------------------------|-------------|---|------------------------|---|---|-----------|-------------------|----------------|------------|
| | | | L | T | P | | Internal Marks | External Marks | |
| Programme Specific Core | | | | | | | | | |
| 1. | DUA-C-101 | Unmanned Airborne System (UAS) Communication and Networking | 4 | - | - | 4 | 60 | 40 | 100 |
| 2. | DUA-C-102 | Dynamics of Drones and Airborne Systems | 4 | - | - | 4 | 60 | 40 | 100 |
| Field/Industry Driven | | | | | | | | | |
| 3. | DUA-I-103 | Aerial Robotics | 3 | - | - | 3 | 60 | 40 | 100 |
| Inter-disciplinary Electives | | | | | | | | | |
| 4. | DUA-E-xxx | Elective 1 | 3 | - | - | 3 | 60 | 40 | 100 |
| 5. | DUA-E-xxx | Elective 2 | 3 | - | - | 3 | 60 | 40 | 100 |
| Laboratory | | | | | | | | | |
| 6. | DUA-P-106 | Simulation for Drone and UAS | - | - | 4 | 2 | 60 | 40 | 100 |
| 7. | DUA-P-107 | Internet of Things | - | - | 4 | 2 | 60 | 40 | 100 |
| Total | | | 25 | | | 21 | 420 | 280 | 700 |

Second Semester

| S No. | Course Code | Course Title | Contact hours per week | | | Credits | Evaluation Scheme | | Total |
|-------------------------------------|-------------|--|------------------------|---|---|-----------|-------------------|----------------|------------|
| | | | L | T | P | | Internal Marks | External Marks | |
| Programme Specific Core | | | | | | | | | |
| 1. | DUA-C-201 | Design and Operations of Drone and UAS | 4 | - | - | 4 | 60 | 40 | 100 |
| 2. | DUA-C-202 | Data Analysis and Computing for UAS | 4 | - | - | 4 | 60 | 40 | 100 |
| Field/Industry Driven | | | | | | | | | |
| 3. | DUA-I-203 | UAS Navigation Systems | 3 | - | - | 3 | 60 | 40 | 100 |
| Inter-disciplinary Electives | | | | | | | | | |
| 4. | DUA-E-xxx | Elective 3 | 3 | - | - | 3 | 60 | 40 | 100 |
| 5. | DUA-E-xxx | Elective 4 | 3 | - | - | 3 | 60 | 40 | 100 |
| Laboratory | | | | | | | | | |
| 6. | DUA-P-206 | 3D Printing and Drone Prototyping | - | - | 4 | 2 | 60 | 40 | 100 |
| 7. | DUA-P-207 | Artificial Intelligence | - | - | 4 | 2 | 60 | 40 | 100 |
| Total | | | 25 | | | 21 | 420 | 280 | 700 |

Third Semester

| S No. | Course Code | Course Title | Contact hours per week | | | Credits | Evaluation Scheme | | Total |
|--------------|-------------|--|------------------------|---|----|-----------|-------------------|----------------|------------|
| | | | L | T | P | | Internal Marks | External Marks | |
| 1 | DUA-C-301 | Research Methodology (MOOC Course) | 3 | - | - | 3 | 60 | 40 | 100 |
| 2 | DUA-C-302 | Self Study/ Project Specific Subject (MOOC Course) | 3 | - | - | 3 | 60 | 40 | 100 |
| 3 | DUA-P-303 | Monitored Live Lab | - | - | 20 | 10 | 100 | 100 | 200 |
| Total | | | 26 | | | 16 | 220 | 180 | 400 |

Fourth Semester

| S No. | Course Code | Course Title | Contact hours per week | | | Credits | Evaluation Scheme | | Total |
|--------------|-------------|--------------|------------------------|----------|-----------|-----------|-------------------|----------------|------------|
| | | | L | T | P | | Internal Marks | External Marks | |
| 1 | DUA-D-401 | Dissertation | - | - | 27 | 18 | 100 | 100 | 200 |
| Total | | | - | - | 27 | 18 | 100 | 100 | 200 |

Total Credits: 76

Total Marks: 2000

List of Electives

| ELECTIVE - 1 | | |
|---------------------|-----------|---------------------------------------|
| 1. | DUA-E-104 | Deep Learning Techniques |
| 2. | DUA-E-xxx | Advance Sensing Systems |
| 3. | DUA-E-xxx | Virtual Instrumentation and CAD Tools |

| ELECTIVE - 2 | | |
|---------------------|-----------|---|
| 1. | DUA-E-xxx | Artificial Intelligence |
| 2. | DUA-E-xxx | Mechanical Behaviour and Material Characterization for 3D/4D Printing |
| 3. | DUA-E-xxx | Immersive Technologies |

| ELECTIVE - 3 | | |
|---------------------|-----------|-------------------------------------|
| 1. | DUA-E-xxx | Robotic System Design and Modelling |
| 2. | DUA-E-xxx | Modelling for 3D/4D Printing |
| 3. | DUA-E-xxx | Cognitive Computation |

| ELECTIVE - 4 | | |
|---------------------|-----------|---------------------------------------|
| 1. | DUA-E-xxx | Security Management for Drone and UAS |
| 2. | DUA-E-xxx | Virtualisation and Cloud Computing |
| 3. | DUA-E-xxx | Mechatronics systems |

Detailed Syllabus

Course Title: Unmanned Airborne System (UAS) Communication and Networking
DUA-C-101

Aim: To introduce learners about latest communication and networking technologies for drone and UAS

Pre-requisite Knowledge: Communication and Networking

Course Outcomes: After the completion of the course, the student should be able to

- Explain the concepts of wireless networks for airborne systems.
- Comprehend the various routing protocols
- Apply communication techniques for drone & UAS system
- Design and analyze various antennas and radar technology

Detailed Contents:

Unit 1 - Wireless networks for aerial vehicle

Unmanned Aerial Vehicle Communication Networks (UAVCN), Adhoc UAV-ground network (AUGNet), Flying Ad hoc Networks (FANETs), UAVCN Design issues UAV-based networking architectures UAV-to-UAV (U2U) communication architectures, UAV-to-infrastructure (U2I) communication.

Unit 2 - Routing protocols for UAVCN

Node Mobility, Mobility Model, Radio Propagation Model, Routing Protocols: static, proactive like OLSR, DSDV, BABEL, Reactive protocols like DSR, AODV and hybrid-like zone routing protocol (ZRP), TORA, geographic 2-D dimension and 3-D dimension like greedy hull greedy (GHG) greedy random greedy (GRG), greedy distributed spanning tree routing (GDSTR).

Unit 3 - Radio Navigation

ADF, VOR/DME - Doppler - LORAN and Omega Approach, GLS - Ground controlled approach system - surveillance systems-radio altimeter.

Unit 4 - Aerial Wireless Communication

Aeronautical Radio Frequency Spectrum, Line of Sight and Beyond Line of Sight Communication, , issues - Manoeuvrability and Stability - Ground Control Station - UAV-mounted Base Station

(BS), Support / peripheral equipment - Mobility and Transportability - Channel modeling A2G channels.

Unit 5 – Antenna and Radar systems for UAV

Antenna Systems for UAS, Conformal Antenna Design, Doppler signatures of drones and signature extraction, Radar Cross Section for UAV

Suggested Books:

- Barnhart, R., Michael, M., Marshall, D., and Shappee, E. ed. 2016. *Introduction to Unmanned Aircraft Systems, 2nd edition*. Boca Raton. CRC Press. ISBN ISBN 978-1482263930.
- Fahlstrom, P. and Gleason, T. 2012. *Introduction to UAV Systems. 4th edition*. United Kingdom. John Wiley & Sons Ltd. ISBN: 9781119978664

Course Title: Dynamics of Drones and Airborne Systems

DUA-C-102

Aim: To introduce learners about dynamics of drones as Cyber Physical Systems and UAV aerodynamics

Pre-requisite Knowledge: Autonomous systems

Course Outcomes: After the completion of the course, the students will be able to :

- Explain the concepts of unmanned airborne systems.
- Comprehend the concepts of unmanned Aerial Vehicles
- Apply the knowledge about the regulatory framework related to drone & UAS system
- Design and analyze aerodynamics of UAS

Detailed Contents:

Unit 1 - UAS Technology

Drones and unmanned aerial vehicles (UAVs), Systematic Basis of UAS, Classification of drones, Emerging technologies being integrated into the drone market including semi-autonomous and autonomous systems, Operational and performance envelopes, Future Capabilities and commercial applications.

Unit 2– Drones as Cyber Physical System

CPS Concept Learning, Drone Cyber-Systems as CPS Component, Concepts of Spatial Information, Assembling of Drone, Specifications &Architecture, Electronic Speed Controller and Propeller Flight Controller.

Unit 3 – Unmanned Aerial Vehicles/Unmanned Airborne Systems (UAV/UAS).

UAS components, platforms, configurations, characteristics, on-board flight control, payloads, sensing communications, Power storage and Propulsion systems launch / recovery systems, ground control stations.

Unit 4 – Aerodynamics

Concepts of flight, Aerodynamic models, equation of motion, dynamics modelling, Path and trajectory planning: continuous path and interpolated motion, elementary idea of guidance and navigation. flight performance, stability and control.

Unit 5 -Regulatory Framework

Drone maintenance Specific aviation regulation, operational considerations liability / legal issues licensure, insurance, ethical implications.

Suggested Books:

- Jha, Theory, Design, and Applications of Unmanned Aerial Vehicles. CRC Press, 2016. 9781498715423
- Sebbane, Smart Autonomous Aircraft: Flight Control and Planning for UAV. CRC Press, 2015. 978- 1482299151
- Završnik, Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance. Springer, 2015. 978-3-319-23760-2
- Baichtal, Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs. Que Publishing, 2016. 978-0789755988.

Course Title: Aerial Robotics
DUA-I-103

Aim: To familiarize learners about the concepts of aerial robotics, its mechanics, planning and control

Pre-requisite Knowledge: Dynamics of Drones and Airborne Systems

Course Outcomes: After the completion of the course, the students will be able to :

- Explain the concepts of aerial robotics.
- Comprehend the mechanics and geometry of unmanned Aerial Vehicles.
- Apply the knowledge about control and trajectories of drone & UAS system.
- Design and analyze various aerial drones.

Detailed Contents:

Unit 1 Introduction to Aerial Robotics

Types of Unmanned Aerial Vehicles- Fixed wings, Flapping Wings, Rotor Craft, Quadrotors, Key Components of Autonomous Flight, State Estimation, Basic Mechanics, Dynamics and 1-D Linear Control, Design Considerations, Component Selection, Effects of Size

Unit 2 Geometry and Mechanics

Transformations, Rotations, Euler Angles, Axis/Angle Representations for Rotations, Angular Velocity, Formulation, Newton-Euler Equations, Principal Axes and Principal Moments of Inertia, Quadrotor Equations of Motion

Unit 3 Planning and Control

2-D Quadrotor Control, 3-D Quadrotor Control, Time, Motion, and Trajectories, Motion Planning for Quadrotors, Minimum Velocity Trajectories from the Euler-Lagrange Equations, Linearization of Quadrotor Equations of Motion

Unit 4 Advanced Topics

Sensing and Estimation, Nonlinear Control, Control of Multiple UAS, Structure Assembly

Suggested books

- Christensen H.I., Hager G.D., “Sensing and Estimation”, Springer Handbook of Robotics. Springer Handbooks. Springer, 2016
- Anibal Ollero, Bruno Siciliano, “Aerial Robotic Manipulation Research, Development and Applications”, Springer Nature Switzerland , 2019

Course Title: Design and Operations of Drone and UAS
DUA-C-201

Aim: To familiarize learners about the design concepts and operations of various sub system of Drone and UAS.

Pre-requisite Knowledge: Dynamics of Drones and Airborne Systems

Course Outcomes: After the completion of the course, the students will be able to :

- Explain the concepts and design issues of UAS.
- Comprehend the safety and QoS issues of unmanned Aerial Vehicles.
- Use the knowledge of various operations related to drone and UAS system.
- Design and analyze various subsystems of Drones.

Detailed Contents:

Unit 1 - Design Concepts of UAS

Architecture, computer aided design, engineering drawings, structural concepts, metallic and composite materials, aircraft loads and stresses, aerodynamics, and Budgeting.

Unit 2–Design Issues of Sub-Systems

Design and analysis of various sub-systems like fuel, ignition, electric power distribution, digital data, instrumentation, hydraulic, pneumatic, environmental and flight control, System Complexity.

Unit 3–Multirotor Design

Design components in a multirotor system, principle of flight, types of payload, payload installation and utilization

Unit 4–UAS Operations

Pre-flight checks and start-up, preparation cum coordination for flight, take-off and flight stage, post-flight checks, fault finding and rectification, various operational scenarios

Unit 5 - Safety and QoS Issues

Regulations and operational approvals, safety considerations, safety management system, ethics and UAS, ethical decision making and its relationship to safety, quality of service issues.

Suggested Books:

- Austin, Unmanned Aircraft Systems: UAVS Design, Development and Deployment. Wiley, 2010. 978-0-470-05819-0
- Jha, Theory, Design, and Applications of Unmanned Aerial Vehicles. CRC Press, 2016. 9781498715423
- Završnik, Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance. Springer, 2015. 978-3-319-23760-2
- Baichtal, Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs. Que Publishing, 2016. 978-0789755988.
- Elliott, Build Your Own Drone Manual: The practical guide to safely building, operating and maintaining an Unmanned Aerial Vehicle (UAV), Haynes Publishing UK, 2016, 978-0857338136

Course Title: Data Analysis and Computing for UAS
DUA-C-202

Aim: To familiarize learners about the computational tools for data analysis for Drone and UAS.

Pre-requisite Knowledge: Data Analytics

Course Outcomes: After the completion of the course, the students should be able to

- Apply appropriate tools for data acquisition
- Process the acquired data employing various analytical techniques.
- Use various data visualization techniques.
- Analyze various data security issues.

Detailed Contents:

Unit 1 - Data Collection

Data acquisition and handling sensors and systems, types of sensor mounting and control, airborne and ground telemetry system, flight data testing, softwares for data collection.

Unit 2 – Data Processing

Tools for wrangling and cleaning data, Types of the results and their usage, human-data interaction, Post-flight data processing

Unit 3 – Data Analysis

Statistical Analysis, tools to identify patterns, trends, and correlations in data, natural language content analysis, forecasting, systems life cycle analysis

Unit 4 - Visualizing Data

Visualization of Numerical Data, Visualization of Non-Numerical Data, Text Access, Text Retrieval Problem, Text Retrieval Methods

Unit 5 - Data Security Issues

Encryption techniques, cloud data security & management, resource handling platforms, data rights, ethical issues in data governance.

Suggested Books:

- Neeraj Kumar Singh, Porselvan Muthukrishnan, Satyanarayana Sanpini, Industrial System Engineering for Drones: A Guide with Best Practices for Designing, July 2019, Apress; 1st edition, 978-1484235331
- K. Kim, Y. M. Park and C. Seon Hong, Machine Learning Based Edge-Assisted UAV Computation Offloading for Data Analyzing, 2020 International Conference on Information Networking (ICOIN), Barcelona, Spain, 2020, pp. 117-120, doi: 10.1109/ICOIN48656.2020.9016432.
- Dimosthenis C. Tsouros, Anna Triantafyllou, Stamatia Bibi, Panagiotis G. Sarigannidis, Data acquisition and analysis methods in UAVbased applications for Precision Agriculture, May 2019, DOI: 10.1109/DCOSS.2019.00080

Course Title: UAS Navigation Systems
DUA-I-203

Aim: To familiarize learners about the UAS path planning and navigation techniques.

Pre-requisite Knowledge: Communication and Networking

Course Outcomes: After the completion of the course, the students will be able to :

- Explain various navigation and position systems suitable for UAS.
- Comprehend the various Trajectory Planning & Tracking.
- Explain the working of Navigation Sensors.
- Analyze various collision avoidance techniques.

Detailed Contents

Unit 1 Inertial Navigation System

Fixed and Moving Frames, World Geodetic System, Inertial Navigation System-Fundamentals, Navigation Equations, Navigation Basic Calculations, Geodetic Coordinates Calculations

Unit 2 Positioning System

Ground Speed Versus Airspeed, and velocity determination-signal structure, GNSS, GIS, Introduction to Kalman filtering-Estimation, Position Fixing Navigation - Map Reading, Celestial Navigation, Navigation in Reduced Visibility Conditions

Unit 3 Inertial Navigation Sensors and Navigation Disturbances

Accelerometer, Gyroscope, Airspeed Sensor, Altitude Sensor, Radar Altimeter, Mechanical Altimeter, Pressure Sensor, Clock/Timer, Compass, Magnetometer, MEMS Inertial Module, Transponder, Wind, Gust and Disturbance Measurement Noise, Drift, Drift Due to Rotation of Rotor/Propeller, Drift Due to Wind, Coriolis Effect, Magnetic Deviation,

Unit 4 Trajectory Planning & Tracking

Navigation System Design Requirements, Design Flowchart, Design Guidelines, Quadrotor Mathematical Description, Time-Optimal Trajectory Generation, Trajectory Tracking Problem

Unit 5 Obstacle Avoidance

Artificial Potential Field Method, Obstacle Avoidance Algorithm- Geometric Method, Force Field Method, Limit-Cycle Obstacle Avoidance

Suggested Books

- Pedro Castillo-Garcia, Laura Munoz Hernandez, Pedro Gil, “Indoor Navigation Strategies for Aerial Autonomous Systems”, Butterworth-Heinemann, 1st Edition, 2016
- Jung-Sup Um, “Drones as Cyber-Physical Systems Concepts and Applications for the Fourth Industrial Revolution”, Springer Nature Singapore Pte Ltd., 2019
- Dr. Mohammad H. Sadraey, “Design of Unmanned Aerial Systems”, NavigationSystem design- Chapter8, pp. 306-347, John Wiley and Sons, Ltd, 2020

Elective Subjects

Course Title: Deep Learning Techniques
DUA-E-104

Aim: To familiarize learners about the deep learning models.

Detailed Contents:

Deep Neural Networks: Difficulty of training deep neural networks, Greedy layerwise training; Better Training of Neural Networks: Newer optimization methods for neural networks, second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization); Convolutional Neural Networks: LENet, ALEXNet, ZF-Net, VGGNet, GOOGLNet, RESNet, visualizing convolutional neural networks, guided back propagation, deep dream, deep art, fooling convolutional neural networks; Recurrent Neural Networks: Back propagation through time (BPTT), vanishing and exploding gradients, truncated BPTT, GRU, LSTMS encoder decoder models, attention mechanism, attention over images; Recent trends: Variational Auto-encoders, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning; Applications: Vision, NLP, Speech

Suggested Books:

8. J. Patterson, A.Gibson, Deep Learning, (1e), O'Reilly Publication, 2018.
9. Goodfellow I., Bengio Y, Deep Learning (Adaptive Computation and Machine Learning series), (1e), MIT Press, 2017.
10. Shai Shalev-Shwartz, Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, (3e), Cambridge University Press, 2015.

Course Title: Advance Sensing Systems

DUA-E-xxx

Aim: To familiarize learners about the sensors and their interface.

Detailed Contents:

Transducers and Sensors: Mechanical and Electromechanical Sensors, Sensitivity and Linearity of the Sensor, Sensor selection and its calibration techniques; Signal Conditioning, Data Acquisition Systems and Conversion; Smart Sensors Interface, Automation, Sensors Applications, Health monitoring sensors, Industrial sensors; Actuators: Mechanical Actuation Systems, Electrical Actuation Systems, Solid-state switches, Solenoids, D.C. Motors, A.C. Motors, Stepper motors.

Suggested Books:

1. D. Patranabis, “Sensors and Transducers”, PHI Learning Private Limited.
2. W. Bolton, “Mechatronics”, Pearson Education Limited.
3. Transducers & Instrumentation, Rangan Mani Sharma.

Course Title: Virtual Instrumentation and CAD Tools

DUA-E-xxx

Aim: To familiarize learners about the various tools related to virtual instrumentation.

Detailed Contents:

Virtual Instrumentation: Historical perspective, Block diagram and Architecture of Virtual Instruments; Data-flow Techniques: Graphical programming in data flow, Comparison with conventional programming; Programming Techniques: VIs and sub-VIs, Loops and Charts, Arrays, Clusters and graphs, Case and sequence structures, Formula nodes, Local and global variables, Strings and file I/O; Data Acquisition; Instrumentation Interfaces; Analysis Tools, CAD Tools, LabVIEW.

Suggested Books:

5. Johnson, G., LabVIEW Graphical Programming, McGraw-Hill.
6. Sokoloff, L., Basic Concepts of LabVIEW 4, Prentice Hall Inc..
7. Wells, L.K. and Travis, J., LabVIEW for Everyone, Prentice Hall Inc.

Course Title: Artificial Intelligence

DUA-E-xxx

Aim: To familiarize learners about the principles of machine learning, algorithms which underpin many popular learning techniques, as well as support developing an understanding of the theoretical relationships between these algorithms.

Detailed Contents:

Automated Reasoning: knowledge representation and reasoning, representing and reasoning about objects, relations, events, actions, time, and space; predicate logic, situation calculus, description logics, - Logic - Propositional and predicate logic - Syntax - Informal and formal semantics; Uncertain Knowledge - Bayesian networks; Basics of decision theory, sequential decision problems, elementary game theory; Problem-solving through Search - forward and backward, state-space, blind, Introduction to intelligent agents; Machine Learning - Foundations of supervised learning - Decision trees and inductive bias, Linear Regression, Logistic Regression. Generalisation, Training, Validation and Testing, Problem of Overfitting, Bias vs Variance, Confusion Matrix, Precision, Recall, F Measure, Support Vector Machine, Perceptron, Beyond binary classification, Boosting and bagging, bootstrapping - Advanced supervised learning - K-Nearest Neighbour, Markov model, Hidden Markov Model - Nearest Neighbor, Classification - Gaussian processes - Unsupervised Learning - Dimensionality Reduction Techniques, Linear Discriminant Analysis - Clustering: K-means, Hierarchical, Spectral, subspace clustering, association rule mining.

Suggested Books:

1. Russell, Norvig, Artificial Intelligence: A Modern Approach, Third edition, Prentice Hall, 2010
2. Hastie, Tibshirani, Friedman. The elements of statistical learning, Second edition, Springer, 2009

Course Title: Mechanical Behaviour and Material Characterization for 3D/4D Printing
DUA-E-xxx

Aim: To familiarize learners about the importance and methodology of the material characterization as well as principle and operation of characterization equipment's.

Detailed Contents:

Fatigue and Fracture Mechanics: High and low cycle fatigue, process of fatigue fracture, effect of mean stress, Cyclic stress/strain response of materials, establishment of cyclic stress/ strain curve, transition fatigue life, Coffin-Manson relationship, Evaluation of parameters, characterizing resistance against high cycle and Low cycle fatigue, Creep fatigue interaction, environmental effects, thermochemical fatigue; Fracture Mechanics: Brief review of the basic concepts of linear elastic and elastic-plastic fracture mechanics, stress intensity parameter, J-integral and crack tip opening displacement as fracture criteria, standard procedures for experimental determination of these parameters; System Drives, Part Programming: Failure analysis: Analyzing Fractures, Micro mechanisms of brittle and ductile fracture, fracture mechanism maps, fractography, Visual Examination & Management of Applied Failure Analysis, Manage Failure Analysis; Materials characterization techniques: Optical microscopy techniques, Quantitative metallography, Scanning electron microscopy: Image formation methods in SEM. Applications; AM Machines: Atomic Force Microscopy (AFM) - basic principles, instrumentation, operational modes, Applications, Limitations

Suggested Books:

1. ASM Handbook: Materials Characterization, ASM International, 2008.
2. Yang Leng: Materials Characterization-Introduction to Microscopic and Spectroscopic Methods, John Wiley & Sons (Asia) Pte Ltd., 2008.
3. M.F Ashby and David R H Jones : Engineering Materials I : Introduction to Properties, Applications and Design,2010.
4. Richard W. Hertzberg, Richard P. Vinci, Jason L. Hertzberg, Deformation and Fracture Mechanics of Engineering Materials, 5th Edition, Wiley, 2012.

Course Title: Immersive Technologies
DUA-E-xxx

Aim: To familiarize learners about the strengths and limitations of virtual reality and immersive technologies.

Detailed Contents:

Immersive Technology - Augmented Reality and Mixed Reality; Hardware and Software of Immersive Technology; Applications of Immersive Technology; Case Studies

Suggested Books:

- Cai, Y. (Ed.). (2013). 3D immersive and interactive learning. New York: Springer.
- Code, J., Clarke-Midura, J., Zap, N., & Dede, C. (2012). Virtual performance assessment in immersive virtual environments. In *Interactivity in e-learning: Case studies and frameworks* (pp. 230-252). IGI Global.
- Gregory, S., Reiners, T., & Tynan, B. (2010). Alternative realities: Immersive learning for and with students. In *Distance learning technology, current instruction, and the future of education: Applications of today, practices of tomorrow* (pp. 245-272). IGI Global.
- Zheng, R. Z., & Greenberg, K. (2020). Immersive Technology: Past, Present, and Future in Education. In *Cognitive and Affective Perspectives on Immersive Technology in Education* (pp. 107-126). IGI Global.
- Metcalf, S. J., Kamarainen, A. M., Grotzer, T., & Dede, C. (2013). Teacher perceptions of the practicality and effectiveness of immersive ecological simulations as classroom curricula. *International Journal of Virtual and Personal Learning Environments (IJVPLE)*, 4(3), 66-77.

Course Title: Modelling for 3D/4D Printing

DUA-E-xxx

Aim: To familiarize learners about the methodological basis of the 3 D modeling, geometric transformations, part orientation and its algorithm as well as the main theoretical and practical aspects of these topics.

Detailed Contents:

Conceptual Design: Design Theories, develop a concept, implement a concept, creative methods for design, CAD input devices, CAD output devices, CAD Software, Display Visualization Aids, and Requirements of Geometric Modelling, Transformations of Geometry, Developing algorithms/computer codes for transformations; Design of Curves: Hermite Cubic segments, Curve Trimming and Blending, Bezier segments, Bezier- subdivision, Degree elevation, Composite Bezier, B-spline, Properties of basic functions, Continuity, NURBS, Developing algorithms/computer codes for curves; Design of Surfaces and Solids; CAD Data Exchange Formats and Applications: CAD Data exchange formats, Finite element analysis, 3D digitizing: Reengineering; AM Data Formatting and Processing; AM Data Processing; Modelling of AM Process.

Suggested Books:

1. Zeid,Ibrahim. CAD/CAM Theory and Practice. TMH, 2019
2. Rogers, F; Adams, A. Mathematical Elements for Computer Graphics, TMH, 2008.
3. Chua Chee Kai, Leong Kah Fai, “3D Printing and Additive Manufacturing: Principles & Applications”, 4th Edition, World Scientific, 2015.

Course Title: Cognitive Computation

DUA-E-xxx

Aim: To familiarize learners about various cognitive computation techniques

Detailed Contents:

Basic tools for analyzing experimental data, interpreting statistical reports, reasoning under uncertain situations. Axioms of probability, discrete and continuous probability models, law of large numbers, and the Central Limit Theorem. Estimation, likelihood theory, Bayesian methods, bootstrap, Monte Carlo methods, hypothesis testing, confidence intervals, elementary design of experiments, goodness-of-fit. Simple regression model and the analysis of variance.

Suggested books:

1. Pylyshyn, Z. W. *Computation and cognition* (p. 41). Cambridge, MA: MIT press.
2. Bishop, J. M. A cognitive computation fallacy Cognition, computations and panpsychism. *Cognitive Computation*, 1(3), 221-233.

Course Title: Virtualization and Cloud Computing

DUA-E-xxx

Aim: To familiarize learners about various virtualization and cloud computing techniques

Detailed Contents:

Recent Trends in Computing: Distributed Computing, Cluster Computing, Grid Computing, Utility Computing, Cloud Computing. Evolution of Cloud Computing: Migrating into a Cloud; Cloud Computing Characteristics; Applications; Benefits; Limitations; Challenges, SOA; Cloud Computing Service Models: Infrastructure as a Service; Platform as a Service; Software as a Service. Cloud Computing Deployment Models: Private Cloud; Public Cloud; Community Cloud; Hybrid Cloud, Major Cloud Service providers. Types of Virtualization, Benefits of Virtualization, Hypervisors; VM Provisioning & Migration: VM Lifecycle, VM Provisioning Process, VM Migration Techniques; Scheduling in Cloud: Scheduling problem, Different types of scheduling, Scheduling for independent and dependent tasks, Static vs. Dynamic scheduling, Optimization techniques for scheduling; Cloud Storage: Storage as a Service, Benefits and Challenges, Storage Area Networks(SANs), Case Study of Amazon S3;Cloud Security: Infrastructure Security: Network Level Security, Host Level Security and Application Level Security, Data Security: Data Security & Privacy Issues; Identity & Access Management; Legal Issues in Cloud Computing; Mobile Cloud Computing:Overview of Mobile Cloud Computing, Advantages, Challenges, Using Smartphones with the Cloud, Offloading techniques - their pros and cons, Mobile Cloud Security.

Suggested Books:

6. Rajkumar Buyya, James Broberg, Andrzej Goscinski (Editors): Cloud Computing: Principles and Paradigms, Wiley.
7. Barrie Sosinsky: Cloud Computing Bible, Wiley.
8. Anthony T. Velte, Toby J. Velte, and Robert Elsenpeter: Cloud Computing: A Practical Approach, McGraw Hill, 2010.
9. Judith Hurwitz, Robin Bloor, Marcia Kaufman,Fern Halper: Cloud Computing for Dummies, Wiley.
10. Borko Furht, Armando Escalante (Editors): Handbook of Cloud Computing, Springer.

Course Title: Mechatronics Systems

DUA-E-xxx

Aim: To familiarize learners about basic skills useful in identifying the concepts of automated machines and equipment and describe the terms and phrases associated with mechatronics.

Detailed Contents:

Mechatronics & its Elements, Mechatronics Design Process, Integrated Design Issues in Mechatronics, Applications of Mechatronics; Modeling & Simulation of Physical Systems: Mathematical modeling of physical systems, Dynamic response of first and second order systems, System transfer functions, Block Diagram Approach, State Space Approach; Actuators: Fluid power control elements and standard graphical symbols, Directional, Pressure and Flow Control Valves – Construction and Working, Basic fluid power circuits, Mechanical & Solid state switches, AC and DC motors, Stepper motors; Control Theory: Introduction to Open Loop & Closed Loop Control, Transient & Steady state performance characteristics, Frequency response, PID Controllers & their Tuning, Adaptive Control; Data Acquisition: Sensors, Operational amplifier, Protection and filtering, Digital signals, Data acquisition systems; Mechatronics System Design: Traditional & Mechatronics Design, Possible Mechatronics Design Solutions, Digital logic, Programmable logic controllers, Microcontrollers, Simple Logic Circuits using PLC and microcontroller.

Suggested Books:

1. David G. Alciatore, Michael B. Hiestand, “Introduction to Mechatronics and Measurement Systems”, Tata McGraw Hill, 4th Edition, 2014
2. W Bolton, “Mechatronics: A Multidisciplinary Approach”, Pearson Education, 4th Edition, 2014
3. S R Majumdar, “Pneumatic Systems”, Tata McGraw Hill, New Delhi, 2008.
4. S R Majumdar, “Oil Hydraulic Systems”, Tata McGraw Hill, New Delhi, 2010
5. Groover M. P., “Automation, Production Systems and Computer Aided Manufacturing”, Pearson Education, New Delhi, 2015.

M.TECH. IN IIOT AND INDUSTRIAL ROBOTICS

| | |
|----------------------|---|
| Title of the program | Master of Engineering in IIoT and Industrial Robotics |
| Rationale | Industry 4.0 is a quantum leap in automation, requiring major technological changes in the industry. Smart sensors, intelligent robots & machines, artificial intelligence and IoT are changing the very way of working of the industry. In this scenario, Indian industry needs technical manpower having interdisciplinary knowledge and skills, which can drive innovation and technical advancements for the Indian industry to remain competitive globally. The proposed Master of Engineering program in IIoT and Industrial Robotics will enable the students to gain deep insights into the technologies of Industrial IoT and Industrial Robotics which form the backbone of smart manufacturing. The students will understand the opportunities and challenges brought about by Industry 4.0 and will be prepared to reap its benefits for our nation. |
| Total Credits: | 76 |
| Eligibility | B.E. / B.Tech. or Equivalent |
| Salient Features | <ul style="list-style-type: none"> • It is interdisciplinary program and admission is open to all engineering graduates. • Students will have the option to select some the courses offered through MOOCs. • Evaluation focuses more on formative evaluation to enable development of desired competencies. • In first and second semesters, one of the electives being offered is industry driven. • Project specific subject to be selected by the subject will be supervised and monitored by institute faculty. • In third semester, student will be attached to industry/NGO/Start up etc. for hands on training on relevant echo system. • The program is designed to allow the students to spend one full year in field and explore the possibility of developing prototype. • Effective implementation of NEP-2020 is ensured by offering a number of multidisciplinary |

| | |
|--|--|
| | <ul style="list-style-type: none">• To have better industry relevance, industry experts will be engaged to run industry relevant subjects.• To ensure attainment of program outcomes, emerging pedagogical approaches will be inbuilt in the teaching learning methodology.• Since the program is of interdisciplinary nature, bridge courses will be offered to meet the pre requisites of the program. |
|--|--|

Study and Evaluation Scheme:

First Semester

| S. No. | Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|--|-------------|--|--------------------|---------|----------------|----------------|-------|
| Programme Specific Core | | | | | | | |
| 29. | IIR-C-101 | Industrial IoT | 4-0-0 | 4 | 60 | 40 | 100 |
| 30. | IIR-C-102 | Robotic System Design and Modeling | 4-0-0 | 4 | 60 | 40 | 100 |
| Interdisciplinary / Industry Oriented Electives | | | | | | | |
| 31. | | Elective 1 | 3-0-0 | 3 | 60 | 40 | 100 |
| 32. | | Elective 2 | 3-0-0 | 3 | 60 | 40 | 100 |
| 33. | | Elective 3 | 3-0-0 | 3 | 60 | 40 | 100 |
| Laboratory Courses | | | | | | | |
| 34. | IIR-P-101 | Internet of Things Lab (Common to all M.Tech Programmes) | 0-0-4 | 2 | 60 | 40 | 100 |
| 35. | IIR-P-102 | Industrial IoT Laboratory | 0-0-4 | 2 | 60 | 40 | 100 |
| Total | | | 25 | 21 | 420 | 280 | 700 |

Second Semester

| S. No. | Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|--|-------------|---|--------------------|---------|----------------|----------------|-------|
| Programme Specific Core | | | | | | | |
| 29. | IIR-C-201 | Sensing, Communication and Networking | 4-0-0 | 4 | 60 | 40 | 100 |
| 30. | IIR-C-202 | Robot Control and Programming | 4-0-0 | 4 | 60 | 40 | 100 |
| Interdisciplinary / Industry Oriented Electives | | | | | | | |
| 31. | | Elective 4 | 3-0-0 | 3 | 60 | 40 | 100 |
| 32. | | Elective 5 | 3-0-0 | 3 | 60 | 40 | 100 |
| 33. | | Elective 6 | 3-0-0 | 3 | 60 | 40 | 100 |
| Laboratory Courses | | | | | | | |
| 34. | IIR-P-201 | Artificial Intelligence Lab (Common to all M.Tech Programmes) | 0-0-4 | 2 | 60 | 40 | 100 |
| 35. | IIR-P-202 | Robotics Laboratory | 0-0-4 | 2 | 60 | 40 | 100 |
| Total | | | 25 | 21 | 420 | 280 | 700 |

Third Semester

| S. No. | Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|--------------|-------------|--|--------------------|---------|----------------|----------------|-------|
| 5. | IIR-C-301 | MOOC Course 1 – Research Methodology | 4-0-0 | 3 | 60 | 40 | 100 |
| 2. | | MOOC Course 2 – Project Specific Subject | 4-0-0 | 3 | 60 | 40 | 100 |
| 3. | IIR-P-301 | Live Lab | 0-0-20 | 10 | 100 | 100 | 200 |
| Total | | | 28 | 16 | 220 | 180 | 400 |

Fourth Semester

| S. No. | Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|--------------|-------------|--------------|--------------------|---------|----------------|----------------|-------|
| 1. | IIR-D-401 | Thesis Work | 0-0-36 | 18 | 100 | 100 | 200 |
| Total | | | - | 18 | 100 | 100 | 200 |

Total Credits: 76

Total Marks: 2000

LIST OF ELECTIVES - M.E. Industrial IoT and Industrial Robotics

| CODE | SUBJECT | Credits |
|---|---|---------|
| ELECTIVE SUBJECT – 1 | | |
| IIR-E-101 | Machine Learning | 3 |
| IIR-E-102 | Expert Systems | 3 |
| SDI-C-105 | Virtualization and Cloud Computing | 3 |
| ELECTIVE SUBJECT – 2 | | |
| IIR-E-103 | Data Analytics | 3 |
| SDI-E-109 | IoT Application Development | 3 |
| DGD-E-103 | GPU Programming | 3 |
| ELECTIVE SUBJECT – 3 | | |
| IIR-E-104 | Cyber Physical Systems | 3 |
| SDI-C-201 | IoT Security and Trust | 3 |
| SDI-E-104 | Data Warehousing and Mining | 3 |
| ELECTIVE SUBJECT – 4 | | |
| PI-EC107 | Digital Manufacturing | 3 |
| PI-C102 | 3D/4D Printing Processes | 3 |
| IIR-E-201 | Mechanism Design & Analysis | 3 |
| ELECTIVE SUBJECT – 5 | | |
| IIR-E-202 | Computer Vision | 3 |
| IIR-E-203 | System Integration & Packaging | 3 |
| IIR-E-204 | Industrial Safety Engineering | 3 |
| ELECTIVE SUBJECT – 6 | | |
| IIR-E-205 | Robot Motion Planning | 3 |
| IIR-E-206 | Machinery Fault Diagnosis And Signal Processing | 3 |
| IIR-E-207 | Manufacturing Systems Technology | 3 |
| MOOCs/Self-Study Course – Project Specific Subject | | |
| DGD-E-203 | Deep Learning | 3 |
| IIR-E-301 | IoT for Agricultural Applications | 3 |
| SDI-E-203 | Power Management for IoT Devices | 3 |

IIR-C-101: INDUSTRIAL IoT

Maximum marks: 50

L P

Time Allowed: 3 hours

4 --

OBJECTIVE

This course is designed to enable students to create specialized, advanced unique IOT products and solutions for Industrial Applications, Home Automation, Building Security and Assisted Living use cases from scratch all the way to the market. The course touches all the necessary software, hardware platforms, protocols, everything in between to the point it is required.

PRE REQUISITE KNOWLEDGE

- Basic knowledge of business operation, devices, electronics systems and data systems
- Basic understanding of software and systems
- Basic understanding of Statistics

COURSE / LEARNING OUTCOMES

After the completion of this course, the students will be able to

- Design, Code and Build IOT products.
- Work with Micro controllers (Arduino Uno, Nano, NodeMCU), Sensors, Relays, Displays, Keypads, work with mains (220V) etc.
- Code using Arduino IDE from basics
- Use Ethernet and Wifi shields
- Connect to cloud IOT Platforms, Persist Data, Program Triggers and more
- Build IOT products

DETAILED CONTENTS

Module-1 Introduction to IoT

Introduction to IoT, Sensing, Actuation, Basics of Networking, Communication Protocols, Sensor Networks, Machine to Machine Communications. Understanding of the IoT ecosystem, various layers in building an IoT application and interdependencies.

Module-2 Interoperability in IoT

Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino, Introduction to Python programming. Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi. Build use cases using Raspberry Pi.

Module-3 SDN for IoT

Introduction to SDN, SDN for IoT, Data Aggregation, Handling and Analytics, Cloud Computing, Sensors, Fog Computing, Understanding of the various protocols being used in IoT like MQTT, AMQP, REST API.

Module-4 Components of Industrial IoT

Industrial Processes, Industrial Sensing & Actuation, Industrial Internet Systems, IIoT-Introduction, Industrial IoT: Business Model and Reference Architecture: IIoT Business Models-Part I, Part II, IIoT Reference Architecture, Industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking.

Module-5 IIoT Analytics

Industrial IoT: Big Data Analytics and Software Defined Networks.

IIoT Analytics - Introduction, Machine Learning and Data Science, and Julia Programming, Data Management with Hadoop. Data Center Networks, Security and Fog Computing: Cloud Computing in IIoT.

Industrial IoT: Security and Fog Computing, Application Domains: Factories and Assembly Line, Food Industry, Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.

Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies.

Suggested Books:

5. David Etter, "IoT (Internet of Things) Programming: A Simple and Fast Way of Learning IoT," Kindle Edition.
6. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, and David Boyle, "From Machine to Machine to the Internet of Things: Introduction to a New Age of Intelligence," Elsevier Science Publishing Co. Inc, 2014.
7. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases," 1st Edition, Auerbach Publications, 2017.

IIR-C-102: ROBOTIC SYSTEM DESIGN AND MODELING

Maximum marks: 50

L P

Time Allowed: 3 hours

4 --

OBJECTIVE

The objective of this course is to impart knowledge about industrial robots for their design, modeling and simulation.

PRE REQUISITE KNOWLEDGE

- Engineering Mathematics
- Engineering Mechanics
- Basic Electronics
- Basic Programming

COURSE / LEARNING OUTCOMES

After the completion of this course, the students will be able to :

- Perform kinematic and dynamic analysis with simulation.
- Design control laws for a robot.
- Integrate mechanical and electrical hardware for prototyping a robotic manipulator.
- Select a robotic system for given application.

DETAILED CONTENTS

1. Introduction to Robotics & MATLAB

- 1.1. Robot Subsystems & Configurations
- 1.2. Joints & Links
- 1.3. Robot End-Effectors
- 1.4. Sensors & Actuators
- 1.5. Functional Requirements of Robots
- 1.6. Industrial Applications of Robots
- 1.7. MATLAB Basics
- 1.8. Matrix Creation & Manipulation in MATLAB
- 1.9. Programming in MATLAB
- 1.10. Plotting in MATLAB

2. Robot Kinematics

- 2.1. Pose of a Rigid Body
- 2.2. Homogeneous Transformations Matrices
- 2.3. Denavit and Hartenberg (DH) Parameters
- 2.4. Forward Position Analysis
- 2.5. Inverse Position Analysis
- 2.6. Velocity Analysis: The Jacobian Matrix
- 2.7. Jacobian Computations
- 2.8. Forward and Inverse Velocity Analysis
- 2.9. Acceleration Analysis
- 2.10. Design Project: Modeling of 3-DOF Robot Kinematics in MATLAB

3. Robot Dynamics

- 3.1. Force and Moments Balance
- 3.2. Equivalent Joint Torques
- 3.3. Role of Jacobian in Statics
- 3.4. Inertia Properties
- 3.5. Euler-Lagrange Formulation
- 3.6. Newton-Euler Formulation
- 3.7. Recursive Newton-Euler Algorithm
- 3.8. Dynamic Equations for Multiple-DOF Robots
- 3.9. Solving Differential Equations in MATLAB
- 3.10. Design Project: Modeling & Simulation of 3-DOF Robot Manipulator in MATLAB

4. Robot Trajectory Planning

- 4.1. Path versus Trajectory
- 4.2. Basics of Trajectory Planning
- 4.3. Joint Space Trajectory Planning
- 4.4. Cartesian Space Trajectory Planning
- 4.5. Point-to-Point vs. Continuous Path Planning
- 4.6. Design Project: Trajectory Planning of 3-DOF Robot in MATLAB

5. Robot Sensors

- 5.1. Role of Sensors in Robotic system
- 5.2. Internal and External Sensors
- 5.3. Proximity Sensors of various types
- 5.4. Displacement, Velocity & Acceleration Sensors
- 5.5. Force and Touch Sensors
- 5.6. Range Sensors
- 5.7. Vision Systems
- 5.8. Image Processing

6. End-Effectors

- 6.1. End Effectors and Types-Mechanical, Magnetic, Vacuum
- 6.2. Various types of mechanical grippers
- 6.3. Design of mechanical grippers
- 6.4. End-Effector Selection Criteria
- 6.5. End Effector design case studies

7. Robot Actuators

- 7.1. Characteristics of Robot Actuating Systems
- 7.2. Electric Motors
- 7.3. Hydraulic actuators
- 7.4. Pneumatic actuators
- 7.5. Magnetostrictive actuators
- 7.6. Shape-memory type actuators
- 7.7. Electroactive polymer actuators
- 7.8. Selection of actuators

8. Finite Element Analysis

- 8.1. Introduction to FEA
- 8.2. Steps of Finite Element Modeling & Analysis
- 8.3. Structural Analysis of mechanisms
- 8.4. Modal Analysis of mechanisms
- 8.5. Optimization using FEA Technique
- 8.6. Design Project: Structural and modal analysis of a robot manipulator

BOOKS:

9. Introduction to Robotics, S. K. Saha, McGraw Hill Education (India) Pvt. Ltd.
10. Introduction to Robotics – Analysis, Control, Applications, Saeed B. Niku, Wiley India Pvt. Ltd.
11. Introduction to Robotics – Mechanics and Control, John J. Craig, Pearson Education Inc.
12. Robotics & Control – R.K. Mittal & I.J. Nagrath – TMH Publications
13. Industrial Robotics – Technology, Programming and Applications - M.P.Groover, M.Weiss, R.N.Nagel, N.G.Odrey
14. Design of Machinery: An Introduction to the Synthesis and Analysis of Mechanisms and Machines, Robert L.Norton, Tata McGraw-Hill, 3rd Edition
15. Dally and Riley, “Experimental stress analysis”, McGraw-Hill International Student Edition, McGraw-Hill Book Company.
16. Fundamentals of Finite Element Analysis, David V. Hutton, Tata McGraw Hill

IIR-P-102: INDUSTRIAL IoT LABORATORY

Maximum marks: 50

L P

Time Allowed: 3 hours

-- 4

OBJECTIVE

The objective of this course is to expose the students to design and development of real world IoT applications

PRE REQUISITE KNOWLEDGE

- Knowledge of Industrial IoT
- Programming using relevant software

COURSE / LEARNING OUTCOMES

After the completion of this course, the students will be able to

- Identify sensors to be used for different industrial parameters
- Use Web based services/tools for developing IoT applications

PRACTICE TASKS

1. Study of basic components used in IoT.
2. Building a simple IoT application using smartphone and free cloud service.
3. Extraction and uploading of machine data on a free cloud service.
4. Exercises on storage of big data.
5. Using Amazon Web Service for deployment and retrieval of Data.
6. Case study - I : Milk Processing and Packaging Industries
7. Case study – II : Manufacturing Industries
8. Case study – III : Virtual Reality Lab
9. Case study - IV : Steel Plant

IIR-C-201: Sensing, Communication and Networking

Maximum marks: 50

L P

Time Allowed: 3 hours

4 --

OBJECTIVE

This course will introduce students to design of sensors and actuators, and to methods that integrate them into embedded systems used in consumer and industrial products. Students will learn about hardware components and firmware algorithms needed to configure and run sensors and actuators in embedded solutions. The start-of-the-art IoT and wireless networks and networking technologies are introduced

PRE REQUISITE KNOWLEDGE

- Basic knowledge of business operation, devices, electronics systems and data systems
- Basic understanding of software and systems

COURSE / LEARNING OUTCOMES

After the completion of this course, the students will be able to :

- Understand IIoT sensors, IIoT market verticals, and the related standards.
- Understand the protocols, applications, and communication infrastructure needed to support IIoT solutions.
- Identify IIoT networking devices and how they are different from other devices.
- Configure and verify IIoT networking devices to support IIoT solutions.

DETAILED CONTENTS

Module I: Basic Concepts

IOT Devices, Exemplary Device Board, Hardware Platforms, Interface of IOT Devices

Module II: Programming of IOT devices

Embedded wireless communication and Protocols Operating Systems, Linux on Raspberry,

Module III: Media Access Control

Time Synchronization, Energy Consumption, Positioning and Localization, Medium Access Control, Topology and Coverage Control, Fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts, Contention Based protocols, Schedule-based protocols - SMAC – BMAC, Traffic-adaptive medium access protocol (TRAMA), The IEEE 802.15.4 MAC protocol.

Module IV: Networking of IOT Devices

Routing, Transport Protocols, Network Security, Middleware, Databases, Data Center Networks
Wireless Sensor Networks, RS232, RS485, SPI, I2C, CAN, LIN, FLEXRAY.

Suggested Books:

1. Industrial IoT, Ismail Butun
2. Yasuura, H., Kyung C.M., Liu Y., and Lin Y.L., “Smart Sensors at the IoT Frontier,” 1st Edition, Springer International Publishing, 2018.
3. John R. Vacca, “Handbook of Sensor Networking”, CRC Press

4. Holger Karl, Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks" 1st ed., John Wiley & Sons, New Jersey.
5. Jun Zheng, Abbas Jamalipour, "Wireless Sensor Networks: A Networking Perspective", 1st ed., Wiley-IEEE Press, USA.
6. Walteneus W. Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice", 1st ed., John Wiley & Sons, New Jersey.

IIR-C-202: ROBOT CONTROL AND PROGRAMMING

Maximum marks: 50

L P

Time Allowed: 3 hours

4 --

OBJECTIVE

The objective of this course is to provide a practical understanding and applications of Robot Control Systems and Programming Tools for industrial applications.

PRE REQUISITES KNOWLEDGE

- Basic Engineering Mathematics
- Basic Programming in MATLAB

COURSE / LEARNING OUTCOMES

After the completion of this course, the students will be able to

- Understand and apply control algorithms for robot control
- Use Teach Pendant for Robot motion control and programming
- Apply Simulink and Robotics System Toolbox of MATLAB for robot modeling, simulation and application development
- Use open source Robotic Operating System tools and applications.

DETAILED CONTENTS

1. Introduction to Control Systems

- 1.1. Basic Components and Terminology
- 1.2. System Dynamics
- 1.3. Block Diagram Algebra
- 1.4. Laplace Transforms and Transfer Function
- 1.5. State Space Approach
- 1.6. Transient & Steady state performance characteristics
- 1.7. Frequency response
- 1.8. Stability of feedback control systems

2. Linear Control

- 2.1. Proportional Controllers
- 2.2. Proportional Integral (PI) Control
- 2.3. Proportional Derivative (PD) Control
- 2.4. Proportional Integral Derivative (PID) Control
- 2.5. Selection of PID Controller Gains
- 2.6. Position Control in robots

3. Nonlinear and Force Control

- 3.1. Multivariable Robot Control
- 3.2. Stability of Multi-DOF Robot
- 3.3. Linearized Control
- 3.4. Computed-torque (Inverse Dynamics) Control
- 3.5. Robust Control
- 3.6. Adaptive Control
- 3.7. Force Control
- 3.8. Hybrid Control

4. Robot Control System Modeling and Simulation

- 4.1. Introduction to Graphical Programming
- 4.2. Creating Models using Blocks and Signals in Simulink
- 4.3. Running Simulations and Analyzing Results
- 4.4. Position Control of 2-DOF Planar Robot
- 4.5. Position Control of 3-DOF Articulated Robot

5. Robot Teach Pendant & Programming

- 5.1. Teach Pendant layout and functions
- 5.2. Joint motion control
- 5.3. Cartesian control
- 5.4. Recording of positions using Teach Pendant
- 5.5. Robot programming using Teach Pendant

6. Robotics System Toolbox

- 6.1. Features of Robotic System Toolbox
- 6.2. Building Robot Models
- 6.3. Coordinate System Transformations
- 6.4. Inverse Kinematics and Dynamics
- 6.5. Trajectory Tracking

7. Robot Operating System (ROS)

- 7.1. ROS fundamentals and communication tools
- 7.2. Visualization and creation of a custom environment with a robot
- 7.3. Mapping of the robot environment and navigation with a mobile robot
- 7.4. Implement a pick-and-place function with industrial robot arms
- 7.5. Design of a complete robotic application with state machines

BOOKS:

1. S. J. Chapman, "Programming in MATLAB for Engineers", Brooks/Cole Thomson Learning, 2004.
2. Introduction to Robotics, S. K. Saha, McGraw Hill Education (India) Pvt. Ltd.
3. Introduction to Robotics – Analysis, Control, Applications, Saeed B. Niku, Wiley India Pvt. Ltd.
4. Modern Control Engineering, K. Ogata, Prentice Hall of India
5. Automatic Control Systems, Kuo and Golnaraghi, Wiley
6. MATLAB Documentation

IIR-P-202: ROBOTICS LABORATORY

Maximum marks: 50

L P

Time Allowed: 3 hours

-- 4

OBJECTIVE

The objective of this course is to expose the students to components and working of robots and to inculcate skills in using various modeling and simulation tools for design, control and programming of robots.

PRE REQUISITE KNOWLEDGE

- Basic Engineering Mathematics
- Basic Programming in MATLAB

COURSE / LEARNING OUTCOMES

After the completion of this course, the students will be able to :

- Identify robot components and accessories
- Use Teach Pendant for Robot movements and programming
- Use FEA tools for structural and modal analysis of mechanisms.
- Use modeling and simulation software for robot design for various applications.

PRACTICE TASKS

1. Study of a robotic manipulator and its components.
2. Study of robot Teach-pendant functions and its use in moving robot wrist in joint space and Cartesian space.
3. Use of teach-pendant for making simple robot programs for pick and place operations.
4. Creating geometrical models of simple structural components using CAD software.
5. Structural and modal analysis of a cantilever in FEA software.
6. Study and use of sensors for measuring various parameters in robotic systems.
7. Study of working of different types of robotic grippers.
8. Use of Robotic Systems Toolbox for building robot models.
9. Use of Robotic Systems Toolbox for forward/inverse kinematics/dynamics in robots.
10. Motion planning, pick and place behaviors using industrial robots with ROS
11. Building a simple IoT application using smartphone and free cloud service.
12. Extraction and uploading of a Robot Sensor data on a free cloud service.

IIR-E-101: MACHINE LEARNING

Maximum marks: 50

L P

Time Allowed: 3 hours

3 --

OBJECTIVE

This course will serve as a comprehensive introduction to various topics in machine learning. The objective is to familiarize the audience with some basic learning algorithms and techniques and their applications, as well as general questions related to analyzing and handling large data sets. At the end of the course the students should be able to design and implement machine learning solutions to classification, regression, and clustering problems; and be able to evaluate and interpret the results of the algorithms.

PRE REQUISITE KNOWLEDGE

- Basic Engineering Mathematics
- Basic Programming

COURSE / LEARNING OUTCOMES

At the end of this course, the student will be able to

- Understand the fundamental issues and challenges of machine learning.
- Understand the strengths and weaknesses of many popular machine learning approaches.
- Interpret the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.
- Design and implement various machine learning algorithms in a range of real-world applications.

DETAILED CONTENTS

Supervised/unsupervised/reinforcement learning and its key terminology EDA, Data wrangling and Visualization with Pandas, Numpy and Matplotlib, Linear Regression, Model Training and Loss, Gradient Descent and various hyperparameters, TensorFlow and scikit learn, Classification algorithms covering logistic regression, Multi-Layer perceptron, SVM, Decision trees and Random Forest, Probabilistic algorithms covering Bayes classifier and Hidden Markov Models. Unsupervised learning: k-means clustering, hierarchical clustering, Gaussian Mixture models and Density Based clustering. Dimensionality Reduction techniques: PCA, FDA, QDA.

Recommended Books:

1. Machine Learning by Tom Mitchell
2. Introduction to Machine Learning by Ethem Alpaydin
3. Introduction to Statistical Learning, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 2013.

Pattern Classification, 2nd Ed., Richard Duda, Peter Hart, David Stork, John Wiley & Sons, 2001.

NOTE; The subject will be reviewed after getting the university status in the duly constituted BoS

Aim: The aim of this course is to provide comprehensive and in-depth knowledge of Cloud Computing concepts, technologies, architecture and applications by introducing and researching state-of-the-art in Cloud Computing issues, technologies, applications and implementations.

Pre-requisite Knowledge: Internet Protocols

Learning Outcomes: At the end of the course, the student will be able to:

- Understand the main concepts, issues, and direction of cloud computing.
- Deal with Virtualization Technologies
- Use Optimization techniques for scheduling

Module-1 Overview of Computing Paradigms

Recent Trends in Computing: Distributed Computing, Cluster Computing, Grid Computing, Utility Computing, Cloud Computing. Evolution of Cloud Computing: Migrating into a Cloud.

Module-2 Cloud Computing Basics

Cloud Computing Overview; Characteristics; Applications; Benefits; Limitations; Challenges, SOA; Cloud Computing Service Models: Infrastructure as a Service; Platform as a Service; Software as a Service. Cloud Computing Deployment Models: Private Cloud; Public Cloud; Community Cloud; Hybrid Cloud, Major Cloud Service providers.

Module-3 Virtualization Concepts

Overview of Virtualization Technologies, Types of Virtualization, Benefits of Virtualization, Hypervisors; VM Provisioning & Migration: VM Lifecycle, VM Provisioning Process, VM Migration Techniques.

Module-4 Scheduling in Cloud

Overview of Scheduling problem, Different types of scheduling, Scheduling for independent and dependent tasks, Static vs. Dynamic scheduling, Optimization techniques for scheduling.

Module-5 Cloud Storage

Overview; Storage as a Service, Benefits and Challenges, Storage Area Networks(SANs), Case Study of Amazon S3.

Module-6 Cloud Security

Infrastructure Security: Network Level Security, Host Level Security and Application Level Security, Data Security: Data Security & Privacy Issues; Identity & Access Management; Legal Issues in Cloud Computing.

Module-7 Mobile Cloud Computing

Overview of Mobile Cloud Computing, Advantages, Challenges, Using Smartphones with the Cloud, Offloading techniques - their pros and cons, Mobile Cloud Security.

Module-8 SLA Management

Overview of SLA, Types of SLA, SLA Life Cycle, SLA Management Process.

Suggested Books:

11. Raj kumar Buyya, James Broberg, Andrzej Goscinski (Editors): Cloud Computing: Principles and Paradigms, Wiley.
12. Barrie Sosinsky: Cloud Computing Bible, Wiley.

13. Anthony T. Velte, Toby J. Velte, and Robert Elsenpeter: Cloud Computing: A Practical Approach, McGraw Hill, 2010.
 14. Judith Hurwitz, Robin Bloor, Marcia Kaufman, Fern Halper: Cloud Computing for Dummies, Wiley.
- BorkoFurht, Armando Escalante (Editors): Handbook of Cloud Computing, Springer

IIR-E-103: DATA ANALYTICS

Maximum marks: 50

L P

Time Allowed: 3 hours

3 --

OBJECTIVE

This course will provide students with extensive expertise in the booming data analytics field. It will teach how to master descriptive and inferential statistics, hypothesis testing, regression analysis, data blending, data extracts, and forecasting. Through this course, one will also gain expertise in data visualization techniques using Tableau, learning how to organize data and design dashboards. Through this course, those with a basic understanding of mathematical concepts will be able to complete the course and become an expert in data analytics. Upon completing this course, participants will have all the skills required to become a successful Data Analyst.

PRE REQUISITE KNOWLEDGE

- Basic Engineering Mathematics
- Basic Programming

COURSE / LEARNING OUTCOMES

At the end of this course, the student will be able to

- Work with data in Python/R, including reading and writing files, loading, working, and saving data with Pandas.
- Interpret data in Python/R using multi-dimensional arrays in NumPy, manipulate DataFrames in pandas, use SciPy library of mathematical routines, and execute machine learning using Scikit-Learn.
- Use linear and non-linear regression models and classification techniques for data analysis.
- Use clustering methods including K-means, DBSCAN, and hierarchical clustering.
- Deal with latest Microsoft analytics and visualization tools.
- Use visualization techniques such as heat map, treemap, waterfall, Pareto, Gantt chart, and market basket analysis.

Course Contents

Clustering, Decision Trees, Random Forests, Regression, Singular Value Decomposition, Time Series Modeling for IoT Data, R and Julia Programming, Data Management with Hadoop, Cloud Computing in IIoT, Security and Fog Computing.

Recommended Books:

1. Big Data: A Revolution That Will Transform How We Live, Work, and Think
By Viktor Mayer-Schönberger and Kenneth Cukier
2. Developing Analytic Talent: Becoming a Data Scientist By Vincent Granville
3. Data Analytics Made Accessible: 2020 Edition By Anil K. Maheshwari, Ph.D.

NOTE; The subject will be reviewed after getting university status in the duly constituted BoS

Aim: To acquire specific scripting knowledge to develop interactive applications and understand the basics of android application development along with programming skills in developing application pertaining to Industrial, medical, agricultural, etc.

Pre-requisite Knowledge: Fundamentals of IoT

Learning Outcomes: At the end of the course, the student will be able to :

- Design dynamic web forms to acquire and process user & sensor data..
- Interactive forms using Java Script with a focus on internet of things.
- Implement mobile application using android SDK.
- Solve the need for smart systems in a distributed environment.

Module-1 Markup Language

Introduction to Markup language, HTML document structure, HTML forms, Style (CSS), Multiple CSS stylesheets, DHTML, Tools for image creation and manipulation, User experience design, IoT development using charts.

Module-2 Scripting Language

Introduction to JavaScript, Functions, DOM, Forms, and Event Handlers, Object Handlers, Input validation, J2ME, application design using J2ME , IoT development using Real time rules, platforms, alerts.

Module-3 Android Programing Framework

Mobile app development: Android Development environment, Simple UI Layouts and layout properties, GUI objects, Event Driven Programming, opening and closing a Database.

Module-4 Industrial Internet Application

IIoT Fundamentals and Components, Industrial Manufacturing, Monitoring, Control, Optimization and Autonomy, Introduction to Hadoop and big data analytics.

Module-5 Applications in agriculture

Smart Farming: Weather monitoring, Precision farming, Smart Greenhouse, Drones for pesticides.

Module-6 Applications in IoT enabled Smart Cities

Energy Consumption Monitoring, Smart Energy Meters, Home automation, Smart Grid and Solar Energy Harvesting, Intelligent Parking, Data lake services scenarios.

Module-7 Healthcare applications

Architecture of IoT for Healthcare, Multiple views coalescence, SBC-ADL to construct the system architecture. Use Cases : Wearable devices for Remote monitoring of Physiological parameter, ECG, EEG, Diabetes and Blood Pressure.

Suggested Books:

6. John Dean, Web Programming with HTML5, CSS and JavaScript, 2018, Jones and Bartlett Publishers Inc., ISBN-10: 9781284091793.
7. DiMarzio J. F., Beginning Android Programming with Android Studio, 2016, 4th ed., Wiley, ISBN-10: 9788126565580.

8. Fadi Al-Turjman, *Intelligence in IoT- enabled Smart Cities*, 2019, 1st edition, CRC Press, ISBN-10: 1138316849.
9. Giacomo Veneri, and Antonio Capasso, *Hands-on Industrial Internet of Things: Create a powerful industrial IoT infrastructure using Industry 4.0*, 2018, Packt Publishing.
10. Subhas Chandra Mukhopadhyay, *Smart Sensing Technology for Agriculture and Environmental Monitoring*, Springer, ISBN-10: 3642276377.

DGD-E-103: GPU Programming

Aim: To learn parallel programming with graphics processing units (GPUs)

Learning Outcomes: At the end of the course, the student will be able to :

- Use the concepts of parallel programming,
- implement programs on GPUs,
- undertake debugging and profiling parallel programs.

Detailed Contents:

Unit 1: Introduction - History, graphics processors, graphics processing units, GPGPUs. Clock speeds, CPU / GPU comparisons, heterogeneity. Accelerators, parallel programming, CUDA / OpenCL / OpenACC, Hello World Computation, Kernels, launch parameters, thread hierarchy, warps / wavefronts, thread blocks / workgroups, streaming multiprocessors, 1D / 2D / 3D thread mapping, device properties, simple programs

Unit 2: Memory - Memory hierarchy, DRAM / global, local / shared, private / local, textures, constant memory. Pointers, parameter passing, arrays and dynamic memory, multi-dimensional arrays. Memory allocation, memory copying across devices. Programs with matrices, performance evaluation with different memories

Unit 3: Synchronization: Memory consistency. Barriers (local versus global), atomics, memory fence. Prefix sum, reduction. Programs for concurrent data structures such as worklists, linked-lists. Synchronization across CPU and GPU, Functions : Device functions, host functions, kernels, functors. Using libraries (such as Thrust), developing libraries.

Unit 4: Debugging GPU programs. Profiling, profile tools, performance aspects, Streams: Asynchronous processing, tasks, task-dependence. Overlapped data transfers, default stream, synchronization with streams. Events, event-based-synchronization - overlapping data transfer and kernel execution, pitfalls.

Unit 5: Case studies: Image processing. Graph algorithms. Simulations. Deep learning. Advanced topics: Dynamic parallelism. Unified virtual memory. Multi-GPU processing. Peer access. Heterogeneous processing

SUGGESTED BOOKS:

3. Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wen-mei Hwu; Morgan Kaufman; 2010 (ISBN: 978-0123814722)
4. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman; 2012 (ISBN: 978-0124159334)

Aim: This course will give students a theoretical and practical grounding in Internet of Things (IoT), covering IoT systems architecture, hardware platforms, embedded programming and debugging, networking paradigms for IoT, and security.

Pre-requisite Knowledge: Fundamentals of IoT

Learning Outcomes: At the end of the course, the student will be able to :

- Understand the fundamentals of encryption for cyber security.
- Design elementary blocks for threat modelling.
- Deal with security and digital identity issues in cloud computing.
- Understand issues related to cyber crime, hacking and forensics.

Module-1 Fundamentals of encryption for cyber security

Cryptography – Need and the Mathematical basics- History of cryptography, symmetric ciphers, block ciphers, DES – AES. Public-key cryptography: RSA, Diffie-Hellman Algorithm, Elliptic Curve Cryptosystems, Algebraic structure, Triple Data Encryption Algorithm (TDEA) Block cipher.

Module-2 IoT security framework

IOT security frame work, Security in hardware, Bootprocess, OS & Kernel, application, run time environment and containers. Need and methods of Edge Security, Network Security: Internet, Intranet, LAN, Wireless Networks, Wireless cellular networks, Cellular Networks and VOIP.

Module-3 Elementary blocks of IoT Security & Models for Identity Management

Vulnerability of IoT and elementary blocks of IoT Security, Threat modeling – Key elements. Identity management Models and Identity management in IoT, Approaches using User-centric, Device-centric and Hybrid.

Module-4 Identity Management and Trust Establishment

Trust management lifecycle, Identity and Trust, Web of trust models. Establishment: Cryptosystems – Mutual establishment phases – Comparison on security analysis. Identity management framework.

Module-5 Access Control in IoT and light weight cryptography

Capability-based access control schemes, Concepts, identity-based and identity-driven, Light weight cryptography, need and methods , IoT use cases.

Module-6 Security and Digital Identity in Cloud Computing

Cloud security , Digital identity management in cloud, Classical solutions, alternative solutions, Management of privacy and personal data in Cloud.

Module-7 Cyber Crimes, Hackers and Forensics

Cyber Crimes and Laws – Hackers – Dealing with the rise tide of Cyber Crimes – Cyber Forensics and incident Response – Network Forensics.

Suggested Books:

9. John R. Vacca, “Computer and Information Security Handbook”, Elsevier.
Parikshit Narendra Mahalle , Poonam N. Railkar, “Identity Management for Internet of Things”, River Publishers, 2015.
10. William Stallings, “Cryptography and Network security: Principles and Practice”, 5th Edition, Pearson Education, India.
11. Maryline Laurent, Samia Bouzebrane, “Digital Identity Management”, Elsevier, 2015.
12. Joseph Migga Kizza, “Computer Network Security”, Springer.

13. Christof Paar and Jan Pelzl, “Understanding Cryptography – A Textbook for Students and Practitioners”, Springer.
14. Behrouz A.Forouzan : Cryptography & Network Security – The McGraw Hill Company.
15. Charlie Kaufman, Radia Perlman, Mike Speciner, Network Security: “Private Communication in a public World”, PTR Prentice Hall, Second Edition.
16. Alasdair Gilchrist, “IoT security Issues”, Oreilly publications, 2017.

Aim: To identify the scope and essentiality of Data Warehousing and Mining. Analyze data, choose relevant models and algorithms for respective applications. Study spatial and web data mining. Develop research interest towards advances in data mining.

Pre-requisite Knowledge: Data Science

Learning Outcomes: At the end of the course, the student will be able to :

- Understand Data Warehouse fundamentals, Data Mining Principles.
- Design data warehouse with dimensional modelling and apply OLAP operations.
- Identify appropriate data mining algorithms to solve real world problems.
- Evaluate different data mining techniques like classification, prediction, clustering and association rule mining.

Module-1 Data Warehousing

Data types, Data modelling and DBMS Schemas for Decision Support , Data mart, Data ETL operations, Metadata; OLAP operations, Bitmap and Join Indexing, Data Cubing, Star tree construction, inverted index.

Module-2 Data mining

Data, Pre-processing and KDD Process, Association rule mining and Interestingness of Patterns, Frequent Pattern and frequent itemset Mining, A-priori algorithm, Correlation Analysis, Constraint Based Association Mining.

Module-3 Classification and Prediction

Basic Concepts , entropy, Dimensionality reduction, PCA, Decision Tree, Naïve Bayes algorithm, Neural networks, Back propagation, SVM, Associative Classification, Lazy Learners, Ensemble learning, Ada-Boosting, Bagging, Accuracy and Error Measures, Performance evaluation, ROC.

Module-4 Clustering

Types of Data in Cluster Analysis – A Categorization of Major Clustering methods, Partitioning Methods, Hierarchical clustering, Expectation-Maximization Algorithm, Density Based clustering, Constraint-Based Cluster Analysis – Outlier Analysis and Data mining for intrusion detection, mining sequence and time series data.

Module-5 Case study

Case study on Data mining with data sets.

Suggested Books:

4. Han, J and Kambher, M, Data Mining Concepts and Techniques, (3e), Morgan Kaufmann Publishers- Elsevier, ISBN-12: 9780123814791, ISBN-13: 978-9380931913
5. Tan, P N, Steinbach, M and Kumar, V, Introduction to Data Mining, (1e), Person Education India, ISBN-10: 0321321367, ISBN-13: 978-0321321367.
6. A. Berson and S. J. Smith, Data Warehousing, Data Mining & OLAP, (10e), Tata McGraw – Hill, ISBN-10: 0070587418, ISBN-13: 978-0070587410, 2017

PI-EC107: DIGITAL MANUFACTURING

Maximum marks: 50

L P

Time Allowed: 3 hours

3 --

OBJECTIVE

The objective of this course is to understand the transformation taking place, throughout the world, in design and manufacturing of products through digital manufacturing – a shift from paper-based processes to digital processes in the manufacturing industry.

PRE REQUISITE KNOWLEDGE

- Basics of manufacturing

COURSE / LEARNING OUTCOMES

After the completion of this course, the students will be able to

- Understand product design and development process in digital manufacturing environment.
- Use manufacturing technologies like CNC machining, Flexible Manufacturing Systems and additive manufacturing.
- Understand Industry 4.0 standard and its various components.

DETAILED CONTENTS

10. Introduction

- 10.1. Types of manufacturing systems and their characteristics
- 10.2. Computer aided Manufacturing (NC, CNC, DNC and adaptive control systems)
- 10.3. Computer Network architectures and protocols
- 10.4. Computer Integrated Manufacturing Systems
- 10.5. What makes a manufacturing process “digital”

11. CNC Machines

- 11.1. Constructional details
- 11.2. Design features
- 11.3. Safety devices
- 11.4. Part programming

12. Group Technology and Cellular Manufacturing

- 12.1. Parts classification and part coding – approaches and systems
- 12.2. Benefits of group technology
- 12.3. Cellular manufacturing-basics, layout considerations
- 12.4. Cell formation approaches and evaluation of cell designs
- 12.5. Planning and control in cellular manufacturing
- 12.6. Applications in Manufacturing

13. Computer Aided Process Planning

- 13.1. Role of Computer in Planning function
- 13.2. CAPP Approaches
- 13.3. Benefits of CAPP
- 13.4. Machinability Data Systems
- 13.5. Computer – Generated Time Standards

14. Computer Aided Quality Control

- 14.1. Computers in quality control
- 14.2. Contact and non-contact inspection methods
- 14.3. Computer aided testing

15. Flexible Manufacturing Systems

- 15.1. FMS and its Components
- 15.2. Layout considerations in FMS
- 15.3. Material Handling in FMS

16. Reverse Engineering

- 16.1. Reverse Engineering – Principles and Technology
- 16.2. Contact type methods
- 16.3. Non-contact type methods
- 16.4. Applications in Product Manufacturing

17. Additive Manufacturing

- 17.1. Additive Manufacturing Processes
- 17.2. Steps in Additive Manufacturing
- 17.3. Materials used in Additive Manufacturing
- 17.4. Post processing
- 17.5. Challenges, Benefits and Applications

18. Cloud Based Manufacturing

- 18.1. Introduction to Cloud computing
- 18.2. Data Analytics in Manufacturing
- 18.3. Networked manufacturing
- 18.4. Industrial Internet of Things
- 18.5. Industry 4.0 Standard
- 18.6. Applications of Cloud based Manufacturing

BOOKS:

- 8. Groover M. P. and Zimmers E. W., “Computer Aided Design and Manufacturing”, Pearson Education, New Delhi, 2003
- 9. Groover M. P., “Automation, Production Systems and Computer Aided Manufacturing”, Pearson Education, New Delhi, 2015
- 10. P. Radhakrishnan, S. Subramanyan, V. Raju, “CAD/CAM/CIM”, New Age International, 2008
- 11. C.K. Chua, K.F. Leong, C.S. Lim, “Rapid Prototyping: Principles And Applications”, 3rd Edition, World Scientific Publishing Co Pte Ltd, 2008
- 12. Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, Apress, 2016

PI-C102: 3D/4D PRINTING PROCESSES

Maximum marks: 50

L P

Time Allowed: 3 hours

3 --

OBJECTIVE

To impart basic knowledge of 3D/4D printing techniques, material selection, equipment and applications of additive manufacturing.

PRE REQUISITE KNOWLEDGE

- Manufacturing Processes, Casting, Welding and Forming

COURSE / LEARNING OUTCOMES

After the completion of this course, the students will be able to

- Differentiate between different types of 3D/4D printing in manufacturing
- Select suitable materials for 3D/4D printing
- Select suitable 3D printing Technology for a given application.
- Select post-processing of 3D/4D parts
- Compare the conventional processes with 3D/4D printing in the field of Automobile, Aerospace, and Bio-medical.

DETAILED CONTENTS

Unit I: Introduction to 3D/4D printing

- 3) **Introduction to Additive Manufacturing:** Introduction to 3D printing and AM, AM evolution, Distinction between AM & CNC machining, Steps in AM, Classification of AM processes, Advantages of AM and Types of materials for AM. Vat Photopolymerization, 4D printing
- 4) **AM Processes:** Stereo-lithography (SL), Materials, Process Modelling, SL resin curing process, SL scan patterns, Micro-stereo-lithography, Mask Projection Processes, Two-Photon vat photopolymerization, Process Benefits and Drawbacks, Applications of Vat Photopolymerization, Material Jetting and Binder Jetting AM Processes

Unit II: Types of AM processes

- (4) **Extrusion-Based AM Processes:** Fused Deposition Modelling (FDM), Principles, Materials, Process Modelling, Plotting and path control, Bio-Extrusion, Contour Crafting, Process Benefits and Drawbacks, Applications of Extrusion-Based Processes.
- (5) **Sheet Lamination AM Processes:** Bonding Mechanisms, Materials, Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications.
- (6) **Powder Bed Fusion AM Processes:** Selective laser Sintering (SLS), Materials, Powder fusion mechanism and powder handling, Process Modelling, SLS Metal and ceramic part creation, Electron Beam melting (EBM), Process Benefits and Drawbacks, Applications of Powder Bed Fusion Processes.

Unit III: AM Data Formatting and Processing

- (5) **Directed Energy Deposition AM Processes:** Process Description, Material Delivery, Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Electron Beam Based Metal Deposition, Processing-structure-properties, relationships, Benefits and drawbacks, Applications of Directed Energy Deposition Processes.

- (6) **Materials science for AM** - Multifunctional and graded materials in AM, Role of solidification rate, Evolution of non-equilibrium structure, microstructural studies, Structure property relationship.
- (7) **Post Processing of AM Parts:** Support Material Removal, Surface Texture Improvement, Accuracy Improvement, Aesthetic Improvement, Preparation for use as a Pattern, Property Enhancements using Non-thermal and Thermal Techniques.
- (8) **Guidelines for Process Selection:** Introduction, Selection Methods for a Part, Challenges of Selection, Example System for Preliminary Selection, Process Planning and Control.

BOOKS:

1. Kai, C; Fai L. Rapid Prototyping: Principles & Applications, World Scientific, 2003.
2. Gibson, I.; Rosen D., Stucker, B. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010

REFERENCE BOOKS

3. Ian Gibson, David W Rosen, Brent Stucker., “Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing”, 2nd Edition, Springer, 2015.
4. Patri K. Venuvinod and Weiyin Ma, “Rapid Prototyping: Laser-based and Other Technologies”, Springer, 2004.
5. Chua Chee Kai, Leong Kah Fai, “3D Printing and Additive Manufacturing: Principles & Applications”, 4th Edition, World Scientific, 2015.
6. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer 2001.
7. RafiqNoorani, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons, 2006.

IIR-E- 201: MECHANISM DESIGN AND ANALYSIS

Maximum marks: 50

L P

Time Allowed: 3 hours

3 --

OBJECTIVE

The objective of this course is to develop competency in graphical and analytical method for solving problems in static and dynamic force analysis.

PRE REQUISITE KNOWLEDGE

- Engineering mathematics
- Engineering mechanics

COURSE / LEARNING OUTCOMES

After the completion of this course, the students will be able to

- Understand the fundamentals of the theory of kinematics and dynamics of machines.
- Understand techniques for studying motion of machines and their components.
- Use computer software packages in modern design of machines

DETAILED CONTENTS

1. Basics of Mechanisms and Machines

- 1.1 Types of Motion, Links, Kinematic Pair, Types of Joints, Degree of Freedom
- 1.2 Classification of Kinematic Pairs, Kinematic Chain, Linkage, Mechanism and Structure
- 1.3 Planar, Spheric, and Spatial Mechanisms
- 1.4 Inversions of Four-bar and Slider Crank Mechanism
- 1.5 Grashof's Law and Mechanical Advantage
- 1.6 Mobility of Mechanisms, Transmission Angle
- 1.7 Pantograph, Straight Line Mechanisms

2. Kinematic Synthesis of Mechanisms

- 2.1 Velocity and Acceleration Diagrams for four bar and six bar mechanisms, Velocity by Instantaneous Centre Method, Klein Construction, Aronhold-Kennedy Theorem of Three Centers
- 2.2 Radius of Curvature of a Point Trajectory Using Kinematic Coefficients
- 2.3 Stages of Kinematic Synthesis and Errors, Chebyshev Spacing of Precision points

3. Vibrations

- 3.1 Definition and Types of vibrations
- 3.2 Natural frequencies of simple systems
- 3.3 Types of damping- Analysis with viscous damping - Derivations for over, critical and under damped systems, Logarithmic decrement and Problems.
- 3.4 Principle modes of vibrations, Normal mode and natural frequencies of systems
- 3.5 Dynamic testing of machines and structures

4. Friction and Friction Drives

- 4.1 Types & Laws of friction, Coefficient of Friction, Uniform Pressure and Uniform Wear
- 4.2 Law of Belting, Ratio of Friction Tensions in Belts, Power Transmitted by Belts and Ropes, Maximum Power Transmission by Belt
- 4.3 Classification of Gears, Gear Terminology
- 4.4 Law of Gearing, Velocity of sliding, Gear Teeth Profile, Path of Contact, Arc of Contact, Contact Ratio
- 4.5 Interference of in Involute Gears, Minimum Number of Teeth, Undercutting, Gear Forces, Different Types of Gear Trains, Analysis of Epicyclic Gear Train

5. Structural Analysis

- 5.1 Free body diagram and its importance
- 5.2 Classification of structures and components
- 5.3 Notion of stress – normal stress, shear stress and bearing stresses
- 5.4 Stresses on inclined plane in an axial member
- 5.5 Strain – normal strain, shear strain
- 5.6 Mechanical properties – elasticity, plasticity, creep, fatigue, buckling etc.
- 5.7 Deformation of axial members

6. Finite Element Analysis

- 6.1 Introduction to FEA
- 6.2 Steps of Finite Element Modeling & Analysis
- 6.3 Structural Analysis of mechanism
- 6.4 Modal Analysis of mechanism
- 6.5 Optimization using FEA Technique

Text books:

1. Dally and Riley, “Experimental stress analysis”, McGraw-Hill International Student Edition, McGraw-Hill Book Company.
2. Theory of Machines and Mechanisms, A. Ghosh and A.K. Mallik, Affiliated East- West Press
3. Theory of Machines and Mechanisms, J. E. Shigley and J. J. Uicker, 2nd Ed., McGraw-Hill
4. Ferdinand P. Beer, E. Russell Johnston and Jr. John T. DeWolf “Mechanics of Materials”, Tata McGraw-Hill, Third Edition, SI Units

IIR-E- 202: COMPUTER VISION

Maximum marks: 50

L P

Time Allowed: 3 hours

3 --

OBJECTIVE

The objective of this course is to impart knowledge computer vision required in intelligent robots along with tools and algorithms needed to capture, process and analyze the images.

PRE REQUISITE KNOWLEDGE

- Linear Algebra
- Vector Calculus
- Data Structures and Programming

COURSE / LEARNING OUTCOMES

After the completion of this course, the students will be able to

- Apply theory and computation related to imaging geometry, and scene understanding
- Apply clustering, classification and deep learning techniques applied in this area

DETAILED CONTENTS

Module 1: Fundamentals of Image Processing

Module 2: 2-D Projective Geometry and Homography

Module 3: Properties of Homography

Module 4: Camera Geometry

Module 5: Stereo Geometry

Module 6: Feature detection and description

Module 7: Feature matching and model fitting

Module 8: Color Processing

Module 9: Range image processing

Module 10: Clustering and classification

Module 11: Dimensionality Reduction and Sparse Representation

Module 12: Deep Neural Architecture and application

BOOKS:

1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer
2. Forsyth and Ponce, “Computer Vision: A Modern Approach”, Pearson Education India

COURSE PLAN:

Integration of information system, strategies for systems integration, web services for system integration, tools and technologies, enterprise and technical integration architecture, process driven integration

Introduction - Electronic Packaging, Levels of Packaging, Wafer fabrication, Recap of Basic Electronics First level packaging – Package Taxonomy, Chip and chip carrier, lead frame, Interconnection types and methods, Flip-Chip bonding, area arrays

Second level packaging - Design and manufacture of Printed Wiring Boards, Types of circuit boards, Component placement, Routing, Lamination, Solder Masks

Third level packaging and System level integration – cables, connectors, chassis, display

Advanced Packaging - Chip Scale Packaging, Multi-chip Module, Stacked Package, System in package (SIP), system on chip (SOC) Specialized packages (RF, MEMS, Sensors, Harsh Environments, Wearable/Flexible), vibration analysis, creep analysis, thermal analysis, failure modes and mechanism, environmental stress screening

Mechanical Design - Vibration analysis, Theorem of Castigliano; Fatigue and creep analysis

IIR-E- 204: INDUSTRIAL SAFETY ENGINEERING

Maximum marks: 50

L P

Time Allowed: 3 hours

3 --

OBJECTIVE

The objective of this course is to impart knowledge on different facets and aspects of engineering systems safety, focusing on tools, techniques and methodologies needed for prevention of occurrences of unsafe operations and accidents under different industrial settings

PRE REQUISITE KNOWLEDGE

- UG Engineering Degree

COURSE / LEARNING OUTCOMES

After the completion of this course, the students will be able to

- Understand the concepts of engineering systems safety, dimensions of engineering systems
- Integrate safety with other operational goals such as quality and reliability

DETAILED CONTENTS

Module 1 : Introduction, key concepts, terminologies, and safety quantification, safety by design

Module 2 : Hazard identification techniques (e.g., HAZOP, FMEA, etc.)

Module 3 : Fault tree and event tree analysis (qualitative & quantitative)

Module 4 : Bow-tie and quantitative risk assessment (QRA)

Module 5 : Safety function deployment

Module 6 : Safety vs reliability – quantification of basic events (repair to failure, repair-failure-repair, and combined processes)

Module 7 : Safety vs reliability – quantification of basic events (contd.)

Module 8 : Systems safety quantification (e.g., truth tables, structure functions, minimal cut sets)

Module 9 : Human error analysis and safety

Module 10 : Accident investigation and analysis

Module 11 : Application of virtual reality

Module 12 : OSHAS 18001 and OSHMS

BOOKS:

3. L. N. Deshmukh, “Industrial Safety Management”, McGraw Hill Education
4. R. K. Jain and S. S. Rao, “Industrial Safety, Health and Environment Management Systems”, Khanna Publishers
5. D.S.S.Ganguly and C.S.Changeriya., “Safety Engineering”, Chetan Publication

IIR-E- 205: ROBOT MOTION PLANNING

Maximum marks: 50

L P

Time Allowed: 3 hours

3 --

OBJECTIVE

The objective of this course is to provide the student with some knowledge and analysis skills associated with trajectory planning and robot control.

PRE REQUISITE KNOWLEDGE

- Engineering Mathematics and Basics of Robotics

COURSE / LEARNING OUTCOMES

After the completion of this course, the students will be able to

- demonstrate knowledge of the relationship between mechanical structures of industrial robots and their operational workspace characteristics
- demonstrate an ability to generate joint trajectory for motion planning
- demonstrate knowledge of robot motion control

DETAILED CONTENTS

1. Configuration Space

1.1 Specifying a Robot's Configuration

1.2 Obstacles and the Configuration Space

1.3 The Dimension of the Configuration Space

1.4 The Topology of the Configuration Space

1.5 Parameterizations of $SO(3)$

1.6 Example Configuration Spaces

1.7 Transforming Configuration and Velocity Representations

2. Motion Planning

2.1 Joint Space Planning

2.2 Cartesian Space Planning

2.3 Position and Orientation Trajectories

2.4 Point-to-Point Planning

2.5 Continuous Path Generation

3. Trajectory Planning

4.1 Preliminaries

4.2 Decoupled Trajectory Planning

4.3 Direct Trajectory Planning

4. Robot Motion Control

5.1 Control Systems

5.2 Controllability

5.3 Simple Mechanical Control Systems

5.4 Motion Planning

BOOKS:

1. Latombe, J. C. (2012). Robot motion planning (Vol. 124). Springer Science & Business Media.
2. Hegde, G.S. (2009). Industrial Robotics, University Science Press.

IIR-E- 206: MACHINERY FAULT DIAGNOSIS AND SIGNAL PROCESSING

Maximum marks: 50

L P

Time Allowed: 3 hours

3 --

OBJECTIVE

This course will provide students with the state of the art techniques in machinery condition monitoring along with the recent developments in the field of signal processing, thermography, ultrasonics apart from the traditional noise and vibration monitoring.

PRE REQUISITE KNOWLEDGE

- Engineering Mathematics
- Measurement Techniques
- Vibrations

COURSE / LEARNING OUTCOMES

After the completion of this course, the students will be able to :

- Understand the maintenance principles and techniques
- Use data acquisition hardware/software and signal processing techniques
- Select appropriate condition monitoring technique for detecting different faults

BRIEF CONTENTS

Maintenance Principles, FMECA, Fault Prognosis; Vibration Analysis, Experimental Modal Analysis, Rotor Dynamics; Time domain Signal analysis, Data Acquisition, Filtering; Fourier Series, FFT, Modulation and Sidebands; Order Analysis, Orbits; Instrumentation, Data Recording; Vibration and Noise Monitoring; Rotating Machines, Bearings and Gears; Fans, Blowers, Pumps, IC Engines; Motor Current Signature Analysis, Wear Debris and Oil Analysis; NDT, Ultrasonics, EddyCurrent; Case Studies, Failure Analysis

BOOKS:

1. Doebelin E. O., "Measurement Systems", Tata McGraw Hill.
2. Nakra and Chaudhry, "Instrumentation, Measurement and Analysis", Tata McGraw Hill
3. George G. Barely, "Intelligent Instrumentation", Prentice Hall of India
4. Amiya Ranjan Mohanty, "Machinery Condition Monitoring: Principles and Practices", CRC Press

NOTE; The subject will be reviewed after getting the university status in the duly constituted BoS

IIR-E- 207: MANUFACTURING SYSTEMS TECHNOLOGY

Maximum marks: 50

L P

Time Allowed: 3 hours

3 --

OBJECTIVE

This course is an introductory course in manufacturing processes and technology for students who do not have background in manufacturing engineering but would like to take up manufacturing related career.

PRE REQUISITE KNOWLEDGE

- None

COURSE / LEARNING OUTCOMES

After the completion of this course, the students will be able to :

- Understand the various types of manufacturing processes.
- Understand the application of various computer based tools and processes in manufacturing.

BRIEF CONTENTS

Manufacturing properties of materials, Computer aided designing, Principles and process planning of basic machining processes, Machine tools design, Computer aided process planning, Introduction to CNC part programming, Product design, Just-in-time manufacturing, Robotic systems planning and designing, Quality systems engineering, Cost of quality and statistical quality control

BOOKS:

1. Kalpakjian, Serope and Schmid, Steven, R, "Manufacturing Engineering & Technology", Prentice Hall
2. Kalpakjian, Serope and Schmid, Steven, R, "Manufacturing Processes for Engineering Materials", Pearson Education
3. Amitabha Ghosh and Asok Kumar Mallik, "Manufacturing Science", Affiliated East-West Press Pvt. Ltd.
4. Sharma, P. C., "A Textbook of Production Technology: Manufacturing Processes", S. Chand

NOTE; The subject will be reviewed after getting the university status in the duly constituted BoS.

Unit-1 Introduction

Introduction to Deep Learning: history of deep learning, deep learning success stories, mcculloch pitts neuron, thresholding logic, perceptron's, perceptron learning algorithm.

Unit-2 Multi-Layer Network and Optimization Technique

Multilayer perceptron's (mlps), representation power of mlps, sigmoid neurons, gradient descent, feed forward neural networks, representation power of feed forward neural networks feed forward neural networks, back propagation gradient descent (gd), momentum based gd, nesterov accelerated gd, stochastic gd, adagrad, rmsprop, adam, eigenvalues and eigenvectors, eigenvalue decomposition, basis.

Unit-3 Dimension Reduction and Regularization

Principal component analysis and its interpretations, singular value decomposition auto encoders and relation to pca, regularization in auto encoders, denoising auto encoders, sparse auto encoders, contractive auto encoders regularization: bias variance tradeoff, l2 regularization, early stopping, dataset augmentation, parameter sharing and tying, injecting noise at input, ensemble methods, dropout greedy layer wise pre-training, better activation functions, better weight initialization methods, batch normalization learning vectorial representations of words.

Unit-4 Convolutional Neural Networks

Lenet, alexnet, zf-net, vggnet, googlenet, resnet, visualizing convolutional neural networks, guided back propagation, deep dream, deep art, fooling convolutional neural networks.

Unit-5 Recurrent Neural Networks

Back propagation through time (bptt), vanishing and exploding gradients, truncated bptt, gru, lstms encoder decoder models, attention mechanism, attention over images.

SUGGESTED BOOKS:

11. J.Patterson, A.Gibson, Deep Learning, (1e), O'Reilly Publication, 2018.
12. Goodfellow I., Bengio Y, Deep Learning (Adaptive Computation and Machine Learning series), (1e), MIT Press, 2017.
13. Shai Shalev-Shwartz , Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, (3e), Cambridge University Press, 2015

Aim: To provide the knowledge of energy harvesting based sensor networks for IoT devices.

Pre-requisite Knowledge: Fundamentals of IoT

Learning Outcomes: At the end of the course, the student will be able to :

- Understand Lumped parameter model and coupled distributed parameter models.
- Deal with Non-linear techniques – vibration control & steady state cases.
- Use the knowledge of harvesting for RF sensors and ID tags – powering wireless SHM sensor nodes.

Module-1 Energy Harvesting Systems

Introduction – Energy sources – energy harvesting based sensor networks – photovoltaic cell technologies – generation of electric power in semiconductor PV cells – types.

Module-2 Piezo-Electric Energy Harvesting and Electromechanical Modeling

Piezoelectric materials – transducers – harvesters – micro generators – strategies for enhancing the performance of energy harvesters. Electromechanical modelling of Lumped parameter model and coupled distributed parameter models and closed-form solutions.

Module-3 Electromagnetic Energy Harvesting and Non-Linear Techniques

Basic principles – micro fabricated coils and magnetic materials – scaling – power maximizations – micro and macro scale implementations. Non-linear techniques – vibration control & steady state cases.

Module-4 Energy Harvesting Wireless Sensors

Power sources for WSN – Power generation – conversion – examples – case studies. Harvesting microelectronic circuits – power conditioning and losses.

Module-5 Selected Applications of Energy Harvesting Systems

Case studies for Implanted medical devices – Bio-MEMS based applications – harvesting for RF sensors and ID tags – powering wireless SHM sensor nodes.

Suggested Books:

3. Carlos Manuel Ferreira Carvalho, Nuno Filipe Silva VeríssimoPaulino, “CMOS Indoor Light Energy Harvesting System for Wireless Sensing Applications”, springer.
4. Danick Briand, Eric Yeatman, Shad Roundy ,“Micro Energy Harvesting”.

M.SC. IN NANOPHOTONICS

Programme: M.Sc. Nanophotonics

Duration: 2 Years (4 Semester)

Total Credits: 96

Eligibility: Bachelor's degree (B.Sc./B.Tech./B.E.) examination or any other examination recognized as equivalent thereto with one of the subject Physics/Nanoscience & Nanotechnology/Photonics or equivalent.

Rationale:

In a complex world where revolutionary progress has been and continues to be made in communications, computer memory, data processing, and biomedical technology. There is a growing need for new technologies that rapidly detect and treat diseases at an early stage or even pre-stage. As we get accustomed to these advances, our expectations will demand more compact, energy-efficient, rapidly responding, and environmentally safe technologies. Photonic-based technology, coupled with nanotechnology, can meet many of these challenges. Nanomedicine, combined with light-guided and activated therapy, will advance individualized therapy that is based on molecular recognition and thus have minimal side effects. Nanophotonics in its broader vision offers opportunities for interactions among many traditionally disparate disciplines of science, technology, and medicine. It is a multidisciplinary field in term of applications, creating opportunities in physics, chemistry, applied sciences, engineering, and biology, as well as in biomedical technology.

The course is for the larger education, research, and training of students and will integrate the physics and chemistry of nanomaterials, principles of photonics and nanotechnology leading to the understanding of light matter interaction at quantum level. Within this course, students will study nanoscale processes and devices and their applications for manipulating light on the nanoscale.

Salient Features:

1. It is interdisciplinary program and admission is open to B.Sc./B.Tech./B.E. or any other examination recognized as equivalent thereto with one of the subject Physics/Nanoscience & Nanotechnology/Photonics or equivalent.
2. Students will have the option to select some the courses offered through MOOCs.
3. Evaluation focuses more on formative evaluation to enable development of desired competencies.
4. Project specific subject to be selected by the subject will be supervised and monitored by institute faculty.
6. The program is designed to allow the students to spend one year for project work and explore the possibility of developing prototype.
8. Effective implementation of NEP-2020 is ensured by offering a number of multidisciplinary
9. To ensure attainment of program outcomes, emerging pedagogical approaches will be inbuilt in the teaching learning methodology.
11. Since the program is of interdisciplinary nature, bridge courses will be offered to meet the pre-requisites of the program.
12. The programme focusses on the basics and application of physical sciences, especially Nanotechnology, Electronics and Nanophotonics etc.
13. It stresses on interdisciplinary fields like modeling, simulation and extensive laboratory and Project work.
14. The courses designed provide a platform for the research in cutting edge technology and cover major aspects of national examinations of repute like NET, GATE etc.
15. The programme will prepare students for research and career in an industrial or national research laboratory environment.

Aim:

To develop the next generation of experts in the emerging area of nanophotonics.

Programme Outcomes : At the end of the program, the students will be able to :

- Apply the principles of photonics and nanotechnology.
- Use the peculiarities of the quantum models for the light-matter interaction.
- Use of artificial intelligence in nanophotonics.
- Use the understanding of nanoscale processes and quantum models for the light-matter interaction for nanophotonic technological developments.

Programme Objectives : :

To develop the human resources having a clear view about this stimulating field of nanophotonics and shall be ready to contribute to the advances of photonic technology for a broad area of applications, from telecommunication/data communications to solid state display, energy, sensing technologies, etc.

MASTER OF SCIENCE (NANOPHOTONICS)

Scheme of Teaching and Examination

| Semester – I | | | | | | | |
|--------------------------------|--------------------|--|---------------------------|----------------|-----------------------|-----------------------|--------------|
| Sr. No. | Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
| 36. | NP-C-101 | Advanced Mathematics - I | 4-0-0 | 4 | 60 | 40 | 100 |
| 37. | NP-C-102 | Statistical and Thermal Physics | 4-0-0 | 4 | 60 | 40 | 100 |
| 38. | NP-C-103 | Photonics | 4-0-0 | 4 | 60 | 40 | 100 |
| 39. | NP-C-104 | Quantum Electrodynamics | 4-0-0 | 4 | 60 | 40 | 100 |
| 40. | NP-C-105 | Advanced Solid State Physics | 4-0-0 | 4 | 60 | 40 | 100 |
| 41. | NP-P-106 | Devices Laboratory | 0-0-4 | 2 | 60 | 40 | 100 |
| 42. | NP-P-107 | Photonics Laboratory | 0-0-4 | 2 | 60 | 40 | 100 |
| Total | | | 28 | 24 | 420 | 280 | 700 |
| Semester – II | | | | | | | |
| 1. | NP-C-201 | Advanced Mathematics - II | 4-0-0 | 4 | 60 | 40 | 100 |
| 2. | NP-C-202 | Advanced Quantum Physics | 4-0-0 | 4 | 60 | 40 | 100 |
| 3. | NP-C-203 | Atoms, Molecules, Photons and their Technologies | 4-0-0 | 4 | 60 | 40 | 100 |
| 4. | NP-C-204 | Nanomaterials & Characterization | 4-0-0 | 4 | 60 | 40 | 100 |
| 5. | NP-C-205 | Nanophotonics & Modeling | 4-0-0 | 4 | 60 | 40 | 100 |
| 6. | NP-P-206 | Nanomaterials Laboratory | 0-0-4 | 2 | 60 | 40 | 100 |
| 7. | NP-P-207 | Nanophotonics Computational Lab | 0-0-4 | 2 | 60 | 40 | 100 |
| Total | | | 28 | 24 | 420 | 180 | 700 |
| Semester – III | | | | | | | |
| 1. | NP-C-301 | Advanced Photonics | 4-0-0 | 4 | 60 | 40 | 100 |
| 2. | NP-C-302 | Intelligent Nanophotonics | 4-0-0 | 4 | 60 | 40 | 100 |
| 3. | NP-C-303 | MOOC Course - Research Methodology | 4-0-0 | 4 | 60 | 40 | 100 |
| 4. | NP-E-30X | Elective* | 4-0-0 | 4 | 60 | 40 | 100 |
| 5. | NP-D-307 | Mini Project** | - | 8 | 100 | 100 | 200 |
| Total | | | 16 | 24 | 220 | 380 | 600 |
| Semester – IV | | | | | | | |
| 1. | NP-D-401 | Project/Thesis** | - | 24 | 100 | 100 | 200 |
| Total | | | - | 24 | 100 | 100 | 200 |
| Total number of Credits | | | | 96 | Total Marks | | 2200 |

* Elective Courses (NP-E-30X)

| Sr. No. | Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|----------------|--------------------|---------------------------------------|---------------------------|----------------|-----------------------|-----------------------|--------------|
| 1. | NP-E-304 | MOOC Course - Artificial Intelligence | 4-0-0 | 4 | 60 | 40 | 100 |
| 2. | NP-E-305 | Quantum Computing | 4-0-0 | 4 | 60 | 40 | 100 |
| 3. | NP-E-306 | MEMS and NEMS | 4-0-0 | 4 | 60 | 40 | 100 |

**Project should preferably be on live problems of economic/ industrial relevance.

AIMS AND OBJECTIVES OF DIFFERENT COURSES

NP-C-101

The aim and objective of the course on **Advanced Mathematics - I** is to equip the students with the mathematical techniques that he/she needs for understanding theoretical treatment in different courses taught in this class and develop a strong background if he/she chooses to pursue research in physics as a career.

NP-C-102

The aim and objective of the course on **Statistical and Thermal Physics** is to equip the students with the techniques of Ensemble theory so that he/she can use these to understand the macroscopic properties of the matter in bulk in terms of its microscopic constituents.

NP-C-103

The **Photonics** course covers semiconductor physics, physical principles of devices and their basic applications, photodiodes, high frequency high power devices, transducers and nanoelectronic devices.

NP-C-104

The **Quantum Electrodynamics** course covers Electrostatics and Magnetostatics including Boundary value problems, Maxwell equations and their applications to propagation of electromagnetic waves in dielectrics, metals and plasma media; EM waves in bounded media, waveguides, Radiation from time varying sources. It also covers motions of relativistic and non-relativistic charged particles in electrostatic and magnetic fields.

NP-C-105

The aim and objective of the course on **Advanced Solid State Physics** is to expose the students to the topics like elastic constants, lattice vibrations, dielectric properties, energy band theory, transport theory, optical properties, magnetism, superconductivity, magnetic resonance techniques and disordered solids so that they are confident to use the relevant techniques in their later career so that they are equipped with the techniques used in investigating these aspects of the matter in condensed phase.

NP-C-201

The aim and objective of the course on **Advanced Mathematics - II** is to equip the student with the mathematical techniques that he/she needs for understanding theoretical treatment in different courses taught in this class and for developing a strong background if he/she chooses to pursue research as a career.

NP-C-202

The aim and objective of the course on **Advanced Quantum Physics** is to introduce the students to the formal structure of the subject and to equip them with the techniques of angular momentum, perturbation theory and scattering theory so that they can use these in various branches of physics as per their requirement.

NP-C-203

The aim and objective of the course on **Atoms, Molecules, Photons and their Technologies** is to develop a basic understanding of physics of atoms and molecules: definitions, units, laws and rules, to gain an ability of basic problems analyzing and solving in physics of atoms, molecules, and photons to realize a role and practical application of physics of atoms, molecules and photons in the modern world

NP-C-204

The course on **Nanomaterials & Characterization** provides an in-depth understanding of top-down device fabrication. Focus is the unit processes typically used in micro & nanofabrication of devices. Both concepts and practical aspects are covered. Topics include crystal growth, doping, chemical vapor deposition, physical vapor deposition, photolithography, wet etching, dry etching, and packaging. The

course is accessible to students from diverse backgrounds, such as materials, physics, chemistry, mechanical engineering, and electrical engineering.

NP-C-205

The course **Nanophotonics & Modeling** outlines physically the intuitive concepts of nanophotonics using the concept of optical near-fields. Optical near-field is an electromagnetic field that mediates the interaction between nanometric materials used for the realization of novel photonic devices, fabrication techniques, systems, and their modeling.

NP-C-301

The aim and objective of the course on **Advanced Photonics** is to understand the basic concepts of physical and geometrical **optics** as they relate to engineering applications, Layout designs for **basic optical** systems, to understand the properties of **optical** fibers, and to understand the **basic** concepts of quantum entanglement.

NP-C-302

The course on **Intelligent Nanophotonics** provides an in-depth understanding of photonic crystals and optical processes in photonic materials. The course further includes application of artificial intelligence in understand complex optical processes for advance applications.

NP-E-303

The course on **Artificial Intelligence** introduces a variety of concepts in the field of artificial intelligence. It discusses the philosophy of AI, and how to model a new problem as an AI problem. It describes a variety of models such as search, logic, Bayes nets, and MDPs, which can be used to model a new problem. It also teaches many first algorithms to solve each formulation. The course prepares a student to take a variety of focused, advanced courses in various subfields of AI.

NP-E-304

The course on **Quantum Computing** exploits the quantum mechanical nature of matter to simultaneously exist in multiple possible states. Building up on the digital binary logic of bits, quantum computing is built on the basis of interacting two-level quantum systems or 'qubits' that follow the laws of quantum mechanics. Addressability of the quantum system and its fragility to delity are the major issues of concern, which if addressed appropriately, will enable this new approach to revolutionize the present form of computing. After developing the basics, this course delves on various implementation aspects of quantum computing and quantum information processing.

NP-E-305

The aim and objective of the course on **MEMS and NEMS** is to familiarize the students to the scope and recent development of the science and technology of micro- and nano-systems; Gain the physical knowledge underlying the operation principles and design of micro- and nano- systems; and learn some typical or potentially applicable micro- and nano-systems at the frontier of the development of the field.

NP-P-106, NP-P-107, NP-P-206 NP-P-207, NP-D-306 and NP-D-401

The objects of **Devices Laboratory, Photonics Laboratory, Nanomaterials Laboratory, Nanophotonics Computational Laboratory, Mini Project and Project/Thesis** is to equip graduates with experimental and simulation skills to solve live industrial and scientific problems.

Detailed Syllabus

MASTER OF SCIENCE (NANOPHOTONICS)

SEMESTER - I

| Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|-------------|--------------------------|--------------------|---------|----------------|----------------|-------|
| NP-C-101 | Advanced Mathematics - I | 4-0-0 | 4 | 60 | 40 | 100 |

UNIT- I Data interpretation and analysis, Precision and accuracy. Error analysis, propagation of errors, Regression analysis, Least squares fitting, Linear and nonlinear curve fitting, chi-square test. Cauchy-Riemann conditions, analyticity, Cauchy-Goursat theorem, Cauchy's Integral formula, branch points and branch cuts, multivalued functions, Taylor and Laurent expansion, singularities and convergence, calculus of residues, evaluation of definite integrals, Dispersion relation.

UNIT- II Vector algebra and vector calculus. Linear algebra, matrices, Cayley-Hamilton Theorem. Eigenvalues and eigenvectors. Linear ordinary differential equations of first & second order, Special functions (Hermite, Bessel, Laguerre and Legendre functions).

UNIT- III Fourier series, Fourier and Laplace transforms. Elements of complex analysis, analytic functions; Taylor & Laurent series; poles, residues and evaluation of integrals.

UNIT- IV Elementary probability theory, random variables, binomial, Poisson and normal distributions. Central limit theorem.

TUTORIALS: Relevant problems given at the end of each section in Book 1.

Books:

1. Mathematical Methods for Physicists: G. Arfken and H.J. Weber (Academic Press, San Diego).
2. Mathematical Physics : P.K. Chattopadhyay (Wiley Eastern, New Delhi).
3. Mathematical Physics: A.K. Ghatak, I.C. Goyal and S.J. Chua (MacMillan, India, Delhi).
4. Mathematical Methods in the Physical Sciences – M.L. Boas (Wiley, New York) 3rd edition.
5. Special Functions : E.D. Rainville (MacMillan, New York).
6. Mathematical Methods for Physics and Engineering : K.F.Riley, M.P.Hobson and S.J. Bence (Cambridge University Press, Cambridge).
7. Mathematical methods for Physics and Engineering, K.F. Rilay, M.P. Hobson and S.J. Bence, Cambridge Unive. Press.
8. Complex variables and applications, J.W. Brown, R.V. Churchill, 8th Ed., McGraw Hill.
9. Introduction to Mathematical Physics, C. Harper, (PHI).

| Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|--------------------|---------------------------------|---------------------------|----------------|-----------------------|-----------------------|--------------|
| NP-C-102 | Statistical and Thermal Physics | 4-0-0 | 4 | 60 | 40 | 100 |

UNIT- I Laws of thermodynamics and their consequences. Thermodynamic potentials, Maxwell relations, chemical potential, phase equilibria. Phase space, micro- and macro-states, Liouville's theorem. Micro-canonical, canonical and grand-canonical ensembles and partition functions. Free energy and its connection with thermodynamic quantities.

UNIT- II Classical and quantum statistics. Ideal Bose and Fermi gases. Principle of detailed balance. Blackbody radiation and Planck's distribution law.

UNIT- III First- and second-order phase transitions. Diamagnetism, paramagnetism, and ferromagnetism. Ising model. Bose-Einstein condensation.

UNIT IV Fluctuation, Diffusion equation. Random walk and Brownian motion. Introduction to nonequilibrium processes.

TUTORIALS: Relevant problems given in the end of each chapter in the text book.

Books:

1. Statistical Mechanics: R.K. Pathria and P.D. Beale (Butterworth-Heinemann, Oxford), 3rd edition.
2. Statistical Mechanics: K. Huang (Wiley Eastern, New Delhi).
3. Statistical Mechanics: B.K. Agarwal and M. Eisner (Wiley Eastern, New Delhi) 2nd edition.
4. Elementary Statistical Physics: C. Kittel (Wiley, New York).
5. Statistical Mechanics: S.K. Sinha (Tata McGraw Hill, New Delhi).

| Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|--------------------|---------------------|---------------------------|----------------|-----------------------|-----------------------|--------------|
| NP-C-103 | Photonics | 4-0-0 | 4 | 60 | 40 | 100 |

UNIT- I Energy Bands and Charge Carriers in Semiconductors, Bonding Forces and Energy Bands in Solids, Charge Carriers in Semiconductors, Carrier Concentrations, Drift of Carriers in Electric and Magnetic Fields, Excess Carriers in Semiconductors, Optical Absorption, Luminescence, Carrier Lifetime and Photoconductivity, Diffusion of Carriers: Processes, continuity equation, Steady State Carrier Injection, Diffusion Length.

UNIT- II Semiconductor devices (diodes, junctions, transistors, field effect devices, homo- and hetero-junction devices), device structure, device characteristics, frequency dependence and applications.

UNIT- III Nanoelectronic Devices: Spintronic Memory, Nanoelectronic Resistive Memory.

UNIT- V Transducers (temperature, pressure/vacuum, magnetic fields, vibration, optical, and particle detectors).

UNIT- IV Photonic devices: Photodiodes, Current and Voltage in an Illuminated Junction, solar cells, photo-detectors, Gain, Bandwidth, and Signal-to-Noise Ratio of Photodetectors, LEDs, Semiconductor Lasers, fiber and waveguide interconnects, optical filters, and photonic crystals.

TUTORIALS: Relevant problems given in the books.

Books:

1. Semiconductor Devices - Physics and Technology by S.M. Sze (John Wiley), 2002.
2. Solid State Electronic Devices: Ben Streetman, Sanjay Banerjee (Prentice Hall India).
3. Electronic Principles by A.P. Malvino (Tata McGraw, New Delhi) 7th edition, 2009.
4. Linear and Non-linear Circuits by Chua, Desoer and Kuh (Tata McGraw), 1987.
5. Applications of Laplace Transforms by Leonard R. Geis (Prentice Hall, New Jersey), 1989.
6. Circuit theory Fundamentals and Applications, Aram Budak (Prentice-Hall) 1987.
7. Integrated Electronics by Millman and Halkias (Tata McGraw Hill) 1991.
8. Electronic Devices and Circuits Theory, Boylested and Nashelsky, (Pearson Education).
9. Operational amplifiers and Linear Integrated circuits, R.F. Coughlin and F.F. Driscoll, (Prentice Hall of India, New Delhi), 2000.
10. Microwave Devices and circuits, Samuel Y. Liao, 3rd Ed. (Prentice-Hall of India Pvt. India).

| Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|-------------|-------------------------|--------------------|---------|----------------|----------------|-------|
| NP-C-104 | Quantum Electrodynamics | 4-0-0 | 4 | 60 | 40 | 100 |

UNIT- I Symmetry in Quantum mechanics: Symmetry Operations and Unitary Transformations, conservation principles, space and time translation, rotation, space inversion and time reversal, symmetry and degeneracy.

UNIT- II Identical particles: Identity and consequences; Symmetric and anti-symmetric wavefunction; incorporation of spin, symmetric and antisymmetric spin wave function of two identical particles, later determinant, Pauli exclusion principle.

UNIT- III Time Independent Approximation Methods: Non-degenerate perturbation theory, degenerate case, Stark effect, Zeeman effect and other examples, variational methods, WKB method, tunnelling.

UNIT- IV Time-dependent Perturbation Theory: Interaction Picture; Constant and harmonic perturbations; Fermi Golden rule; Sudden and adiabatic approximations. Beta decay as an example.

UNIT- V Scattering Theory: Differential cross-section, scattering of a wave packet, integral equation for the scattering amplitude, Born approximation, method of partial waves, low energy scattering and bound states, resonance scattering.

UNIT- VI Density Matrices: Basic definition and some properties. Pure and Mixed states.

UNIT- VII Quantum Computing: Basic Idea of Quantum Computation and Quantum Information Theory.

TUTORIALS : Relevant problems given in each chapter in the text and reference books.

Reference Books:

1. Claude Cohen-Tannoudji, Bernard Diu, Frank Laloe: Quantum Mechanics, Wiley.
2. Albert Messiah: Quantum Mechanics, Dover Publications.
3. S. Flugge: Quantum Mechanics, Springer.
4. L. I. Schiff: Quantum Mechanics, Mc-Graw Hill.
5. J. J. Sakurai: Modern Quantum Mechanics, Pearson Education.
6. E. Merzbecher: Quantum Mechanics, John Wiley.
7. Introduction to Electrodynamics: D.J. Griffiths (Prentice Hall India, New Delhi).

| Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|-------------|------------------------------|--------------------|---------|----------------|----------------|-------|
| NP-C-105 | Advanced Solid State Physics | 4-0-0 | 4 | 60 | 40 | 100 |

UNIT- I Bravais lattices. Reciprocal lattice. Diffraction and the structure factor. Bonding of solids. Elastic properties, phonons, lattice specific heat. Free electron theory and electronic specific heat. Response and relaxation phenomena. Drude model of electrical and thermal conductivity. Hall effect and thermoelectric power. Electron motion in a periodic potential, band theory of solids: metals, insulators and semiconductors

UNIT- II. Dielectric properties of solids, Electronic, ionic, and orientational polarization; static dielectric constant of gases and solids; Complex dielectric constant and dielectric losses, relaxation time, Debye equations; Cases of distribution of relaxation time, Cole - Cole distribution parameter, Dielectric modulus; Ferroelectricity, displacive phase transition, Landau Theory of Phase Transition.

UNIT- III Magnetic properties of solids. Diamagnetism, Langevin equation. Quantum theory of paramagnetism. Curie law. Hund's rules. Elementary idea of crystal field effects. Ferromagnetism. Curie-Weiss law. Heisenberg exchange interaction. Mean field theory. Antiferromagnetism. Neel point. Other kinds of magnetic order.

UNIT- IV Imperfections in solids, Frenkel and Schottky defects, defects by non-stoichiometry; electrical conductivity of ionic crystals; classifications of dislocations; role of dislocations in plastic deformation.

UNIT- V Superconductivity, Survey of important experimental results. Critical temperature. Meissner effect. Type I and type II superconductors. thermodynamics of superconducting transition. London equation. London penetration depth. energy gap. Basic ideas of BCS theory. Josephson junctions. High-T_c superconductors. Ordered phases of matter: translational and orientational order, kinds of liquid crystalline order. Quasi crystals.

TUTORIALS: Relevant problems given in the books listed below.

Books:

1. Introduction to Solid State Physics: C. Kittel (Wiley, New York).
2. Quantum Theory of Solids: C. Kittel (Wiley, New York) 1987.
3. Principles of the Theory of Solids: J. Ziman (Cambridge University Press).
4. Solid State Physics: H. Ibach and H. Luth (Springer Berlin).
5. Solid State Theory: Walter A. Harrison (Tata McGraw-Hill, New Delhi).
6. Liquid Crystals: S. Chandrasekhar (Cambridge University).
7. The Liquid Crystal Phases: Physics & Technology: T.J. Sluckin, Contemporary Physics (Taylor & Francis).

| Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|--------------------|---------------------|---------------------------|----------------|-----------------------|-----------------------|--------------|
| NP-P-106 | Devices Laboratory | 0-0-4 | 2 | 60 | 40 | 100 |

This lab includes 10 experiments

1. To plot I-V characteristics of diodes: Ge & Si and determine the operating bias for each.
2. To find the value of Planck's constant from the I-V characteristic of a LED and its temperature dependence.
3. To verify inverse square law of radiation using a photo-electric cell.
4. To draw I-V characteristics of a solar cell and find the maximum useful power for the device.
5. To study photoconductivity of photo-resistor at constant irradiance and constant voltage.
6. To plot LED and Laser Characteristics and to determine threshold current for the laser
7. To measure the wavelength of He-Ne/Semiconductor laser using a Vernier caliper.
8. To study dependence of capacitance of a parallel plate capacitor on various factors and hence to determine permittivity of air.
9. To plot I-V characteristics of diodes: Zener & LED and determine the operating bias for each.
10. Determining wavelength of sodium light by Newton's ring method.
11. To find wavelength of sodium light using Fresnel's biprism.
12. To draw B-H curve for different magnetic materials and hence determine the energy loss due to cyclic magnetization.

| Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|--------------------|----------------------|---------------------------|----------------|-----------------------|-----------------------|--------------|
| NP-P-107 | Photonics Laboratory | 0-0-4 | 2 | 60 | 40 | 100 |

This lab includes 10 experiments

1. Study and comparison of the external beam parameters of He-Ne/diode lasers.
 - a) Power distribution within the beam
 - b) Spot size of the beam
 - c) Divergence of the beam
2. To measure the wavelength of He-Ne laser with a Vernier caliper/ meter scale.
3. Verification of Snell's law and to determine the critical angle for high to low index incidence.
4. Study of Fraunhofer diffraction patterns from single and multiple slits and hence to determine the slit width using He-Ne laser.
5. To study the Fraunhofer diffraction patterns of a circular apertures and to measure diameter using He-Ne laser.
6. Study of diffraction pattern from diffraction grating and hence to measure the grating constant and number of lines using a laser beam.
7. To measure the grating constant of a given diffraction grating using a laser light.
8. To determine the dispersive power of a prism using spectrometer.
9. To determine numerical aperture (NA) and V-number for optical fibers at given wavelength.
10. Investigations of laser interference patterns using Michelson's interferometer and hence deduce the wavelength of the laser.
11. Investigation of polarization state of the laser beam and hence verification of Malus law for linearly polarized light.
12. Comparison of P-I characteristics of a LED and laser diode (ILD) and to determine the threshold current for ILD operation.
13. Study of V-I and P-I characteristics of an injection laser diode and determine the threshold current for operation and external power efficiency of the device.
14. To determine speed of light in air using a modulated laser beam.
15. Investigations of magneto-optic and electro-optic effects on modulation of laser beam.

SEMESTER - II

Syllabus

| Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|-------------|---------------------------|-----------------------|---------|----------------|----------------|-------|
| NP-C-201 | Advanced Mathematics - II | 4-0-0 | 4 | 60 | 40 | 100 |

UNIT- I Green's function. Partial differential equations (Laplace, wave and heat equations in two and three dimensions).

UNIT- II Elements of computational techniques: root of functions, interpolation, extrapolation, integration by trapezoid and Simpson's rule.

UNIT- III Solution of first order differential equation using Runge-Kutta method. Finite difference methods. Tensors (Introduction, definition of different rank tensors, Contraction and direct product, quotient rule, pseudo tensors, General tensors, Metric tensors). Introductory group theory: $SU(2)$, $O(3)$.

UNIT- IV Optimization Techniques & elementary statistics- Introduction, Linear Programming Problems, Graphical Method, Simplex Method, etc. Use of Mathematica in solving mathematical problems. Introduction to probability theory, random variables, Binomial, Poisson and Normal distributions, Central limit theorem.

TUTORIALS : Relevant problems given in the books listed below .

Books :

1. Group Theory for Physicists : A.W. Joshi (Wiley Eastern, New Delhi).
2. Mathematical Methods for Physicists : G. Arfken and H.J. Weber, (Academic Press, San Diego).
3. Matrices and Tensors in Physics : A.W. Joshi (Wiley Eastern, New Delhi).
4. Numerical Mathematical Analysis, J.B. Scarborough (Oxford Book Co., Kolkata).
5. A First Course in Computational Physics: P.L. Devries (Wiley, New York).
6. Mathematical Physics : P.K. Chatopadhyay (Wiley Eastern, New Delhi).
7. Introduction to Mathematical Physics : C. Harper (Prentice Hall of India, New Delhi).

| Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|-------------|--------------------------|--------------------|---------|----------------|----------------|-------|
| NP-C-202 | Advanced Quantum Physics | 4-0-0 | 4 | 60 | 40 | 100 |

Review of Quantum Physics: Postulates of quantum mechanics, operator methods, time-dependence, symmetry. Solutions to the Schrödinger equation in one dimension. Angular momentum and spin; matrix representations.

Motion of charged particle in electromagnetic fields: normal Zeeman effect; diamagnetic hydrogen; gauge invariance; Aharonov-Bohm effect; Landau levels.

Approximate Methods: Time-independent perturbation theory, first and second order expansion; Degenerate perturbation theory; Stark effect; nearly free electron model. Variational method: ground state energy and eigenfunctions; excited states. The WKB method: bound states and barrier penetration.

Identical particles: Particle indistinguishability and quantum statistics; free particle systems; effects of interactions.

Atomic and molecular structure: Revision of Hydrogen Atom. Fine structure: relativistic corrections; Spin-orbit coupling; hyperfine structure. Multi-electron atoms: LS coupling; Hund's rules; Zeeman effect. Born-Oppenheimer approximation; H₂⁺ ion; molecular orbitals; H₂ molecule; ionic and covalent bonding.

Time-dependent perturbation theory: Two-level system, Rabi oscillations, Magnetic resonance. Perturbation series, Fermi's Golden rule, scattering and the Born approximation. Radiative transitions, dipole approximation, spontaneous emission and absorption, stimulated emission, Einstein's A and B coefficients, selection rules; Cavity rate equations and lasers.

Elements of quantum field theory: Quantization of the classical atomic chain; phonons; rules of field quantization and quantum electrodynamics; number states, coherent states, non-classical light.

TUTORIALS : Relevant problems given in the books listed below.

Books

Quantum Physics, S. Gasiorowicz (Wiley)

Quantum Mechanics: Non-Relativistic Theory, Volume 3, L. D. Landau and L. M. Lifshitz (Butterworth-Heinemann)

Quantum Mechanics, F. Schwabl, (Springer).

Quantum Mechanics, B. H. Bransden and C. J. Joachain (Pearson)

The Physics of Atoms and Quanta, H. Haken and H. C. Wolf (Springer).

Principles of Quantum Mechanics, R. Shankar, (Springer).

Problems in Quantum Mechanics, G. L. Squires (CUP).

| Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|-------------|--|--------------------|---------|----------------|----------------|-------|
| NP-C-203 | Atoms, Molecules, Photons and their Technologies | 4-0-0 | 4 | 60 | 40 | 100 |

UNIT- I Electromagnetic spectrum, Effect of electromagnetic radiations on atoms and molecules, Quantization and hydrogen atom, Quantum states of an electron and electron spin. Quantization in polyatomic molecules- Spectrum of helium and alkali atom, Selection rules. Relativistic corrections for energy levels of hydrogen atom, hyperfine structure and isotopic shift, width of spectrum lines, LS & JJ couplings. Zeeman, Paschen-Bach & Stark effects. Electron spin resonance, Nuclear magnetic resonance,

UNIT- II Molecular Structures, Molecular vibrations- diatomic, polyatomic molecules, vibrations in excited electronic states Molecular rotations- diatomic and linear polyatomic molecules, non-linear polyatomic molecules, chemical shift. Frank-Condon principle. Rotational spectroscopy and molecular structure determination, Vibrational spectroscopy, Raman effect and Raman spectra of diatomic molecules, selection rules and spectral line widths.

UNIT- III Lasers: Quantum theory of light, Atomic distributions, Excitation and de-excitation processes, Einstein prediction and stimulated emission, Einstein A & B coefficients, population inversion and photon density, pumping methods, threshold and steady conditions, optical feedback, laser cavity and resonance conditions, modes of resonators, energy level schemes, Laser rate equation, optimum power. Laser types- solid state (Ruby, Nd-YAG), dye and gas (He-Ne, CO₂, Ar-ion, Excimer) lasers, laser beam properties, Modulation effects- electro-optic and magneto-optic, controls of laser output.

UNIT-IV Laser Applications – Holography, Optical storage, Medicines, Communication, Material processing, Interferometric measurements, environment and pollution measurements, Laser cooling, trapping and ablation, laser based spectroscopic techniques.

Tutorials: Relevant problems pertaining to the topics covered in the course.

Books :

1. Spectra of Atoms and Molecules: Oxford University Press, 3rd Edn (Peter F Bernath, 2016).
2. Fundamentals of Molecular spectroscopy: Banwell and McCash (Tata McGraw Hill).
3. Molecular Structure and Molecular Spectroscopy G. Aruldhas (PHI Learning)
4. Lasers – Theory and Applications, Macmillan India Ltd. (Thyagarajan and Ghatak)
5. An introduction to Lasers- theory and applications, S.Chand and Company Ltd., (M N Avadhanulu,)
6. Lasers and Non-linear Optics: B.B. Laud. (Wiley Eastern).

| Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|-------------|----------------------------------|--------------------|---------|----------------|----------------|-------|
| NP-C-204 | Nanomaterials & Characterization | 4-0-0 | 4 | 60 | 40 | 100 |

UNIT – I Size/quantum confinement and density of states of low dimensional structures (e.g. Quantum dots, Quantum wells, Quantum wires), size-dependent oscillator strength, surface states and effects in nanomaterials, Electrical, optical and magnetic properties of nanomaterials.

UNIT – II Physical and Chemical Synthesis Methods: Thermal evaporation, e-beam evaporation, Sputtering techniques, Pulse Laser Deposition, Atomic Layer Deposition, Molecular beam epitaxy, Chemical Vapor Deposition (CVD), Sol-gels techniques, Co-precipitation, Hydrothermal, Microwave, Electroplating, Liquid Phase Epitaxy, Langmuir Blodgett, Spin and Dip coating techniques and Spray pyrolysis.

UNIT – III Lithographic Techniques- SPM based nanolithography and nanomanipulation, E-beam lithography and SEM based nanolithography and nanomanipulation, Ion beam lithography, oxidation and metallization. Mask and its application. Deep UV lithography, X-ray based lithography, Dip pen nanolithography.

UNIT – IV Characterization of Nanomaterials: Characterization by X-ray Diffraction, Characterization by Scanning Probe Microscopy (e.g. STM, AFM, SEM, TEM), Energy Dispersive X-ray Spectroscopy, X-ray photoelectron spectroscopy, Optical Characterization (UV-Visible, Ellipsometry, Photoluminescence), IR spectroscopy, and Mossbauer spectroscopy, VSM, thermal characterizations (TGA, DTA, DSC).

UNIT – V Application of Nanomaterials: Applications of nanostructured materials in optoelectronic and electronic devices for display, storage, sensing and NEMS, bionanotechnology, medical, textile, ceramic industries etc.

TUTORIALS: Relevant problems given in the text and reference books.

Books :

1. Nanostructures & Nanomaterials: Synthesis, Properties & Applications, Guozhong Cao, Imperial College Press.
2. Physics of Low-Dimensional Semiconductor Structures, P. Butcher, N. H. March and M. P. Tosi, Plenum Press New York & London.
3. Springer Handbook of Nanotechnology, Edited by B. Bhushan, Springer Verlag.
4. Introduction to Nano: Basics to Nanoscience and Nanotechnology, A Sengupta, CK Sarkar, Springer (2015).
5. Introduction to Nanoscience and Nanotechnology, Chris Binns, Wiley.
6. Optical Properties and Spectroscopy of Nanomaterials, Jin Zhong Zhang, World Scientific Publishing Co.

| Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|-------------|--------------------------|--------------------|---------|----------------|----------------|-------|
| NP-C-205 | Nanophotonics & Modeling | 4-0-0 | 4 | 60 | 40 | 100 |

UNIT-I: Introduction to Nanophotonics

Modern optical science and technology and the diffraction limit – Breaking through the diffraction limit – Nanophotonics and its true nature. Optical near fields and effective interactions as a base for nanophotonics – Principles of operations of nanophotonic devices using optical near fields – Principles of nanofabrication using optical near fields.

UNIT -III: Nanophotonic Devices

Excitation energy transfer – Device operation: nanophotonic AND gate & nanophotonic OR gate – Interconnection with photonic devices– Room temperature operation.

UNIT -IV: Nanophotonic Systems

Introduction – Optical excitation transfer and system fundamentals – Parallel architecture using optical excitation transfer – Interconnections for nanophotonics – Signal transfer and environment – tamper resistance – Hierarchy in nanophotonics and its system fundamentals.

UNIT -V: Modeling in Nanophotonics

Photonic Band structures, Transfer Matrices, time-domain simulations, leapfrog PDE solvers, Yee lattice finite-difference time-domain (FDTD), time-dependent density functional theory, applications to photovoltaics, thermal management, radiative control.

TUTORIALS: Relevant problems given in the text and reference books.

Books:

1. *Photonic Crystals: Molding the Flow of Light* J.D. Joannopoulos, S.G.Johnson, J.N. Winn, and R.B. Meade Princeton University Press.
2. *Photonic Crystals: Towards Nanoscale Photonic Devices*, Jean-Michel Lourtioz, Henri Benisty, Jean-Michel Gerard, Vincent Berger, Daniel Maystre, Alexei Tcheltnokov, Springer Science & Business Media.
3. *Photonic Crystals: The Road from Theory to Practice* Steven G. Johnson, John D. Joannopoulos, Springer Science & Business Media.
4. Motoichi Ohtsu, Kiyoshi Kobayashi, Tadashi Kawazoe, Takashi Yatsui and Makoto Naruse, *Principles of Nanophotonics*. New York, USA: CRC Press-Taylor & Francis Group.
5. Herve Rigneault, Jean-Michel Lourtioz, ClaudeDelalande and Ariel Levenson, *Nanophotonics*. London, UK: ISTE Ltd.
6. Paras. N. Prasad, *Nanophotonics*. New Jersey, USA:John Wiley & Sons Inc..
7. davidkirkpatrick.wordpress.com/tag/nanophotonics/ www.nanophotonics.de/
8. www.ece.rice.edu/~halas/ nanohub.org/courses/nanophotonics

| Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|-------------|--------------------------|--------------------|---------|----------------|----------------|-------|
| NP-P-206 | Nanomaterials Laboratory | 0-0-4 | 2 | 60 | 40 | 100 |

This lab includes 10 experiments

1. To synthesize the semiconducting nanomaterials (e.g. CdSe) using coprecipitation method.
2. To study the semiconducting nanomaterials for its transmission or absorption characteristics.
3. To determine the dielectric constant of a non-aqueous liquid sample.
4. To determine velocity of ultrasonic in different liquids using ultrasonic interferometer.
5. To determine the magnetic susceptibility (e.g. FeCl₃) using Quincke's method
6. To determine the electrical permittivity of free space and Dielectric constant of various materials.
7. To synthesize the magnetic (e.g. Fe₃O₄) nanoparticles using coprecipitation technique.
8. To study of Hall Effect and hence determination of Hall coefficient of a material.
9. To determine the resistivity of a given semiconductor sample using four probe method.
10. To study the magnetic susceptibility of ferrofluid (e.g. Fe₃O₄) nanoparticles.
11. To determine the band gap of semiconducting sample using four probe set up.
12. To measure velocity of ultrasonic in nanofluids (Ag/Au/Cu nanoparticles) using nanofluid interferometer
13. To study the effect of temperature on velocity in nanofluids of different concentrations using nanofluid interferometer.
14. Basic operation of MATLAB
15. Simple Plotting of 2 D curves

| Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|--------------------|---------------------------------|---------------------------|----------------|-----------------------|-----------------------|--------------|
| NP-P-207 | Nanophotonics Computational Lab | 0-0-4 | 2 | 60 | 40 | 100 |

This lab includes 10 experiments

1. Operations of MATLAB
2. Plotting of 2 D curves
3. 3 D Plotting Grid graphs
4. 3 D Plotting of Mesh curves
5. Investigations of magneto-optic effects on modulation of laser beam.
6. Investigations of electro-optic effects on modulation of laser beam.
7. Measurement of reflectance and transmittance from an optical interface.
8. Setting up a fiber optic digital link and to determine the maximum permissible bit rate transmitted through the link.
9. To measure the optical loss, fiber link length and fiber attenuation coefficient for both LED and ILD transmitters
10. Synthesis of semiconducting quantum dots using wet chemical approach.
11. To study the interaction of light with the semiconducting quantum dots.
12. Photonic bandgap measurement.
13. Study of plasmonic nanophotonic absorbers.
14. Optical properties of nanophotonic crystals.
15. Electrical properties of nanophotonic crystals.

SEMESTER - III

Syllabus

| Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|-------------|--------------------|--------------------|---------|----------------|----------------|-------|
| NP-C-301 | Advanced Photonics | 4-0-0 | 4 | 60 | 40 | 100 |

UNIT- I: Optical laws, Refractive index, Total Internal Reflection, Fresnel Relations: Reflectance and Transmittance, Fourier Optics: Wave Propagation, Fraunhofer Diffraction, Fresnel Diffraction, Spatial Filtering, Spatial Optics: Divergence, Coherence, Monochromaticity, Interference, Polarization.

UNIT- II: Fiber Optics: Optical fibers- structure and profiles, Optical Waveguiding, Ray Theory, EM theory, concept of modes, Mode Analysis, V-number and mode delay factor, Transmission Characteristics – Attenuation and dispersion, dispersion modified fibers, Photonic Crystals fibers, Fabrication techniques and Performance tests, Cabling requirements, joints and termination.

UNIT IV: Fiber-Optic Communication and Sensing Applications; Optical transmission- potential and benefits, Fiber-optic Link- design and budgets, Wavelength division multiplexing and de-multiplexing techniques, Optical devices and components - couplers and splitters, multiplexers/demultiplexers, fiber gratings, fiber amplifiers and dispersion compensators, OTDR. Non-linear effects (SBS, SRS, SPM, XPM, FWM) and mitigations. Fiber-optic Sensors; Concept and types, intensity, interferometric, wavelength and polarization based sensors. Distributed and multiplexed sensors.

UNIT- IV Photon-atom interactions, Preliminary concepts, The two-level atom approximation, Coherent superposition states, The density matrix, The time-dependent Schrodinger equation, The weak-field limit: Einstein's B coefficient, The strong-field limit: Rabi oscillations, Basic concepts, Damping, Experimental observations of Rabi oscillations, The Bloch sphere. Entangled states and quantum teleportation, Entangled states, Generation of entangled photon pairs, Single-photon interference experiments, Bell's theorem: Introduction, Bell's inequality, Experimental confirmation of Bell's theorem; Principles of teleportation, Experimental demonstration of teleportation

TUTORIALS : Relevant problems given in the text and reference books.

Books :

1. Introduction to Optics, Pearson; 3rd edn (Pedrotti)
2. Introduction to Modern Optics (Grant R. Fowles)
3. Introduction to Fiber Optics, Cambridge University Press (Ajoy Ghatak)
4. Optical Fiber Communication- Principles and Practices, PHI 2nd Edition (John M Senior).
5. Optical Fiber Communication, Mc Graw Hill 3rd Edition (Gerd Keiser)
6. Optoelectronics and Photonics- Principles and Practices, Pearson (SO Kasap).
7. Fundamentals of Fibre Optics Telecommunication and Sensor Systems, New Age International Publishers (Bishnu P. Pal)
8. Quantum Optics: An Introduction by Mark Fox (Oxford University Press)
9. The Quantum Theory of Light (Oxford Science Publications) By R Loudon

| Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|--------------------|---------------------------|---------------------------|----------------|-----------------------|-----------------------|--------------|
| NP-C-302 | Intelligent Nanophotonics | 4-0-0 | 4 | 60 | 40 | 100 |

UNIT- I Photonic crystals in 1, 2 and 3 dimensions 1D: Planar dielectric multilayer films, planar diffraction gratings, fiber Bragg gratings 2D: Planar films with 2D patterns, holey fibers 3D: Photonic crystal structures with a photonic band gap Bloch waves in one, two, and three dimensions. Brillouin zones, band diagrams.

UNIT- II Optical processes in semiconductors, Quantum well structures, quantum confined Stark effect, second and third order optical materials, Photorefractive materials, Optical limiting and switching.

UNIT- III Artificial intelligence enabled optical processes: Optical imaging, Optical spectroscopy; 3D nano-printing, nanoplasmonics and topological photonics, nanoplas solar cells

UNIT- IV Nanophotonic devices for ML applications, such as optical matrix multipliers using free-space optics and integrated photonic platforms; Photonic integrated circuits for deep neural networks

TUTORIALS: Relevant problems given in the text and reference books.

Books:

1. Photonic Crystals: Physics and Technology, Concita Sibilia, Trevor M. Benson, Marian Marciniak, Tomasz Szoplik, Springer Science & Business Media.
2. Advances in Information Optics and Photonics, Ari T. Friberg, René Dändliker, SPIE Press.
3. Neuromorphic Photonics, Paul R. Prucnal, Bhavin J. Shastri, CRC Press.

| Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|--------------------|------------------------------------|---------------------------|----------------|-----------------------|-----------------------|--------------|
| NP-C-303 | MOOC Course - Research Methodology | 4-0-0 | 4 | 60 | 40 | 100 |

1. Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process
2. Problem Identification & Formulation – Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance
3. Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.
4. Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches.
5. Measurement: Concept of measurement– what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio.
6. Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample – Practical considerations in sampling and sample size.
7. Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.
8. Interpretation of Data and Paper Writing – Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish ? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.
9. Use of Encyclopaedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline. (5%) 10. Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism

Books Recommended: -

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology – C.R.Kothari
4. Select references from the Internet

| Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|--------------------|-------------------------|---------------------------|----------------|-----------------------|-----------------------|--------------|
| NP-E-304 | Artificial Intelligence | 4-0-0 | 4 | 60 | 40 | 100 |

UNIT- I Introduction: Philosophy of AI, Definitions Modeling a Problem as Search Problem, Uninformed Search, Heuristic Search, Domain Relaxations, Local Search, Genetic Algorithms, Adversarial Search

UNIT- II Constraint Satisfaction, Propositional Logic & Satisfiability, Uncertainty in AI, Bayesian Networks

UNIT- III Bayesian Networks Learning & Inference, Decision Theory, Markov Decision Processes

UNIT- IV Reinforcement Learning, Introduction to Deep Learning & Deep RL

TUTORIALS : Relevant problems given in the text and reference books.

Books :

<https://nptel.ac.in/courses/106102220/#>

| Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|--------------------|---------------------|---------------------------|----------------|-----------------------|-----------------------|--------------|
| NP-E-305 | Quantum Computing | 4-0-0 | 4 | 60 | 40 | 100 |

UNIT- I Quantum Measurements Density Matrices, Positive-Operator Valued Measure, Fragility of quantum information: Decoherence, Quantum Superposition and Entanglement

UNIT- II Quantum Gates and Circuits, No cloning theorem & Quantum Teleportation, Bell's inequality and its implications, Quantum Algorithms & Circuits, Deutsch and Deutsch–Jozsa algorithms, Grover's Search Algorithm

UNIT- III Quantum Fourier Transform, Shore's Factorization Algorithm, Quantum Error Correction: Fault tolerance, Quantum Cryptography, Implementing Quantum Computing: issues of fidelity

UNIT- IV Scalability in quantum computing, NMR Quantum Computing, Spintronics and QED approaches, Linear Optical Approaches, Nonlinear Optical Approaches, Limits of all the discussed approaches

TUTORIALS: Relevant problems given in the text and reference books.

Books:

1. Michael A. Nielsen and Issac L. Chuang, "Quantum Computation and Information", Cambridge.
2. Riley Tipton Perry, "Quantum Computing from the Ground Up", World Scientific Publishing Ltd.
3. Scott Aaronson, "Quantum Computing since Democritus", Cambridge.
4. P. Kok, B. Lovett, "Introduction to Optical Quantum Information Processing", Cambridge.
5. <https://nptel.ac.in/courses/104104082/>

| Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|--------------------|---------------------|---------------------------|----------------|-----------------------|-----------------------|--------------|
| NP-E-306 | MEMS and NEMS | 4-0-0 | 4 | 60 | 40 | 100 |

UNIT I INTRODUCTION

New trends in Engineering and Science: Micro and Nano scale systems Introduction to Design of MEMS and NEMS, Overview of Nano and Micro electromechanical Systems, Applications of Micro and Nano electro mechanical systems, Micro electromechanical systems, devices and structures Definitions, Materials for MEMS: Silicon, silicon compounds, polymers, metals

UNIT II FABRICATION TECHNOLOGIES

Microsystem fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation. Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect-Ratio (LIGA and LIGA-like) Technology; Packaging: Microsystems packaging, Essential packaging technologies, Selection of packaging materials

UNIT III SENSORS

MEMS Sensors: Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Microsensors. Case study: Piezo-resistive pressure sensor

UNIT IV ACTUATORS

Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), Micromechanical Motors and pumps. Case study: Comb drive actuators

UNIT V NANOSYSTEMS AND QUANTUM MECHANICS

Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Schrodinger Equation and Wavefunction Theory, Density Functional Theory, Nanostructures and Molecular Dynamics, Electromagnetic Fields and their quantization, Molecular Wires and Molecular Circuits.

TEXT BOOKS:

1. Marc Madou, "Fundamentals of Micro fabrication", CRC press 1997.
2. Stephen D. Senturia, "Micro system Design", Kluwer Academic Publishers, 2001
3. Tai Ran Hsu, "MEMS and Microsystems Design and Manufacture", Tata Mcraw Hill, 2002.
4. Chang Liu, "Foundations of MEMS", Pearson education India limited, 2006

| Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|--------------------|---------------------|---------------------------|----------------|-----------------------|-----------------------|--------------|
| NP-D-307 | Mini Project** | - | 8 | 100 | 100 | 200 |

**Mini Project should preferably be on live problems of economic/ industrial relevance.

Semester - IV

| Course Code | Course Title | Hours / Week L-T-P | Credits | Internal Marks | External Marks | Total |
|--------------------|---------------------|---------------------------|----------------|-----------------------|-----------------------|--------------|
| NP-D-401 | Project/Thesis** | - | 24 | 100 | 100 | 200 |

**Project should preferably be on live problems of economic/ industrial relevance.

Annexure-II(a)

(61 Pages)

Detailed Study and Evaluation Scheme of New Courses

MASTER OF ENGINEERING IN MECHANICAL ENGINEERING (ROBOTICS)

FIRST SEMESTER

| SUBJECT | SCHEDULE FOR TEACHING | | | CRED-ITS | MARKS | | |
|-----------------------------|-----------------------|---|-------|-----------|---------------------|------------------------|------------|
| | L | P | TOTAL | | Internal Assessment | University Examination | TOTAL |
| Industrial Robotics | 4 | - | 4 | 4 | 50 | 50 | 100 |
| Mechanism Design & Analysis | 4 | - | 4 | 4 | 50 | 50 | 100 |
| Machine Learning | 3 | - | 3 | 3 | 50 | 50 | 100 |
| Fundamentals of IoT | 3 | - | 3 | 3 | 50 | 50 | 100 |
| Elective Subject – I | 4 | - | 4 | 4 | 50 | 50 | 100 |
| Robotics Lab – I | - | 4 | 4 | 2 | 50 | - | 50 |
| SEMESTER TOTAL: | | | | 20 | 300 | 250 | 550 |

SECOND SEMESTER

| SUBJECT | SCHEDULE FOR TEACHING | | | CRED-ITS | MARKS | | |
|---|-----------------------|---|-------|-----------|---------------------|------------------------|------------|
| | L | P | TOTAL | | Internal Assessment | University Examination | TOTAL |
| Sensors & Grippers for Robotics | 4 | - | 4 | 4 | 50 | 50 | 100 |
| Computer Programming for Robotic Applications | 4 | - | 4 | 4 | 50 | 50 | 100 |
| Industrial IoT | 3 | - | 3 | 3 | 50 | 50 | 100 |
| Big Data Analytics | 3 | - | 3 | 3 | 50 | 50 | 100 |
| Elective Subject – II | 4 | - | 4 | 4 | 50 | 50 | 100 |
| Robotics Lab – II | - | 4 | 4 | 2 | 50 | - | 50 |
| SEMESTER TOTAL: | | | | 20 | 300 | 250 | 550 |

THIRD SEMESTER

| SUBJECT | SCHEDULE FOR TEACHING | | | CREDITS | MARKS | | |
|------------------------|-----------------------|----|-------|-----------|---------------------|------------------------|------------|
| | L | P | TOTAL | | Internal Assessment | University Examination | TOTAL |
| Elective Subject - III | 2 | - | 2 | 2 | 50 | 50 | 100 |
| Elective Subject - IV | 2 | - | 2 | 2 | 50 | 50 | 100 |
| Preliminary Thesis | - | 20 | 20 | 10 | - | - | - |
| SEMESTER TOTAL: | | | | 14 | 100 | 100 | 200 |

FOURTH SEMESTER

| SUBJECT | SCHEDULE FOR TEACHING | | | CREDITS | MARKS | | |
|---------|-----------------------|----|-------|---------|---------------------|------------------------|-------|
| | L | P | TOTAL | | Internal Assessment | University Examination | TOTAL |
| Thesis | - | 32 | 32 | 16 | 100 | 100 | 200 |

NOTE: Requirement for the award of M. Tech. Mechanical Engineering (Robotics) degree is 70 credits with minimum CGPA of 6.0

ELECTIVE SUBJECTS GROUPS (Any one to be selected from each group):

| ELECTIVE SUBJECT – I | ELECTIVE SUBJECT – III | ELECTIVE SUBJECT – IV |
|------------------------------|--|----------------------------------|
| Computer Aided Design | Machinery Fault Diagnosis And Signal Processing | Blockchain Architecture & Design |
| Mechatronics Systems | Rapid Manufacturing | Deep Learning |
| Digital Logic & Circuits | Finite Element Analysis | Programming in Python |
| Digital Signal Processing | Mathematical Modeling of Manufacturing Processes | Natural Language Processing |
| ELECTIVE SUBJECT – II | Advanced Materials and Processes | Fuzzy Systems and Applications |
| Robot Motion Planning | Manufacturing Systems Technology | Computer Vision |
| Digital Manufacturing | Industrial Safety Engineering | Digital Image Processing |

| | | |
|-------------------------|----------------------------------|---|
| Optimization Techniques | System Design for Sustainability | Pattern Recognition and Application |
| Research Methodology | Applied Ergonomics | Patent Law For Engineers And Scientists |

LIST OF BOOKS:

1. *Introduction to Robotics – Mechanics and Control*; John J. Craig; Pearson Education; 2017
2. *Introduction to Robotics*; S. K. Saha; McGraw Hill Education (India) Pvt. Ltd.; 2014
3. *Introduction to Robotics – Analysis; Control; Applications*; Saeed B. Niku; Wiley India Pvt. Ltd.; 2011
4. *Theory of Machines and Mechanisms*; J. E. Shigley and J. J. Uicker; Oxford University Press; 2014
5. *Mechanics of Materials*; Ferdinand P. Beer, E. Russell Johnston and Jr. John T. DeWolf ; Tata McGraw-Hill; 3rd Edition; 2014
6. *Introduction to Machine Learning*; EthemAlpaydin; PHI Learning Pvt. Ltd.; 2015
7. *Introduction to Statistical Learning*; Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani; Springer; 2013
8. *The Internet of Things: Enabling Technologies, Platforms, and Use Cases*; Pethuru Raj and Anupama C. Raman; Auerbach Publications; 2017
9. *Smart Sensors at the IoT Frontier*; Yasuura; H., Kyung C.M., Liu Y., and Lin Y.L.; Springer International Publishing; 1st Edition;2018
10. *Measurement Systems: Application & Design*; E. A. Doebelin; McGraw Hill; 7th Edition; 2019
11. *Robotic Engineering – An Integrated Approach*; Klafter R.D.,Chmielewski T.A and Negin M.; Prentice Hall; 2003
12. *MATLAB Programming for Engineers*; Stephen J. Chapman; Cengage Learning India Pvt. Ltd; 6thEdition; 2019
13. *Modeling and Simulation using MATLAB – Simulink*; Shailendra Jain; Wiley;2nd Edition; 2015
14. *Industry 4.0: The Industrial Internet of Things*”; by Alasdair Gilchrist; Apress; 1st Edition; 2017
15. *Industrial Internet of Things: Cyber manufacturing Systems*; by Sabina Jeschke; Christian Brecher; Houbing Song; Danda B. Rawat; Springer; 1st Edition; 2017
16. *Big Data Analytics: A Hands-On Approach*; Arshdeep Bahga; Vijay Madiseti; VPT Publishers; 2018

M.E.MECHANICAL ENGINEERING (DIGITAL MANUFACTURING)
REGULAR PROGRAMME

Rationale

In last one decade digital manufacturing has become popular with the rise in quantity and quality of computer systems in conventional manufacturing facilities. Since more automated tools are being used in manufacturing units it is necessary to model/ simulate and analyze all machines, tooling and input materials to optimize the manufacturing process. The master's course in Digital manufacturing is in-line with the integrated approach to manufacturing which is centred on computer system. This M.E Mechanical Engineering (Digital Manufacturing) course also full-fill goals of computer-integrated manufacturing, flexible manufacturing, lean manufacturing, and design for manufacturability. This course has been especially designed for use in the computerized world.

STUDY & EVALUATION SCHEME

Duration 2 Years (4 Semester)

FIRST SEMESTER

| CODE | SUBJECT | SCHEDULE FOR TEACHING | | | CREDITS | MARKS | | |
|------------------------|-------------------------------------|-----------------------|---|-------|-----------|---------------------|------------------------|------------|
| | | L | P | TOTAL | | Internal Assessment | University Examination | TOTAL |
| MDM-601 | Advanced Engineering Materials | 4 | - | 4 | 4 | 50 | 50 | 100 |
| MDM - 602 | Manufacturing Technology | 4 | - | 4 | 4 | 50 | 50 | 100 |
| MDM - 603 | Design for Additive Manufacturing | 4 | - | 4 | 4 | 50 | 50 | 100 |
| MDM - 604 | Computer Programming & Applications | 4 | - | 4 | 4 | 50 | 50 | 100 |
| ----- | Elective Subject – I | 4 | - | 4 | 4 | 50 | 50 | 100 |
| MDM - 701 | Digital Manufacturing Lab – I | - | 4 | 4 | 2 | 50 | - | 50 |
| SEMESTER TOTAL: | | | | | 22 | 300 | 250 | 550 |

SECOND SEMESTER

| CODE | SUBJECT | SCHEDULE FOR TEACHING | CREDITS | MARKS |
|------|---------|-----------------------|---------|-------|
|------|---------|-----------------------|---------|-------|

| | | L | P | TOTAL | | Internal Assessment | University Examination | TOTAL |
|------------------------|---|---|---|-------|-----------|---------------------|------------------------|------------|
| MDM - 605 | Computer Integrated Manufacturing Systems | 4 | - | 4 | 4 | 50 | 50 | 100 |
| MDM - 606 | Industrial Robotics | 4 | - | 4 | 4 | 50 | 50 | 100 |
| MDM - 607 | Industrial IoT | 4 | - | 4 | 4 | 50 | 50 | 100 |
| MDM - 608 | Additive Manufacturing of Metals and Non-metals | 4 | - | 4 | 4 | 50 | 50 | 100 |
| ----- | Elective Subject - II | 4 | - | 4 | 4 | 50 | 50 | 100 |
| MDM - 702 | Digital Manufacturing Lab – II | - | 4 | 4 | 2 | 50 | - | 50 |
| SEMESTER TOTAL: | | | | | 22 | 300 | 250 | 550 |

THIRD SEMESTER

| CODE | SUBJECT | SCHEDULE FOR TEACHING | | | CREDITS | MARKS | | |
|------------------------|------------------------|-----------------------|----|-------|-----------|---------------------|------------------------|------------|
| | | L | P | TOTAL | | Internal Assessment | University Examination | TOTAL |
| ----- | Elective Subject – III | 4 | - | 4 | 4 | 50 | 50 | 100 |
| ----- | Elective Subject – IV | 4 | - | 4 | 4 | 50 | 50 | 100 |
| MDM 751 | Preliminary Thesis | - | 20 | 20 | 10 | - | - | - |
| SEMESTER TOTAL: | | | | | 18 | 100 | 100 | 200 |

FOURTH SEMESTER

| CODE | SUBJECT | SCHEDULE FOR TEACHING | | | CREDITS | MARKS | | |
|------|---------|-----------------------|----|-------|-----------|---------------------|------------------------|--------------|
| | | L | P | TOTAL | | Internal Assessment | University Examination | TOTAL |
| | Thesis | - | 30 | 30 | 15 | 100* | 100 | 200** |

| | | |
|------------|--|--|
| MDM 752 | * Internal assessment is based on the following criterion: | |
| | Grade | Condition |
| | A+ | Publication from Thesis in SCI indexed journal |
| | A | Publication from Thesis in Scopus indexed journal |
| | B+ | Publication from Thesis in UGC journal OR Scopus indexed conference proceedings |
| | B | Publication from Thesis in International Conference |
| | C+ | Publication from Thesis in National Conference |
| | ** Final Grade will be average of the grades of internal assessment and university viva-voce examination | |

NOTE: Requirement for the award of ME Mechanical Engineering (Manufacturing Technology) degree is 75 credits with minimum CGPA of 6.0

LIST OF ELECTIVES

Students will opt for 4 elective courses out of which 2 to 3 elective courses will be in online mode

CONTACT MODE

| CODE | SUBJECT | Credits |
|----------|---|---------|
| MDM-651 | Mechatronics | 4 |
| MDM-652 | Design of Experiment | 4 |
| MDM-653 | Big Data Analysis for Manufacturing | 4 |
| MDM-654 | Cyber security for Manufacturing | 4 |
| MMT-651 | Computer Programming & Applications | 4 |
| MMT-652 | Computer Aided Design for Manufacturing | 4 |
| MMT-653 | Industrial Instrumentation | 4 |
| MMT-654 | Welding Technology | 4 |
| MMT-655 | Optimization Techniques | 4 |
| MMT-656 | Industrial Project Management | 4 |
| MMT-657 | Research Methodology | 4 |
| MMT-658 | Technology Management | 4 |
| CS 8111* | Cloud Computing | 4 |
| CS 8203* | Soft Computing | 4 |

** For CS 8111 and CS 8203 courses, the syllabi of M.E. (Computer Science & Engineering) of Panjab University will be followed*

ONLINE MODE (SWAYAM-NPTEL)**

***For SWAYAM-NPTEL courses, the online syllabus as per the respective SWAYAM-NPTEL code will be followed*

| CODE (NPTEL code) | SUBJECT | Credits |
|----------------------|---|---------|
| MMT-671 (noc19-mm02) | Introduction to Materials Science and Engineering | 4 |
| MMT-672(noc19-mm08) | Material Characterization | 4 |
| MMT-673(noc19-me35) | Introduction To Composites | 4 |
| MMT-674(noc19-me23) | Product Design and Manufacturing | 4 |
| MMT-675(noc19-me26) | Introduction To Mechanical Micro Machining | 4 |
| MMT-676(noc19-me24) | Rapid Manufacturing | 4 |
| MMT-677(noc19-me02) | Basics of Finite Element Analysis - I | 4 |
| MMT-678(noc19-me27) | Machinery Fault Diagnosis And Signal Processing | 4 |
| MMT-679(noc19-cs32) | Introduction to Industry 4.0 and Industrial Internet of Things | 4 |
| MMT-680(noc19-cs19) | Artificial Intelligence: Knowledge Representation and Reasoning | 4 |
| MMT-681(noc19-cs14) | Machine Learning for Engineering and Scientific Applications | 4 |
| MMT-682(noc19-cs26) | Blockchain Architecture Design and Use Cases | 4 |
| MMT-683(noc19-ge11) | Non-Conventional Energy Resources | 4 |

Recommended Books:

- Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Book by Brent Stucker, David W. Rosen, and Ian Gibson (2010)
- Fundamentals of Digital Manufacturing Science, Book by Dejun Chen, Shane Xie, and Zude Zhou (2011)
- Digital Manufacturing and Assembly Systems in Industry 4.0, edited by Kaushik Kumar, Divya Zindani, J. Paulo Davim (2019)
- Digital Manufacturing in Design and Architecture, Editor: [Asterios Agkathidis](#) (2010)

- Collaborative Design and Planning for Digital Manufacturing, [Editors: Andrew Yeh Chris Nee, Lihui Wang](#) (2009)
- Digital Manufacturing: Prospects and Challenges, Christoph Haag, Torsten Niechoj (2016)
- Industry 4.0: Developments towards the Fourth Industrial Revolution, Book by Divya Zindani, J. Paulo Davim, and Kaushik Kumar (2019)
- Math for the Digital Factory, edited by Luca Ghezzi, Dietmar Hömberg, Chantal Landry (2017)
- The CNC Handbook: Digital Manufacturing and Automation from CNC to Industry 4.0, Book by Hans Kief, Helmut Roschiwal, Karsten Schwarz (2020)

**COURSE SCHEME FOR M.E. CIVIL ENGINEERING
(SMART INFRASTRUCTURE)**

M.E. Semester –I

| CODE | SUBJECT | SCHEDULE FOR TEACHING | | Credits |
|---------|---|-----------------------|-----|-----------|
| | | L | P/T | |
| MCS6101 | Smart Infrastructure Planning & Development | 4 | - | 4 |
| MCS6102 | Remote Sensing in Data Analysis & Software Application | 2 | 4 | 4 |
| MCSXXX | Elective Subject – I <ul style="list-style-type: none"> • <i>Sustainable Construction Materials</i> • <i>Infrastructure Automation</i> • <i>Smart Water Management</i> | 4 | - | 4 |
| MCSXXX | Elective Subject – II <ul style="list-style-type: none"> • <i>Integrated Waste Management</i> • <i>Environment Management</i> • <i>Resilient Structures</i> | 4 | - | 4 |
| MCSYYY | Open Elective- I | 2 | - | 2 |
| MCSZZZ | Audit Course | - | - | - |
| | TOTAL | | | 18 |

M.E. Semester –II

| CODE | SUBJECT | SCHEDULE FOR TEACHING | | Credits |
|---------|---|-----------------------|-----|---------|
| | | L | P/T | |
| MCS6201 | Intelligent Transporting System | 4 | - | 4 |
| MCS6202 | Infrastructure Health Monitoring & Retrofitting | 3 | 2 | 4 |
| MCSXXX | Elective Subject – III <ul style="list-style-type: none"> • <i>3 D Printing for Civil structure</i> • <i>Pre-Fabricated structure</i> • <i>IOT Application in Civil Engineering (SWAYAM)</i> | 4 | - | 4 |
| MCSXXX | Elective Subject – IV <ul style="list-style-type: none"> • <i>Advance Construction Technology</i> | 4 | - | 4 |

| | | | | |
|--------|---|---|---|-----------|
| | <ul style="list-style-type: none"> • <i>Green Buildings and Services</i> • <i>Advance Foundations</i> | | | |
| MCSYYY | Open Elective- II | 2 | - | 2 |
| MCSZZZ | Audit Course | - | - | - |
| | TOTAL | | | 18 |

M.E. Semester –III

| CODE | SUBJECT | SCHEDULE FOR TEACHING | | Credits |
|--------|---|-----------------------|-----|-----------|
| | | L | P/T | |
| MCSXXX | Elective Subject – V <ul style="list-style-type: none"> • Disaster Management • Digital Land Surveying and Mapping(NPTEL) | 3 | - | 3 |
| MCSXXX | Elective Subject – VI <ul style="list-style-type: none"> • Smart Cities- Planning • Alternative Energy Sources(SWAYAM) | 3 | - | 3 |
| MCSYYY | Preliminary Thesis | - | - | 10 |
| MCSZZZ | Audit Course | - | - | - |
| | TOTAL | | | 16 |

M.E. Semester –IV

| CODE | SUBJECT | SCHEDULE FOR TEACHING | | Credits |
|---------|------------------------|-----------------------|-----|-----------|
| | | L | P/T | |
| MCS6401 | Thesis | - | - | 16 |
| | TOTAL | | | 16 |
| | PROGRAMME TOTAL | | | 68 |

NOTE:

1. Requirement for the award of MECivil Engineering (Smart Infrastructure) degree is 65 credits with minimum CGPA of 6.0 and successful completion of thesis work.
2. Criteria for evaluating/grading of thesis is given below:

| S. No. | Grade | Condition |
|--------|-------|--|
| 1. | A+ | Publication from Thesis in SCI indexed journal |
| 2. | A | Publication from Thesis in Scopus indexed journal |
| 3. | B+ | Publication from Thesis in proceedings in conference which is Scopus indexed |
| 4. | B | Publication from Thesis in International Conference |
| 5. | C | Publication from Thesis in National Conference |
| 6. | X | Unsatisfactory |

ME IN CLEAN TECHNOLOGY AND SUSTAINABLE DEVELOPMENT

ME - SEMESTER I

| CODE | SUBJECT | SCHEDULE FOR TEACHING | | Credits |
|--------|---|-----------------------|----------|-----------|
| | | L | P/T | |
| MCSXXX | Environmental issues and Sustainable Development | 4 | - | 4 |
| MCSXXX | Clean Production and Techniques | 2 | 4 | 4 |
| MCSXXX | Elective Subject – I <ul style="list-style-type: none"> • <i>Sustainable Construction Materials</i> • Renewable energy sources and Energy management • <i>Smart Water Management</i> | 4 | - | 4 |
| MCSXXX | Elective Subject – II <ul style="list-style-type: none"> • <i>Integrated Waste Management</i> • Prevention and Control of Water Pollution • SANITARY CHEMISTRY & MICROBIOLOGY | 4 | - | 4 |
| MCSYYY | Open Elective- I | 2 | - | 2 |
| MCSZZZ | Audit Course | - | - | - |
| | TOTAL | | | 18 |

M.E. Semester –II

| CODE | SUBJECT | SCHEDULE FOR TEACHING | | Credits |
|---------|--|-----------------------|----------|-----------|
| | | L | P/T | |
| MCS6201 | Waste minimization techniques | 4 | - | 4 |
| MCS6202 | Environment Impact Assessment | 3 | 2 | 4 |
| MCSXXX | Elective Subject – III <ul style="list-style-type: none"> • Solid Waste Management • ENERGY AND ENVIRONMENT | 4 | - | 4 |
| MCSXXX | Elective Subject – IV <ul style="list-style-type: none"> • <i>Green Buildings and Services</i> • DESIGN OF WATER & WASTEWATER TREATMENT SYSTEMS • AIR AND WATER QUALITY MODELLING | 4 | - | 4 |
| MCSYYY | Open Elective- II | 2 | - | 2 |
| MCSZZZ | Audit Course | - | - | - |
| | TOTAL | | | 18 |

M.E. Semester –III

| CODE | SUBJECT | SCHEDULE FOR TEACHING | | Credits |
|--------|---|-----------------------|-----|-----------|
| | | L | P/T | |
| MCSXXX | Elective Subject – V <ul style="list-style-type: none"> Disaster Management ENVIRONMENTAL LEGISLATION AND MANAGEMENT SYSTEM INDUSTRIAL WASTEWATER MANAGEMENT | 3 | - | 3 |
| MCSXXX | Elective Subject – VI <ul style="list-style-type: none"> Smart Cities- Planning Alternative Energy Sources (SWAYAM) | 3 | - | 3 |
| MCSYYY | Preliminary Thesis | - | - | 10 |
| MCSZZZ | Audit Course | - | - | - |
| | TOTAL | | | 16 |

M.E. Semester –IV

| CODE | SUBJECT | SCHEDULE FOR TEACHING | | Credits |
|---------|------------------------|-----------------------|-----|-----------|
| | | L | P/T | |
| MCS6401 | Thesis | - | - | 16 |
| | TOTAL | | | 16 |
| | PROGRAMME TOTAL | | | 68 |

NOTE: Requirement for the award of Masters in Engineering on Clean Technologies and Sustainable Development degree is 65 credits with minimum CGPA of 6.0 for successful completion of thesis work.

3. Criteria for evaluating/grading of thesis is given below:

| S. No. | Grade | Condition |
|--------|-------|--|
| 1. | A+ | Publication from Thesis in SCI indexed journal |
| 2. | A | Publication from Thesis in Scopus indexed journal |
| 3. | B+ | Publication from Thesis in proceedings in conference which is Scopus indexed |
| 4. | B | Publication from Thesis in International Conference |
| 5. | C | Publication from Thesis in National Conference |
| 6. | X | Unsatisfactory |

**MASTER OF ENGINEERING - ELECTRONICS AND COMMUNICATION
ENGG. (ARTIFICIAL INTELLIGENCE)**

Year: First

Semester I

| Sr. No. | Course Code | Course Name | Scheme of Evaluation | | | Scheme of Examination | | | |
|--------------|-------------|---------------------|----------------------|-----------|-----------|-----------------------|-----------|------------|-----------|
| | | | | | | | | | |
| 1 | ECEAI 1101 | Data Structures and | 4-0-0 | 4 | 4 | 50 | 50 | 100 | - |
| 2 | ECEAI 1102 | Natural Language | 4-0-0 | 4 | 4 | 50 | 50 | 100 | - |
| 3 | CSEI 8106* | Machine Learning | 3-0-0 | 3 | 3 | 50 | 50 | 100 | - |
| 4 | CSEI 8107* | Fundamentals of | 3-0-0 | 3 | 3 | 50 | 50 | 100 | - |
| 5 | | Elective - I | 4-0-0 | 4 | 4 | 50 | 50 | 100 | - |
| 6 | ECEAI | AI Laboratory -I | 0-0-4 | 4 | 2 | - | - | - | 100* |
| 7 | | Audit Course | - | - | - | - | - | - | - |
| Total | | | 18-0- | 22 | 20 | 25 | 25 | 500 | 10 |

* Industry Core subjects - Common with M.E. in Computer Science & Engineering with specialization in IoT

Elective I (SELECT ANY ONE)

ECEAI 1103 : Cloud Computing & Virtualization (Common with M.E. in Computer Science & Engineering with specialization in IoT - CSEI 8104)

ECEAI 1104 : Industrial Robotics (Common with M.E. in Mechanical Engineering with specialization in Robotics - MER 601)

ECEAI 1105 : Wireless Sensor Networks

ECEAI 1106 : Parallel and Distributed Computing (Common with M.E. in Computer Science & Engineering - CS 8110)

Audit Course

1. Technical Report Writing
2. Start-up/ Venture Capitalism
3. Digital Pedagogy
4. Stress Management by Yoga

| S. No | Course | Course Name | Scheme of Teaching | | | Scheme of Examination | | | |
|--------------|----------------|------------------------|--------------------|-----------|-----------|-----------------------|------------|------------|-----------|
| | | | L-T-P | Contact | Credits | Theo | | | Practical |
| | | | | | | Internal | University | Total | |
| 1 | ECEAI | Computer Vision | 4-0-0 | 4 | 4 | 50 | 50 | 100 | - |
| 2 | ECEAI | Deep Learning | 4-0-0 | 4 | 4 | 50 | 50 | 100 | - |
| 3 | CSEI 8206** | Industrial Internet of | 3-0-0 | 3 | 3 | 50 | 50 | 100 | - |
| 4 | CSEI | Big Data | 3-0-0 | 3 | 3 | 50 | 50 | 100 | - |
| 5 | | Elective -II | 4-0-0 | 4 | 4 | 50 | 50 | 100 | - |
| 6 | ECEAI | AI Laboratory -II | 0-0-4 | 4 | 2 | | | | 100* |
| Total | | | 18-0- | 22 | 20 | 25 | 25 | 500 | 10 |

** Industry Core subjects - Common with M.E. in Computer Science & Engineering with specialization in IoT

Elective II (SELECT ANY ONE)

ECEAI 1203 : Research Methodology (Common with M.E. in Computer Science & Engineering - CS 8202)

ECEAI 1204 : Bio-Inspired Computation

ECEAI 1205 : Embedded System Design and Architecture

ECEAI 1206 : Fuzzy Systems and Applications

* Practical marks are for continuous and end semester evaluation

Year: Second

Semester III

| S. No. | Course Code | Course Name | Scheme of Teaching | | | Scheme of Examination | | | |
|--------------|-------------|-------------|--------------------|------------------|-----------|-----------------------|------------|------------|-----------|
| | | | L-T-P | Contact hrs/week | Credits | Theory | | | Practical |
| | | | | | | Internal | University | Total | |
| 1 | ECEAI | MOOCS – | - | - | 2 | 10 | - | 100 | - |
| 2 | ECEAI | MOOCS – | - | - | 2 | 10 | - | 100 | - |
| 3 | ECEAI | Preliminary | - | - | 10 | 10 | - | 100 | |
| Total | | | - | - | 14 | 30 | - | 300 | |

** Tentative list attached. However, the Dept. should prepare the list only from the MOOCS which conduct proctored examinations like NPTEL. Depending upon the availability of online MOOCS courses, students will be intimated one month prior to the commencement of the course.

Year: Second

Semester IV

| S. No | Course Code | Course | Scheme of Teaching | | | Scheme of Examination | | | |
|--------------|-------------|--------|--------------------|----------------|-----------|-----------------------|-------------|------------|------------|
| | | | L-T-P | Contact hrs/we | Credits | Theo | | | Practic al |
| | | | | | | Intern al | Universit y | Tota l | |
| 1 | ECEAI | Thesis | 0-0- | 25 | 16 | 10 | 10 | 200 | - |
| Total | | | 0-0- | 25 | 16 | 10 | 10 | 200 | - |

** Candidate shall make a presentation along with a demo of work done in the presence of panel of experts and nominees as per Panjab University, Chandigarh norms.

Total M.E. Credits = 70

MASTER OF ENGINEERING PROGRAMME IN COMPUTER SCIENCE AND ENGINEERING WITH SPECIALISATION IN INTERNET OF THINGS (IoT)

First Semester

| Sr. No. | Course No. | Course Title | Hours / Week | Credits | SEE Marks | CIE Marks | Total |
|--------------|---------------------|--|--------------|---------|-----------|-----------|-------|
| 1. | CSEI 8101 | Advanced Wireless Networks | 4 | 4 | 50 | 50 | 100 |
| 2. | CSEI 8102 | Sensors and Actuators | 4 | 4 | 50 | 50 | 100 |
| 3. | Branch Elective - 1 | Choose one course from the list | 4 | 4 | 50 | 50 | 100 |
| 4. | CSEI 8106 | Machine Learning | 3 | 3 | 50 | 50 | 100 |
| 5. | CSEI 8107 | Fundamentals of IoT | 3 | 3 | 50 | 50 | 100 |
| 6. | Audit Course | Choose one course from the list | - | - | - | - | - |
| 7. | CSEI 8150 | IoT Laboratory-I | 4 | 2 | - | 100 | 100 |
| Total | | | 22 | 20 | 250 | 350 | 600 |

| | |
|--|---|
| <p>List of Program Electives– Semester I (SELECT ANY ONE)</p> <ul style="list-style-type: none"> • Logic and Functional Programming • Cloud Computing and Virtualization • Programming and Interfacing with Microcontrollers | <p>List of Audit Courses</p> <ol style="list-style-type: none"> 1. Technical Report Writing 2. Start-up/ Venture Capitalism 3. Digital Pedagogy 4. Stress Management by Yoga |
|--|---|

Second Semester

| Sr. No. | Course No. | Course Title | Hours / Week | Credits | SEE Marks | CIE Marks | Total |
|--------------|---------------------|--|--------------|---------|-----------|-----------|-------|
| 1. | CSEI 8201 | Mobile Applications Development | 4 | 4 | 50 | 50 | 100 |
| 2. | CSEI 8202 | IoT Protocols and Security Issues | 4 | 4 | 50 | 50 | 100 |
| 3. | Branch Elective - 2 | Choose one course from the list | 4 | 4 | 50 | 50 | 100 |
| 4. | CSEI 8206 | Industrial IoT | 3 | 3 | 50 | 50 | 100 |
| 5. | CSEI 8207 | Big Data Analytics | 3 | 3 | 50 | 50 | 100 |
| 6. | CSEI 8250 | IoT Laboratory - II | 4 | 2 | - | 100 | 100 |
| Total | | | 22 | 20 | 250 | 350 | 600 |

| |
|--|
| <p>List of Program Electives– Semester II (SELECT ANY ONE)</p> <ul style="list-style-type: none"> • Beyond IoT – Ubiquitous Sensing and Wireless Sensor Networks • Fog/ Edge Computing • Energy Harvesting Technologies and Power Management for IoT Devices |
|--|

Third Semester

| Sr. No. | Course No. | Course Title | Hours / Week | Credits | CIE | Total |
|--------------|------------------|--|--------------|---------|-----|-------|
| 1 | MOOCs Course - 1 | MOOCs Course to be chosen from the list of curated courses (Non-Technical) | - | 2 | 100 | 100 |
| 2 | MOOCs Course - 2 | MOOCs Course to be chosen from the list of curated courses (Technical) | - | 2 | 100 | 100 |
| 3 | CSEI 8350 | Preliminary Thesis Work | 20 | 10 | 100 | 100 |
| Total | | | 20 | 14 | 300 | 300 |

The Dept. should prepare the list only from the MOOC which conduct proctored examinations like NPTEL. Depending upon the availability of online MOOC courses, students will be intimated one month prior to the commencement of the course.

Fourth Semester

| Sr. No. | Course No. | Course Title ** | Hours / Week | Credits | SEE Marks | CIE Marks | Total |
|--------------|------------|-----------------|--------------|---------|-----------|-----------|-------|
| 1 | CSEI 8450 | Thesis Work | 32 | 16 | 100 | 100 | 200 |
| Total | | | 32 | 16 | 100 | 100 | 200 |

Total Credits: 70

**MASTER OF ENGINEERING PROGRAMME IN COMPUTER SCIENCE AND
ENGINEERING WITH SPECIALISATION IN CYBER SECURITY**

Duration: 2 years

Eligibility: B.E/B.Tech in Circuit Branches

First Semester

| Sr. No. | Course No. | Course Title | Hours / Week | Credits | SEE Marks | CIE Marks | Total |
|----------------|---------------------|----------------------|---------------------|----------------|------------------|------------------|--------------|
| 8. | CSEI 8101 | Subject from list | 4 | 4 | 50 | 50 | 100 |
| 9. | CSEI 8102 | Subject from list | 4 | 4 | 50 | 50 | 100 |
| 10. | Branch Elective - 1 | Subject from list | 4 | 4 | 50 | 50 | 100 |
| 11. | CSEI 8106 | Subject from list | 3 | 3 | 50 | 50 | 100 |
| 12. | CSEI 8107 | Subject from list | 3 | 3 | 50 | 50 | 100 |
| 13. | Audit Course | Subject from list | - | - | - | - | - |
| 14. | CSEI 8150 | Cyber Security Lab 1 | 4 | 2 | - | 100 | 100 |
| Total | | | 22 | 20 | 250 | 350 | 600 |

Second Semester

| Sr. No. | Course No. | Course Title | Hours / Week | Credits | SEE Marks | CIE Marks | Total |
|----------------|---------------------|----------------------|---------------------|----------------|------------------|------------------|--------------|
| 1. | CSEI 8201 | Subject from list | 4 | 4 | 50 | 50 | 100 |
| 2. | CSEI 8202 | Subject from list | 4 | 4 | 50 | 50 | 100 |
| 3. | Branch Elective - 2 | Subject from list | 4 | 4 | 50 | 50 | 100 |
| 4. | CSEI 8206 | Subject from list | 3 | 3 | 50 | 50 | 100 |
| 5. | CSEI 8207 | Subject from list | 3 | 3 | 50 | 50 | 100 |
| 6. | CSEI 8250 | Cyber Security Lab 2 | 4 | 2 | - | 100 | 100 |
| Total | | | 22 | 20 | 250 | 350 | 600 |

Third Semester

| Sr. No. | Course No. | Course Title | Hours / Week | Credits | CIE | Total |
|--------------|------------------|--|--------------|---------|-----|-------|
| 1 | MOOCs Course - 1 | MOOCs Course to be chosen from the list of curated courses (Non-Technical) | - | 2 | 100 | 100 |
| 2 | MOOCs Course - 2 | MOOCs Course to be chosen from the list of curated courses (Technical) | - | 2 | 100 | 100 |
| 3 | CSEI 8350 | Preliminary Thesis Work | 20 | 10 | 100 | 100 |
| Total | | | 20 | 14 | 300 | 300 |

The Dept. should prepare the list only from the MOOC which conduct proctored examinations like NPTEL. Depending upon the availability of online MOOC courses, students will be intimated one month prior to the commencement of the course.

Fourth Semester

| Sr. No. | Course No. | Course Title ** | Hours / Week | Credits | SEE Marks | CIE Marks | Total |
|--------------|------------|-----------------|--------------|---------|-----------|-----------|-------|
| 1 | CSEI 8450 | Thesis Work | 32 | 16 | 100 | 100 | 200 |
| Total | | | 32 | 16 | 100 | 100 | 200 |

Total Credits: 70

M.E. in Smart Grid

Rationale

The restructuring and deregulation of electric utilities together with recent progress in new and renewable energy technologies introduce unprecedented challenges and wide scope for power and energy systems research and open up new opportunities to young Power Engineers. Conventional Power system is redefined and power electronic components are incorporated along with the existing system. This includes flexible ac transmission, HVDC links embedded in the conventional ac transmission networks etc. Further, use of renewable energy such as solar and wind power, coupled with higher efficiency and conservation, will be the key factors to a sustainable world for future generations.

Semester-1

| Course Number | Subject | Scheme of Studies Periods Per Week | | | Credits | MARKS | | |
|---------------|--|---------------------------------------|---|---------------------|-----------|---------------------|------------------------|------------|
| | | L | T | Internal Assessment | | Internal Assessment | University Examination | TOTAL |
| 1ES01 | Smart Grid Technologies | 4 | - | 0 | 4 | 50 | 50 | 100 |
| 1ES02 | Advanced Power Electronics | 4 | - | 0 | 4 | 50 | 50 | 100 |
| 1ES03 | Electric Vehicles and its Integration to Grid | 4 | - | 0 | 4 | 50 | 50 | 100 |
| 1ESxx | Core Elective I- 1ES04 Energy Conservation 1ES05 Advanced Control Theory 1ES06 Artificial Intelligence and Applications 1ES07 Real Time Power System Analysis and Smart Grid | 4 | - | 0 | 4 | 50 | 50 | 100 |
| 1ES08 | Energy Systems and Smart Grid Laboratory-I | 0 | 0 | 4 | 2 | 50 | - | 50 |
| Total | | | | | 18 | 250 | 200 | 450 |

Semester-2

| Course Number | Subject | Scheme of Studies Periods Per Week | | | Credits | MARKS | | |
|---------------|---|---------------------------------------|---|---|-----------|---------------------|------------------------|------------|
| | | L | T | P | | Internal Assessment | University Examination | TOTAL |
| 2ES09 | Advanced Metering Infrastructure | 4 | - | 0 | 4 | 50 | 50 | 100 |
| 2ES10 | Smart Grid- Standards Planning & Design Energy Auditing | 4 | - | 0 | 4 | 50 | 50 | 100 |
| 2ES11 | Integration of Distributed Generation to Grid | 4 | - | 0 | 4 | 50 | 50 | 100 |
| 2ESxx | Core Elective II- 2ES09IOT for Industrial Applications 2ES10 Big Data Analytics for Smart Grid 2ES11 Energy Systems Modelling and Analysis | 4 | - | 0 | 4 | 50 | 50 | 100 |
| 2ES12 | Energy Systems and Smart Grid Laboratory -II | 0 | 0 | 4 | 2 | 50 | - | 50 |
| Total | | | | | 18 | 250 | 200 | 450 |

Semester-3

| Course Number | Subject | Scheme of Studies Periods Per Week | | | Credits | MARKS | | |
|---------------|-----------------------|---------------------------------------|---|---|---------|---------------------|------------------------|-------|
| | | L | T | P | | Internal Assessment | University Examination | TOTAL |
| 3ES13 | Research Methodology | 4 | - | 0 | 4 | 50 | 50 | 100 |
| 3ES14 | Power System Analysis | 4 | - | 0 | 4 | 50 | 50 | 100 |

| | | | | | | | | |
|--------------|------------------------------------|---|---|----|-----------|------------|------------|------------|
| 3ES15 | Industrial Project/Dissertation -I | 0 | - | 24 | 12 | 100 | - | 100 |
| Total | | | | | 20 | 200 | 100 | 300 |

Semester-4

| Course Number | Subject | Scheme of Studies Periods Per Week | | | Credits | MARKS | | |
|---------------|--------------------------------------|---------------------------------------|---|----|-----------|---------------------|------------------------|--------------|
| | | | | | | Internal Assessment | University Examination | TOTAL |
| | | L | T | P | | | | |
| 4ES16 | Industrial Project/Dissertation – II | 0 | - | 32 | 16 | 100* | 100 | 200** |
| Total | | | | | 16 | 100* | 100 | 200** |

* Internal assessment is based on the following criterion:

| Grade | Condition |
|--|--|
| A+ | Publication from Thesis in SCI indexed journal |
| A | Publication from Thesis in Scopus indexed journal |
| B+ | Publication from Thesis in UGC journal OR Scopus indexed conference proceedings |
| B | Publication from Thesis in International Conference |
| C+ | Publication from Thesis in National Conference |
| ** Final Grade will be average of the grades of internal assessment and university viva-voce examination | |

M.E. IN ENERGY AND ENVIRONMENTAL MANAGEMENT

Rationale

Energy engineers are needed to address some of the most challenging issues facing the global economies, namely how to

- Reduce the human impact on the climate (energy accounts for 80% of greenhouse gas emissions)
- Prepare for the global peaking of oil production and further price increase with innovative, sustainable engineering solutions
- Launch a proactive approach to problems faced by the power and energy industries of an aging workforce, infrastructure degradation, and technology development deficiencies. This is where energy engineering becomes important as there is an urgent need and increasing demand worldwide for people trained to design, operate, maintain and optimize sustainable energy systems.

Semester-1

| Course Number | Subject | Scheme of Studies Periods Per Week | | | Credits | MARKS | | |
|---------------|---|---------------------------------------|---|---|-----------|---------------------|------------------------|------------|
| | | L | T | P | | Internal Assessment | University Examination | TOTAL |
| 1EM01 | Energy Technologies | 4 | - | 0 | 4 | 50 | 50 | 100 |
| 1EM02 | Instrumentation for Environmental Engineering | 4 | - | 0 | 4 | 50 | 50 | 100 |
| 1EM03 | Photovoltaic & Solar Thermal Energy | 4 | - | 0 | 4 | 50 | 50 | 100 |
| 1EMxx | Core Elective I- 1EM04 Energy Management in Building 1EM05 Energy Conservation 1EM06 Smart Grid Technologies | 4 | - | 0 | 4 | 50 | 50 | 100 |
| 1EM07 | Energy Instrumentation & Measurement Lab 1 | 0 | 0 | 4 | 2 | 50 | - | 50 |
| Total | | | | | 18 | 250 | 200 | 450 |

Semester-2

| Course Number | Subject | Scheme of Studies Periods Per Week | | | Credits | MARKS | | |
|---------------|---|---------------------------------------|---|---|-----------|---------------------|------------------------|------------|
| | | L | T | P | | Internal Assessment | University Examination | TOTAL |
| 2EM08 | Climate Change and Mitigation | 4 | - | 0 | 4 | 50 | 50 | 100 |
| 2EM09 | Environment laws, Standards & certifications | 4 | - | 0 | 4 | 50 | 50 | 100 |
| 2EM10 | Energy Management | 4 | - | 0 | 4 | 50 | 50 | 100 |
| 2EMxx | Core Elective II- 2EM11 Industrial Waste Management & Recycling 2EM12 Environmental Impact Analysis 2EM13 Energy Systems Modelling and Analysis | 4 | - | 0 | 4 | 50 | 50 | 100 |
| 2EM14 | Modelling and Simulation Lab | 0 | 0 | 4 | 2 | 50 | - | 50 |
| Total | | | | | 18 | 250 | 200 | 450 |

Semester-3

| Course Number | Subject | Scheme of Studies Periods Per Week | | | Credits | MARKS | | |
|---------------|-----------------------------------|---------------------------------------|---|---|---------|---------------------|------------------------|-------|
| | | L | T | P | | Internal Assessment | University Examination | TOTAL |
| 3EM15 | Research Methodology | 4 | - | 0 | 4 | 50 | 50 | 100 |
| 3EM16 | Pollution Control In Power Plants | 4 | - | 0 | 4 | 50 | 50 | 100 |

| | | | | | | | | |
|--------------|--|---|---|----|-----------|------------|------------|------------|
| 3EM17 | Industrial Project/Dissertation- I | 0 | - | 24 | 12 | 100 | - | 100 |
| Total | | | | | 20 | 200 | 100 | 300 |

Semester-4

| Course Number | Subject | Scheme of Studies Periods Per Week | | | Credits | MARKS | | |
|---------------|--|---------------------------------------|---|----|-----------|---------------------|------------------------|--------------|
| | | L | T | P | | Internal Assessment | University Examination | TOTAL |
| 3EM18 | Industrial Project/Dissertation – II | 0 | - | 32 | 16 | 100* | 100* | 200** |
| Total | | | | | 16 | 100* | 100 | 200** |

* Internal assessment is based on the following criterion:

| Grade | Condition |
|--|--|
| A+ | Publication from Thesis in SCI indexed journal |
| A | Publication from Thesis in Scopus indexed journal |
| B+ | Publication from Thesis in UGC journal OR Scopus indexed conference proceedings |
| B | Publication from Thesis in International Conference |
| C+ | Publication from Thesis in National Conference |
| ** Final Grade will be average of the grades of internal assessment and university viva-voce examination | |

MASTER'S DEGREE IN DIGITAL MEDIA APPLICATION FOR SOCIAL AND ENVIRONMENTAL JOURNALISM

Title of the program: Master's Degree in **Digital Media Application for Social and Environmental Journalism**

- Duration: Two Year
- Proposed intake: 40 persons
- Proposed year of starting: 2020-21

Basic Qualifications for Entry:

- **Bachelor Degree in any Subject of Arts, Science and Commerce, Engineering, Agriculture, Environmental Science or**
- **Diploma in Engineering, Diploma in Arts and Crafts with two years' Working Experience**

Rationale:

Digital media is a powerful mass media tool which has surpassed the print media and traditional medium of communication in last one decade. With the revolution in media technology, the information from one part of the globe to other part is transmitted no time. But mushroom growth of media channels and information flood, the audience or viewers get more and more confused. Many a time fake news and miscommunication also create problems among the viewers or common public. There are various social and environmental issues, which are directly related to all common persons and many times it becomes lives threatening for humans. If such issues are neglected, it leads to various kind of social and environmental problems and sometimes they take a shape of manmade and natural disaster. Similarly, the media professionals need to be oriented more towards social and environmental issues which are major concerns for all human beings. In the background of above issues and facts, a need of Digital Media Application for Social and Environmental Journalism has been felt by many learned media professionals. This master's degree programme would be handy to begin a new chapter in purposeful professional journalism raising relevant social and environmental issues.

1 Study and Evaluation Scheme

The two years master's degree plan is divided in four semesters. In the first semester basic of digital media and journalism and mass communication will be covered. It will also cover the project planning of media production along with research techniques applicable in case of media film production and research. It will also cover the development of studio and other infrastructure development for media production. In the second semester the social and environmental journalism will be covered in details along with various environmental and social issues of the India and world. It would also cover issues like disaster and pandemic management. In third semester, video film production techniques will be covered in detail which will empower the students with respect to script writing, camera operation, video and audio recording, arrangement of lights, shooting, editing and video film production, graphics and animation, news reading and anchoring and conduct of interview and debates. The evaluation of the students would done through class level quiz, seminar and practical tasks in first three semesters. The fourth semester would be purely based on projects and film production be each of the participants. Each student is supposed to make a video programme by his own or in a small group selecting any social and

environmental issues of his/her choice listed from the optional topics for the project. It will be master's degree dissertation.

2 Detailed content:

Semester I Introduction to Digital Media and its Application

- Basics of Digital Media
- Basics of Journalism and Mass Communication
- Script Writing and Content Generation
- Project Planning, Implementation and Monitoring in Media Production
- Research Methodology
- ICT Application for Digital Media
- Studio and basic infrastructure and their applications
- Government Programmes and Agencies working for Social and Environmental Issues
- Public Relation and Communication

Semester II Social and Environmental Journalism

- Social Journalism and its Components
- Professional Ethics of Journalism: Journalism with Difference
- Social Issues and Concerns in Indian Context
- Environmental Journalism
- Environmental Issues and Concerns at the Global and National Level
- Sustainable Development Goals and Sustainable Development Reporting
- Media and Green Agenda
- Climate Change, Disaster and Pandemic Management

Semester III Script Writing, Video Recording, Production and Editing

- Script Writing and shooting plan
- Basics of Camera
- Role of lights in Shooting
- Video and Audio Recording
- Video Engineering and Use of Modern Digital Media
- Shooting and Recording
- Editing
- News Production and Anchoring
- Difference between Documentaries and Commercial Movies
- Graphics and Animation
- Web Designing
- Basics of Conducting any Interview and Debates

Semester IV Project Work and Dissertation

Suggested Topics for Project Work

- Farmers Suicides
- Rape Victims and Their Case Studies
- Women Empowerment
- Domestic Violence
- Road Safety and Traffic Management
- Air Pollution
- Water Pollution
- Climate Change
- Disaster Management: Earthquake, Landslides, Floods, Cyclone, Cloud Bursting
- Farm Residues Management
- Wild Life Conservation
- Forest Conservation
- Water and Sanitation
- Birds Migration and Their Conservation
- Bio-diversity Conservation
- Participatory Rural Development
- Watershed Management
- Joint Forest Management
- Disaster Management
- Agriculture
- Dairy Farming
- Organic Farming
- Role of Panchayati Raj
- Disability and Issues of PWDs

5. References

- Navigating Social Journalism: A Handbook for Media Literacy and Citizen Journalism Book by Martin Hirst
- Citizen Journalism: Valuable, Useless, Or Dangerous? Book by Melissa Wall
- We the Media: Book by Dan Gillmor

MASTERS IN DIGITAL MEDIA AND SOCIAL JOURNALISM

Rationale:

The world is changing rapidly as a result of globalisation, digitisation, web connectivity and social media, making it an exciting time to study digital media and social journalism. Social journalism is all about finding new ways to serve communities. The Masters Programme on “Digital Media and Social Journalism” has been designed to focus on the skills that are hot in journalism today, like engagement, audience growth, social news gathering and verification, data, analytics, digital media tools, design thinking, product development and more with an aim to establish trust and relationships with communities. The course shall equip the learners with the use of all of the digital tools possible, from social media to data to new platforms, to conceive creative and innovative ways to reach communities and audiences. In other words, the course shall set up the learners to take a variety of routes in the media world: traditional journalism, strategy, audience development, analytics, and beyond.

Detailed Contents:

Semester-I

1. Basics of Digital Media.
 - Concept of Digital media
 - Need & Impact
 - Advantages of Digital Media
 - Augmented reality
 - Virtual reality
2. Introduction to Journalism.
 - Concept of Journalism
 - Types of Journalism
3. Social Journalism
 - Community engagement techniques
 - Metrics & Outcomes
 - Reporting for Social Journalism
4. Computer Application in Social Journalism.
 - Concept of Computer assisted journalism
 - Data gathering
 - Data analysis and presentation
5. Communication & Public relation in Journalism.
 - Management skills
 - Communication skills & ethics
 - Digital Public relations

Semester-II

1. Digital Content Generation pre - production
 - Production crew
 - Organizing production
 - Script writing
 - Lighting
2. Videography & Photo journalism.
 - Definition & Concept of Still photography

- Definition & Concept Of Videography
 - Relation Between still & Video Photography
3. Digital Content Generation Post- Production
 - Types of Video editing
 - Image Editing
 4. Law & Ethics in Journalism and mass Media
 - Intellectual Property rights
 - # Fundamental rights , freedom of speech & Expression and their limits
 - Directive principles of state & national Policies
 - Accountability & Independence of media
5. Web Designing
- Basics of web development
 - HTML & CSS
 - Web page interactivity with java script

Semester-III

1. Digital Publishing
 - Open standards in digital publishing
 - Cross platform publication / E-Pub & kindle
 - Tools & Services for digital Publishing
2. Digital Marketing
 - Digital Marketing concept, strategy and Implementation
 - Website marketing and Email marketing, Social Media Marketing
 - Search Engine Optimization(SEO)
 - SEO Campaigns & Pay per Click Campaign
 - Integrating Digital marketing with Traditional Marketing
3. Information Communication & Technology
 - Concept of ICT
 - Components Of ICT
 - Social & economical Impact
 - Ethical & Legal ways of ICT
4. News Production & Reporting
 - Interactive Story telling, Public speaking & Communication
 - Camera Facing Techniques, Personality Development
5. Human Rights & Duties
 - Human Rights issues & needs, Concept of Basic human rights & Duties
 - Difference between human rights & Duties , Laws & Policies regarding human rights

Semester - IV

Project work in Social Journalism / Digital Media

M.B.A. IN RURAL ENTREPRENEURSHIP

1. **Rationale:** The future of India lies in its villages. The statement made by Mahatma Gandhi stands relevant even today. The development of the country like India is largely dependent on the development of the rural areas. While deciding upon his career path, an MBA aspirant generally chooses a specialization which is not only lucrative in terms of building a career but also give you a sense of giving it back to the society. Rural Entrepreneurship is one such specialization which gives you the chance to contribute towards uplifting and betterment of those sections of the society, where the light of development is yet to reach fully.

The MBA program in Rural Entrepreneurship will introduce the learner about the basics of business management and both the opportunities and challenges that rural areas presents in terms of Entrepreneurship. The main focus will be to aid the students in overcoming the inherent weakness in the domain of rural entrepreneurship wherein the students will be introduced to a series of tools and methods that help them in taking an idea and make it happen, in a way that can sustain the business or organization that delivers it to the humanity.

The various core component of business administration involving Management of - Operations, Marketing, Finance, and Human Resource though have common basics but cannot be adopted in rural context as it is and would require imparting the modified context to the budding entrepreneurs. Especially the components of Behavioral Sciences and Business Communication hold a much different platform with respect to urban corporate sector.

This program will expose the student to the framework that converts identified potential into a commercially viable business idea in line with the various Government schemes. The opportunities that rural entrepreneurship promises through digital Inclusion, Agri-Business, sustainable development, Tourism, e-governance, export of rural produces will not only lead to better livelihood but also bridge the gap between rural and urban economy and development. The end result is expected to be sustainable, eco-friendly and equitable socioeconomic development of villages.

2. Study and Evaluation Scheme

The duration of the programme will be two years. Candidates applying for admission must have pursued at least a Bachelor's Degree programme (duly recognized by respective Indian educational regulatory bodies) after twelve years of formal schooling with at least 50% marks at graduation level (SC/ST: Passing Marks; OBC/PWD/CW: 45% as per the University Rules) or equivalent CGPA. The programme will offered by the department of Entrepreneurship Development and Industrial Coordination along with the department of Rural Development of NITTTR Chandigarh.

| | Semester I | Semester II |
|----------|--------------------------------|--|
| 1 | Managerial Economics | Operations Management |
| 2 | Financial Accounting | Rural Marketing Management |
| 3 | Statistics for Decision Making | Financial Management |
| 4 | Behavioral Sciences | Human Resource Management |
| 5 | Business Communication | Information System Management (ISM) for Rural Entrepreneurship |

| | | |
|----------|---|---|
| 6 | Fundamentals of Rural Development | Research Methods for Rural Business |
| | Semester III | Semester IV |
| 1 | Strategic Management of Rural Enterprises | Business Ethics and Corporate Social Responsibility (CSR) |
| 2 | Legal Aspects of Rural Enterprises | Project Management |
| 3 | Group Entrepreneurship | Social Entrepreneurship Management |
| 4 | Micro Financing | ** Elective II - |
| 5 | Managing Rural Start-ups | **Elective III - |
| 6 | ** Elective I - | ## MBA Dissertation |
| # | Course of Independent Study (CIS) | |

Indicative Scheme for Evaluation of Grade:

End Semester Evaluation: 50%

Project Work / Assignment(s): 15%

Mid Semester Evaluation: 20%

Class Participation: 15%

****Electives Offered:**

- Digital Inclusion in rural economy
- Agri-Business Management
- Green Business and Sustainable Development
- Rural Tourism
- Platform based strategies for Rural Enterprises
- Management of Rural Service Enterprises
- Rural Infrastructure Management
- ‘SMART’ Rural Governance
- Technology Management for Rural Entrepreneurship
- Analytics for Rural Supply Chain Management
- Rural Health Management
- Import Export of Rural Produces

The end deliverable CIS will require a student to submit a document containing the ideation of a Rural Enterprise (either product based or service based). This will involve the identification of gaps, opportunities and target customers. A summary of tentative budgeted expenditure as well as potential revenue generation will also be the part of the same.

Under MBA dissertation student is expected to carry out comprehensive fieldwork for becoming a Rural Entrepreneur. The CIS document submitted in the IIIrd Semester will form the basis of the MBA dissertation. Here the student will be expected to come-out with the detail project report of the venture identified. Desirably, it is expected that the venture can be submitted for incubation.

M.B.A. IN INFRASTRUCTURE MANAGEMENT

Rationale:

The infrastructure sector is constantly evolving and transforming with a diverse set of innovative and sustainable schemes and projects. And, due to this, all participating stakeholders such as government authorities, private developers, non-government sector, policy think tanks, domestic, bilateral and multilateral financial institutions, management, technical and legal consulting firms are constantly looking for capable professionals. Developing infrastructure has necessitated a demand for these professionals who should have good exposure to domains of demand analysis, regulatory and governance framework, legal & policy guidelines, environmental & social issues, tendering, bidding & contract management, etc.

MBA program in Infrastructure Management is designed to develop the students as complete infrastructure management professional with a thorough grounding in general management traits. The program will hone students' technical skills and managerial ability to enhance their data management & decision making, understanding and compliance management processes relating to accounting, finance, marketing, organizational behaviour, business law, and computer applications. The program is about managing interactions across diverse stakeholder groups in a sustainable manner. Students will be exposed to a range of softer skills required, and presented with opportunities to imbibe them through various practical tools.

Upon successful completion of the course, candidates can find employment opportunities in various areas like construction and project management, facilities management, real estate finance, infrastructure finance and such others.

3. Study and Evaluation Scheme

The duration of the programme will be two years. Candidates applying for admission must have pursued at least a Bachelor's Degree programme (duly recognized by respective Indian educational regulatory bodies) after twelve years of formal schooling with at least 50% marks at graduation level (SC/ST: Passing Marks; OBC/PWD/CW: 45% as per the University Rules) or equivalent CGPA. The programme will offered primarily by the Entrepreneurship Development and Industrial Coordination of NITTTR Chandigarh with the support of Civil Engineering, Informatics & CSE, Electronics and Communication Engg. Departments.

Tentative Program Structure for MBA (Infrastructure Management)

| | Semester I | Semester II |
|---|---|--|
| 1 | Economics of Infrastructure Business | Operations Management |
| 2 | Financial Accounting | Marketing Management |
| 3 | Statistics for Decision Making | Financial Management |
| 4 | Behavioral Sciences | Human Resource Management |
| 5 | Business Communication | Management of Information Systems |
| 6 | Fundamentals of Infrastructure Management | Research Methods for Infrastructure Business |

| | Semester III | Semester IV |
|----------|---|---|
| 1 | Strategic Management | Business Ethics and Corporate Social Responsibility (CSR) |
| 2 | Legal and Regulatory Aspects of Infrastructure Business | Business Analytics for Sustainable Urban Transport |
| 3 | Supply Chain and Logistics Management | Project Finance |
| 4 | Macroeconomic Environment | ** Elective II - |
| 5 | Project Management | **Elective III - |
| 6 | Elective I | ## MBA Dissertation |
| # | Course of Independent Study (CIS) | |

Indicative Scheme for Evaluation of Grade:

End Semester Evaluation: 50%

Project Work / Assignment(s): 15%

Mid Semester Evaluation: 20%

Class Participation: 15%

****Electives Offered:**

- Tourism Management
- Management of Rural Infrastructure
- Supply Chain Analytics
- Waste Management
- Real Estate Management
- Agri-Business Management
- Digital Infra Management for Inclusive Growth
- Technology and Innovation Management
- Green Business and Sustainable Development
- Social Entrepreneurship Management
- Legal Aspects of Rural Enterprises
- Micro Financing

The end deliverable CIS will require a student to submit a document containing the ideation of a Infrastructure Management project (either product based or service based). This will involve the identification of gaps, opportunities and intended audience / customers. A summary of tentative budgeted expenditure as well as potential revenue generation will also be the part of the same.

Under MBA dissertation student is expected to carry out comprehensive fieldwork for becoming a Infrastructure Management expert. The CIS document submitted in the IIIrd Semester will form the basis of the MBA dissertation. Here the student will be expected to come-out with the detailed report of the project identified. Desirably, it is expected that the project can be submitted for practical purposes.

M.TECH. ENGINEERING EDUCATION

Rationale:

The course will be of Two years duration. Candidates with Graduation in Engineering, Architecture; Or Post Graduation in Applied Sciences, Pharmacy and Management are eligible in the course. The Programme is not offered in any Indian University except at NITTTR, Chandigarh in affiliation with PU, Chandigarh till 2013. The programme, with 70 Credits, will develop professional capabilities amongst the faculty related to:

Teaching, management, evaluation, curriculum development, instructional material development, research, entrepreneurship development, rural development etc. thereby enhance their professional and career development for improving the effectiveness and efficiency of the technical education system, etc.

Study & Evaluation Scheme:

All students will be required to qualify in 10 theory papers (40 credits) and one Practical Subject (2 credits) as per study and evaluation scheme during the course. There shall be at least ten hours of lectures/tutorials/practicals/drawing classes during the semester, for every hour of lecture/tutorial/practical per week. In addition, all students will be required to qualify preliminary thesis-based project work (10 credits) in third semester and, thesis work (20 credits) in fourth semester.

| Code No | Course of Study | Hours | | | CREDI TS | MARKS | | |
|--|---|-------|-----|-------|-----------|---------------------|------------------------|------------|
| | | L | P/T | Total | | Internal Assessment | University Examination | Total |
| Semester I | | | | | | | | |
| Core Courses of Study: | | | | | | | | |
| MTE 101 | Educational Technology | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| MTE 102 | Research Methodology | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| MTE 103 | Curriculum Development & Student Evaluation | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| Elective Subject (Any One of the following) | | | | | | | | |
| MTE 104 | Education Project Planning & Management | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| MTE 105 | Technology Management | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| Semester Total | | | | | 16 | 200 | 200 | 400 |
| Semester II | | | | | | | | |
| Core Courses of Study: | | | | | | | | |
| MTE 106 | HRD & Training Methods | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| MTE 107 | Entrepreneurship Development | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| MTE 108 | Micro Teaching | - | 4 | 4 | 2 | 50 | - | |

| Elective Subjects (Any Two of the following) | | | | | | | | |
|---|--|---|----|----|-----------|------------|------------|-------------|
| MTE 109 | Web Based Training & Development of MOOC | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| MTE 110 | Institutional Climate & Organizational Behaviour | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| MTE 111 | Teaching in Digital Age | 3 | 2 | | | | | |
| Semester Total | | | | | 18 | 250 | 200 | 450 |
| Semester III | | | | | | | | |
| MTE 201 | Institutional Management & Evaluation | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| MTE 202 | Instructional Media Design & Development | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| MTE 251 | Preliminary Thesis Work | - | 20 | 20 | 10 | 50 | 50 | 100 |
| Semester Total | | | | | 18 | 150 | 150 | 300 |
| Semester IV | | | | | | | | |
| MTE 252 | Thesis Work | - | 40 | 40 | 20 | 50 | 100 | 150 |
| Grand Total | | | | | 72 | 850 | 650 | 1500 |

Detailed Contents: There are 10 courses of Study; one Practical, one Pre-thesis and Final Thesis; Students will study five core courses, one Practical and five Elective subjects (to be chosen out of 7 elective subjects) as detailed below:

Core Courses include:

Educational Technology, Curriculum Development and Evaluation, Research Methodology, HRD & Training Methods, Entrepreneurship Development,

Practical: Micro Teaching

Elective Courses include:

Web Based Training & Development of MOOC, Technology Management, Education Project Planning & Management, Institutional Climate & Organizational Behaviour, Teaching in Digital Age, Institutional Management & Evaluation, Instructional Media Design & Development.

References:

1. Bloom, BS (1974). Taxonomy of Educational Objectives, Book 1: Cognitive Domain, Longman Group Ltd., London.
2. Borg, W and Gall, M (2003). Educational Research: An Introduction, New York, Longman.
3. Brown, JW: Lewis, RB and Harclerod, FF (1985). AV Instruction – Technology Media and Methods, New York: Mc Graw Hill Book Company.
4. Cole, PG & Chan, LKG (1987). Teaching Principles and Practice. New York, Prentice Hall, 210-240p.

5. CPSC, Manila: Aspects of Curriculum Design.
6. CPSC: Developing Skills in Technician Education Research Modules 1 to 11 Singapore, Colombo Plan Staff College for Technician Education.
7. Driscoll, MP and Driscoll MP (2004). Psychology of Learning for Instruction. Allyn & Bacon.
8. Dutt, Sunil (2020). MOOC on Development of Self Learning Material. https://swayam.gov.in/nd2_ntr20_ed25/preview.
9. Gagne, RM (1977). The Conditions of Learning. Third Edition, New York: Holt, Rinehart & Winston Inc.
10. Garrett, HE and Woodworth, RS (2003). Statistics in Psychology and Education, Educational Research, Bombay: Vakils Fetter and Simons Ltd.
11. Gronlund, NE and Linn, RL (1990). Measurement and Evaluation in Teaching Sixth Edition. New York, Macmillan Publishing Company Inc. 3 – 240 pp
12. Horton, Williams (2003). Designing Web Based Training. John Wiley and Sons.
13. Koontz, H and Wehrich H (2005). 'Essentials of Management', New Delhi; McGraw Hill Publishing Company Ltd.
14. Lynton, RP and Pareek, Udai (2009). 'Training for Development' New Delhi: Sage Publication.
15. Sampath, K et al. (1981). Introduction to Educational Technology'. New Delhi: Sterling Publishers Pvt. Ltd.
16. Sodhi, GS and Dutt, S (1998, 2006). Essentials of Educational Technology Patiala: Twenty first Century Publications.
17. Stoner, JAF (2004) Management, Progressive Books.
18. Sunny and Kim Bake (1998). 'Project Management (The Complete Idiots Guide)', New Delhi – Prentice Hall of India Pvt Ltd.
19. Taba, Hilda, Curriculum Development – Theory and Practice. Harcourt, Brace and World.

P.G Diploma Mechanical Engineering (Digital Manufacturing)

Rationale

In last one decade digital manufacturing has become popular with the rise in quantity and quality of computer systems. Since more automated tools are being used in manufacturing units it is necessary to model/ simulate and analyze all machines, tooling and input materials to optimize the manufacturing process. The P.G Diploma in Digital manufacturing is in-line with the integrated approach to manufacturing which is centred on computer system. This P.G Diploma Mechanical Engineering (Digital Manufacturing) course has been especially designed to full-fill goals of computer-integrated manufacturing, flexible manufacturing, lean manufacturing, and design for manufacturability.

STUDY & EVALUATION SCHEME

P.G Diploma Mechanical Engineering (Digital Manufacturing) – REGULAR PROGRAMME

FIRST SEMESTER

| CODE | SUBJECT | SCHEDULE FOR TEACHING | | | CREDITS | MARKS | | |
|------------------------|---|-----------------------|---|-------|-----------|---------------------|------------------------|------------|
| | | L | P | TOTAL | | Internal Assessment | University Examination | TOTAL |
| MDM-601 | Advanced Engineering Materials | 4 | - | 4 | 4 | 50 | 50 | 100 |
| MDM - 603 | Design for Additive Manufacturing | 4 | - | 4 | 4 | 50 | 50 | 100 |
| MDM - 604 | Computer Programming & Applications | 4 | - | 4 | 4 | 50 | 50 | 100 |
| MDM-651 | Mechatronics | 4 | - | 4 | 4 | 50 | 50 | 100 |
| MDM-605 | Computer Integrated Manufacturing Systems | 4 | - | 4 | 4 | 50 | 50 | 100 |
| MDM - 701 | Digital Manufacturing Lab – I | - | 4 | 4 | 2 | 50 | - | 50 |
| SEMESTER TOTAL: | | | | | 22 | 300 | 250 | 550 |

SECOND SEMESTER

| CODE | SUBJECT | SCHEDULE FOR TEACHING | | | CREDITS | MARKS | | |
|--|--|-----------------------|----|-------|-----------|---------------------|------------------------|------------|
| | | L | P | TOTAL | | Internal Assessment | University Examination | TOTAL |
| MDM - 606 | Industrial Robotics | 4 | - | 4 | 4 | 50 | 50 | 100 |
| MDM - 607 | Industrial IoT | 4 | - | 4 | 4 | 50 | 50 | 100 |
| MDM - 608 | Additive Manufacturing of Metals and Non-metals | 4 | - | 4 | 4 | 50 | 50 | 100 |
| MDM - 702 | Digital Manufacturing Lab – II | - | 4 | 4 | 2 | 50 | - | 50 |
| PGDM 751 | Project | - | 20 | 20 | 8 | 100* | 100 | 200* |
| SEMESTER TOTAL: | | | | | 22 | 300 | 250 | 550 |
| * Internal assessment is based on the following criterion: | | | | | | | | |
| Grade | Condition | | | | | | | |
| A+ | Publication from Thesis in SCI indexed journal | | | | | | | |
| A | Publication from Thesis in Scopus indexed journal | | | | | | | |
| B+ | Publication from Thesis in UGC journal OR Scopus indexed conference proceedings | | | | | | | |
| B | Publication from Thesis in International Conference | | | | | | | |
| C+ | Publication from Thesis in National Conference | | | | | | | |
| ** Final Grade will be average of the grades of internal assessment and university viva-voce examination | | | | | | | | |

Duration 1 Years (2 Semester)

PG Diploma in Rehabilitation Engineering

Rationale

The goal of this course is to apply biomedical engineering principles to the design and development of artificial limbs, orthotic devices, and seating systems. Specific course objectives are:

- 1) to familiarize students with the musculoskeletal anatomy of the upper and lower extremities;
- 2) to familiarize students with human locomotion, muscle mechanics and the electromyogram;
- 3) to familiarize students with biologic soft tissue and interface mechanics related to seating, positioning, prostheses, and load transfer;
- 4) to introduce various methods of prosthetic and orthotic control and power;

Study and Evaluation Scheme for

PG Diploma in REHABILITATION ENGINEERING

Year: First

Semester I

| S. No. | Course Code | Course Name | Scheme of Teaching | | | Scheme of Examination | | |
|--------|-------------|---|--------------------|------------------|---------|-----------------------|-----------------------|-------|
| | | | L-T-P | Contact hrs/week | Credits | Theory | | |
| | | | | | | Internal Assessment | University Assessment | Total |
| 1 | PGDRE1101 | Human Anatomy and Physiology | 3-0-0 | 3 | 3 | 50 | 50 | 100 |
| 2 | PGDRE1102 | Sensorimotor Systems and Human Performance Assessment | 3-0-0 | 3 | 3 | 50 | 50 | 100 |
| 3 | PGDRE1103 | Assistive Devices for Rehabilitation | 4-0-0 | 4 | 4 | 50 | 50 | 100 |
| 4 | PGDRE1104 | Embedded Systems | 3-0-0 | 3 | 3 | 50 | 50 | 100 |
| 5 | PGDRE1105 | Lab 1: Laboratory on Rehabilitation Assistive Devices | 0-0-3 | 3 | 3 | 50 | 50 | 100 |
| 6 | PGDRE1106 | Lab 2: Laboratory on | 0-0-3 | 3 | 3 | 50 | 50 | 100 |

| | | | | | | | | |
|--------------|-----------|------------------|---------------|-----------|-----------|------------|------------|------------|
| | | Embedded Systems | | | | | | |
| 7 | PGDRE1107 | Seminar | 0-0-1 | 1 | 1 | 50 | - | 50 |
| Total | | | 13-0-7 | 20 | 20 | 350 | 300 | 650 |

Year: First

Semester II

| S. No. | Course Code | Course Name | Scheme of Teaching | | | Scheme of Examination | | |
|--------------|-------------|---|--------------------|------------------|-----------|-----------------------|-----------------------|------------|
| | | | L-T-P | Contact hrs/week | Credits | Theory | | |
| | | | | | | Internal Assessment | University Assessment | Total |
| 1 | PGDRE1201 | Wheeled Mobility | 3-0-0 | 3 | 3 | 50 | 50 | 100 |
| 2 | PGDRE1202 | Neuro-Rehabilitation | 3-0-0 | 3 | 3 | 50 | 50 | 100 |
| 3 | PGDRE1203 | Implantable Devices for Rehabilitation | 4-0-0 | 4 | 4 | 50 | 50 | 100 |
| 4 | PGDRE1204 | Psychosocial Issues in Disability | 3-0-0 | 3 | 3 | 50 | 50 | 100 |
| 5 | PGDRE1205 | Lab 3: Laboratory on Wheeled Mobility | 0-0-3 | 3 | 3 | 50 | 50 | 100 |
| 6 | PGDRE1206 | Lab 4: Laboratory on Implantable Devices for Rehabilitation | 0-0-3 | 3 | 3 | 50 | 50 | 100 |
| 7 | PGDRE1207 | Project | 0-0-5 | 5 | 5 | - | 150 | 150 |
| Total | | | 13-0-11 | 24 | 24 | 300 | 450 | 750 |

PG Diploma in Reconfigurable Electronics

Rationale

The proposed PG diploma is a de-novo program to prepare the Electronics and Communication Engineering graduates to work in this specialization and emerging area. The syllabus of this program shall be designed in collaboration with industry to address the challenges and issues in this area. Also this program shall be offered in partnership with industry to teach students the latest principles, software and hardware components. The Reconfigurable Electronics program shall focus on the theory and techniques to develop reconfigurable electronics systems which shall learn the environment and adapt it as per the requirement. The artificial intelligence and machine learning based techniques shall be major part of this program. The software based reconfigurability of electronics systems shall be emphasized in this program to develop cost effective and high speed application. The designing of systems keeping in mind the requirements of IoT issues and challenges shall make this program a high end technical program. The major constituent of this course is to apply Application Specific Integrated Circuits Design (ASIC) and embedded system design concepts for development of reconfigurable electronics using Hardware Descriptive Language (HDL) and Field Programmable Gate Array (FPGA) implementation. Specific course objectives are:

- 1) to familiarize students with the techniques to develop reconfigurable electronics systems;
- 2) to familiarize students with ASIC design with HDL;
- 3) to familiarize students with FPGA implementation and testing of design;
- 4) to introduce various embedded systems and hardware design for the applications of IoT and Artificial Intelligence (AI);

Study and Evaluation Scheme for

PG Diploma in RECONFIGURABLE ELECTRONICS

Year: First

Semester I

| S · N o · | Course Code | Course Name | Scheme of Teaching | | | Scheme of Examination | | |
|-----------------------|----------------|--|--------------------|-----------------------------|-------------|----------------------------|----------------------------------|-----------|
| | | | L-T- P | Contac t hrs/we ek | Credi ts | Theory | | |
| | | | | | | Internal Assessme nt | Universit y Assessme nt | Tota l |
| 1 | PGDREC11 01 | ASIC and FPGA-based Systems | 3-0-0 | 3 | 3 | 50 | 50 | 100 |
| 2 | PGDREC11 02 | Reconfigurable and Flexible antennas | 3-0-0 | 3 | 3 | 50 | 50 | 100 |
| 3 | PGDREC11 03 | Hardware Description | 4-0-0 | 4 | 4 | 50 | 50 | 100 |

| | | | | | | | | |
|--------------|------------|---|---------------|-----------|-----------|------------|------------|------------|
| | | Language for Reconfigurable Electronics | | | | | | |
| 4 | PGDREC1104 | Reconfigurable electronics for wearable and implantable devices | 3-0-0 | 3 | 3 | 50 | 50 | 100 |
| 5 | PGDREC1105 | Lab 1: Laboratory on HDL | 0-0-3 | 3 | 3 | 50 | 50 | 100 |
| 6 | PGDREC1106 | Lab 2: Laboratory on Antenna Design | 0-0-3 | 3 | 3 | 50 | 50 | 100 |
| 7 | PGDREC1107 | Seminar | 0-0-1 | 1 | 1 | 50 | - | 50 |
| Total | | | 13-0-7 | 20 | 20 | 350 | 300 | 650 |

Year: First

Semester II

| S · N o · | Course Code | Course Name | Scheme of Teaching | | | Scheme of Examination | | |
|-----------------------|-------------|---|--------------------|------------------|---------|-----------------------|-----------------------|-------|
| | | | L-T-P | Contact hrs/week | Credits | Theory | | |
| | | | | | | Internal Assessment | University Assessment | Total |
| 1 | PGDREC1201 | Programmable System-on-Chip and Peripherals | 3-0-0 | 3 | 3 | 50 | 50 | 100 |
| 2 | PGDREC1202 | Integrated Circuits and Their Applications | 3-0-0 | 3 | 3 | 50 | 50 | 100 |
| 3 | PGDREC1203 | Reconfigurable Embedded System Design | 4-0-0 | 4 | 4 | 50 | 50 | 100 |
| 4 | PGDREC1204 | Modelling and Simulation of Electronics Systems | 3-0-0 | 3 | 3 | 50 | 50 | 100 |
| 5 | PGDREC1205 | Lab 3: Laboratory on CAD Tools for Reconfigurable Electronics | 0-0-3 | 3 | 3 | 50 | 50 | 100 |
| 6 | PGDREC1206 | Lab 4: Laboratory on | 0-0-3 | 3 | 3 | 50 | 50 | 100 |

| | | | | | | | | |
|--------------|------------|------------------|----------------|-----------|-----------|------------|------------|------------|
| | | Embedded Systems | | | | | | |
| 7 | PGDREC1207 | Project | 0-0-5 | 5 | 5 | - | 150 | 150 |
| Total | | | 13-0-11 | 24 | 24 | 300 | 450 | 750 |

PG Diploma in Smart and Flexible Electronics

Rationale

The proposed PG diploma is a de-novo program to prepare the Electronics and Communication Engineering graduates to work in this specialization and emerging area. The syllabus of this program shall be designed in collaboration with industry to address the challenges and issues in this area. Also this program shall be offered in partnership with industry to teach students the latest principles, software and hardware components. The program on Smart and Flexible Electronics shall focus on the development of intelligent, flexible and wearable systems and solutions for medical and non medical applications for real-time healthcare and fitness monitoring in various fields like telemedicine, entertainment, sports, military training, disaster events etc. In this program, the students shall learn various types of flexible and wearable electronic components, material, sensors and displays, biomedical devices, and many more. The internetworking principles of wearable devices to form body centric networks shall also be focused upon to meet the seamless and remote monitoring of devices. The application oriented development of low cost fabrication techniques and testing of prototypes shall be another major part of this program.

Study and Evaluation Scheme for

**PG Diploma in
Smart and Flexible Electronics**

Year: First

Semester I

| S. No | Course Code | Course Name | Scheme of Teaching | | | Scheme of Examination | | |
|--------------|--------------|---|--------------------|------------------|-----------|-----------------------|-----------------------|------------|
| | | | L-T-P | Contact hrs/week | Credits | Theory | | |
| | | | | | | Internal Assessment | University Assessment | Total |
| 1 | PGDSF E 1101 | Materials for Smart and Flexible Electronics | 3-0-0 | 3 | 3 | 50 | 50 | 100 |
| 2 | PGDSF E 1102 | Flexible Electronics: Sensors and Devices | 3-0-0 | 3 | 3 | 50 | 50 | 100 |
| 3 | PGDSF E 1103 | Flexible and Reconfigure Antennas | 3-0-0 | 3 | 3 | 50 | 50 | 100 |
| 4 | PGDSF E 1104 | Flexible and Stretchable Printed Electronics | 3-0-0 | 3 | 3 | 50 | 50 | 100 |
| 5 | PGDSF E 1105 | Reconfigurable Embedded System Design | 3-0-0 | 3 | 3 | 50 | 50 | 100 |
| 6 | PGDSF E 1106 | Lab 1 Flexible and Reconfigure Antennas Lab | 0-0-2 | 2 | 2 | 50 | 50 | 100 |
| 7 | PGDSF E 1107 | Lab 2 Reconfigurable Embedded System Design Lab | 0-0-2 | 2 | 2 | 50 | 50 | 100 |
| 8 | PGDSF E 1108 | Seminar | 0-0-1 | 1 | 1 | 50 | - | 50 |
| Total | | | 15-0-5 | 20 | 20 | 400 | 300 | 700 |

Year: First

Semester II

| S. No. | Course Code | Course Name | Scheme of Teaching | | | Scheme of Examination | | |
|--------------|--------------|---|--------------------|------------------|-----------|-----------------------|-----------------------|------------|
| | | | L-T-P | Contact hrs/week | Credits | Theory | | |
| | | | | | | Internal Assessment | University Assessment | Total |
| 1 | PGDSF E 1201 | Organic Electronics | 3-0-0 | 3 | 3 | 50 | 50 | 100 |
| 2 | PGDSF E 1202 | 3D Manufacturing Techniques for Flexible Electronics | 3-0-0 | 3 | 3 | 50 | 50 | 100 |
| 3 | PGDSF E 1203 | Flexible and Stretchable RF Electronics | 3-0-0 | 3 | 3 | 50 | 50 | 100 |
| 4 | PGDSF E 1204 | Reconfigurable electronics for wearable and implantable devices | 3-0-0 | 3 | 3 | 50 | 50 | 100 |
| 5 | PGDSF E 1205 | Technologies for Smart Cities | 3-0-0 | 3 | 3 | 50 | 50 | 100 |
| 6 | PGDSF E 1206 | Lab3 Organic Electronics Lab | 0-0-2 | 2 | 2 | 50 | 50 | 100 |
| 7 | PGDSF E 1207 | Lab4 3D Manufacturing Techniques for Flexible Electronics Lab | 0-0-2 | 2 | 2 | 50 | 50 | 100 |
| 8 | PGDSF E 1208 | Project | 0-0-1 | 1 | 1 | 50 | - | 50 |
| Total | | | 15-0-5 | 20 | 20 | 400 | 300 | 700 |

P.G Diploma Mechanical Engineering (Material Characterization)

Rationale

In last two decades for conventional and modern mechanical manufacturing, material characterization has become popular with the rise in hybrid material processing technologies. Since more hybrid processes are being used in manufacturing units it is necessary to characterize input and output materials to optimize the manufacturing process. The P.G Diploma in Material Characterization is in-line with the integrated approach to manufacturing which is centred on available processing technologies. This P.G Diploma Mechanical Engineering (Material Characterization) course has been especially designed to full-fill goals of [mechanical](#), [morphological](#), thermal characterization for metals/alloys/ polymers and other bio-materials (both for additive and subtractive manufacturing).

STUDY & EVALUATION SCHEME

P.G Diploma Mechanical Engineering (Material Characterization)

REGULAR PROGRAMME

FIRST SEMESTER

| CODE | SUBJECT | SCHEDULE FOR TEACHING | | | CREDITS | MARKS | | |
|---------|---|-----------------------|---|-------|---------|---------------------|------------------------|-------|
| | | L | P | TOTAL | | Internal Assessment | University Examination | TOTAL |
| MDM-601 | Advanced Engineering Materials | 4 | - | 4 | 4 | 50 | 50 | 100 |
| MMC-603 | Fundamentals of optics | 4 | - | 4 | 4 | 50 | 50 | 100 |
| MMC-604 | Introduction to Scanning electron microscopy (SEM) and Energy Dispersive X-Ray Analysis (EDX) | 4 | - | 4 | 4 | 50 | 50 | 100 |
| MMC-651 | Quantitative analysis, residual stress analysis | 4 | - | 4 | 4 | 50 | 50 | 100 |

| | | | | | | | | |
|------------------------|-----------------------------------|---|---|---|-----------|------------|------------|------------|
| MMC-605 | Mechanical behaviour of materials | 4 | - | 4 | 4 | 50 | 50 | 100 |
| MMC-701 | Material characterization Lab – I | - | 4 | 4 | 2 | 50 | - | 50 |
| SEMESTER TOTAL: | | | | | 22 | 300 | 250 | 550 |

SECOND SEMESTER

| CODE | SUBJECT | SCHEDULE FOR TEACHING | | | CREDITS | MARKS | | |
|------------------------|--------------------------------------|-----------------------|----|-------|-----------|---------------------|------------------------|--------------|
| | | L | P | TOTAL | | Internal Assessment | University Examination | TOTAL |
| MMC-606 | Fundamentals of material processing | 4 | - | 4 | 4 | 50 | 50 | 100 |
| MMC-607 | Biomaterials science and engineering | 4 | - | 4 | 4 | 50 | 50 | 100 |
| MMC-608 | Polymer Blends and Nano-composites | 4 | - | 4 | 4 | 50 | 50 | 100 |
| MMC-702 | Material characterization Lab – II | - | 4 | 4 | 2 | 50 | - | 50 |
| PGMC 751 | Project | - | 20 | 20 | 8 | 100* | 100 | 200** |
| SEMESTER TOTAL: | | | | | 22 | 300 | 250 | 550 |

* Internal assessment is based on the following criterion:

| Grade | Condition |
|-------|--|
| A+ | Publication from Thesis in SCI indexed journal |
| A | Publication from Thesis in Scopus indexed journal |
| B+ | Publication from Thesis in UGC journal OR Scopus indexed conference proceedings |
| B | Publication from Thesis in International Conference |

| | |
|--|--|
| C+ | Publication from Thesis in National Conference |
| ** Final Grade will be average of the grades of internal assessment and university viva-voce examination | |

PG Diploma in Cyber Security and Mitigation Techniques

1. **Duration :** 1 year
2. **Objective:** The overall objective is to give a high level training on advanced cyber-security concepts to make you specialize for various industries required job roles such as Penetration tester, Forensic expert, and Network analyst.
3. **Rationale:** Development of a leading resource institute for promoting excellence in technical education system. The institute shall develop leadership in technical teachers training and provide high quality and customized education, training, internship programs, research and development and services to enable the technical education system to achieve excellence internationally. NITTTR Chandigarh offers continuing education and training programs for the faculty and staff of technical education system. The institute undertakes research and development in engineering & technology and technical education and provides extension and consultancy services to technical education system.

This internship program strives for continuous improvement in cyber-security discipline and actively support the growth and quality improvement of technical education through involvement in activities. NITTTR Chandigarh is equipped with broadcast grade multi-camera studio production facility and High speed National Knowledge Network (NKN) based IT resources. It also has a wide experience of developing instructional material such as videos, e-content, multimedia packages, and MOOCs. The institute penetrates the unreached region by integrating Social Network, Video Conferencing & Face-to-Face mode of communication through NITTTR, Chandigarh Technology Enabled Learning (NCTEL).

The proposed internship program is designed to provide specialized training on advanced cyber-security concepts to participants to make them eligible for required industrial job roles.

PG Diploma in Digital Marketing

1. **Duration:** 1 year
2. **Rationale:** The modern consumer is increasingly moving toward a more digital experience when it comes to researching and making purchases. Search engines like Google remain the most popular channel for consumer research. Whether consumers are at the beginning stages of the customer
3. journey or ready to buy, they often use search engines to find the information they need to make an informed purchasing decision and research specific brands. It is vital that companies' work is visible during these digital searches so they can engage the customer and work to influence their purchasing decisions by providing valuable information. Another **reason** why **digital marketing** is a must for most modern brands is that it allows companies to foster better customer relationships. Whereas most traditional **marketing** provides one-way communication with the consumer, **digital marketing** allows for two-way communication in real time.
4. **Study and Evaluation Scheme:** **Study and Evaluation Scheme:** PG Diploma in Digital Marketing
First Semester

| Sr. No. | Course No. | Course Title | Hours / Week | Credits | SEE Marks | CIE Marks | Total |
|--------------|------------|--|--------------|---------|-----------|-----------|-------|
| 15. | DM101 | SEO Foundation | 4 | 4 | 50 | 50 | 100 |
| 16. | DM102 | Content, E-mail and Mobile Marketing | 4 | 4 | 50 | 50 | 100 |
| 17. | DM103 | Pay-Per-Click and Conversion Optimization | 4 | 4 | 50 | 50 | 100 |
| 18. | DM104 | Digital Analytics | 3 | 3 | 50 | 50 | 100 |
| 19. | DM105 | Marketing Automation and Programmatic Buying | 3 | 3 | 50 | 50 | 100 |
| 20. | DM106 | Seminar | - | - | - | - | - |
| 21. | DM107 | Marketing and Digital Branding Communications | 4 | 2 | - | 100 | 100 |
| Total | | | 22 | 20 | 250 | 350 | 600 |

Second Semester

| Sr. No. | Course No. | Course Title | Hours / Week | Credits | SEE Marks | CIE Marks | Total |
|---------|------------|--|--------------|---------|-----------|-----------|-------|
| 1. | DM201 | E-Commerce & Digital Marketing Fundamentals | 4 | 4 | 50 | 50 | 100 |
| 2. | DM202 | Consumer Behaviour in the Digital Environment | 4 | 4 | 50 | 50 | 100 |
| 3. | DM203 | Digital Marketing Tools | 4 | 4 | 50 | 50 | 100 |

| | | | | | | | |
|--------------|-------|------------------------------------|----|----|-----|-----|-----|
| 4. | DM204 | Digital Marketing Research | 3 | 3 | 50 | 50 | 100 |
| 5. | DM205 | Web Marketing and Analytics | 3 | 3 | 50 | 50 | 100 |
| 6. | DM206 | Project | 4 | 2 | - | 100 | 100 |
| Total | | | 22 | 20 | 250 | 350 | 600 |

5. References:

- Morris, Neil. "Understanding digital marketing: marketing strategies for engaging the digital generation." (2009): 384-387.
- Chaffey, Dave, Paul Russell Smith, and Paul Russell Smith. *eMarketingXcellence: Planning and optimizing your digital marketing*. Routledge, 2013.
- Wind, Yoram Jerry, and Vijay Mahajan. *Digital marketing: global strategies from the world's leading experts*. John Wiley & Sons, 2002.
- Chaffey, Dave. *Digital marketing*. Pearson UK, 2019.
- Tiago, Maria Teresa PinheiroMelo Borges, and José Manuel CristóvãoVeríssimo. "Digital marketing and social media: Why bother?." *Business horizons* 57.6 (2014): 703-708.
- Miller, Michael. *B2B digital marketing: Using the web to market directly to businesses*. Que publishing, 2012.
- Todor, Raluca Dania. "Blending traditional and digital marketing." *Bulletin of the Transilvania University of Brasov. Economic Sciences. Series V* 9.1 (2016): 51.

PG Diploma in Data Analytics

Rationale: Now a days majority of the decisions are taken from analysing stake holders data. In this context education sector is not exempted. Therefore, minimal knowledge of data analysis is mandatory at all levels in education sector, to take proactive decisions towards improving the system. Education and Training are progressively taking place on digital environments. As a result, these environment are generating unstructured amount of interaction and behavioral data that can be used to design better learning and teaching models for learning, teaching and assessment. The main objective of this course is to use different kind of methods from data analytics to identify unique patterns from educational data. In particular, the participants will learn about the methods and models that are being developed in data analytics, students' behavior modeling, personalized learning material recommendation etc. The programme will be covered both at the theoretical level as well as the practical level where software tools (such as R programming / Python) will be used to analyse the data

2. Study and Evaluation Scheme: Study and Evaluation Scheme:

First Semester

| Sr. No. | Course No. | Course Title | Hours / Week | Credits | SEE Marks | CIE Marks | Total |
|---------|------------|-------------------------------------|--------------|---------|-----------|-----------|-------|
| 1. | DA101 | Introduction to Data Science | 4 | 4 | 50 | 50 | 100 |

| | | | | | | | |
|--------------|-------|--|----|----|-----|-----|-----|
| 2. | DA102 | Mathematical Foundations for Data Science | 4 | 4 | 50 | 50 | 100 |
| 3. | DA103 | Introduction to Statistical Methods | 4 | 4 | 50 | 50 | 100 |
| 4. | DA104 | Data Structures and Algorithms Design | 3 | 3 | 50 | 50 | 100 |
| 5. | DA105 | Systems for Data Analytics | 3 | 3 | 50 | 50 | 100 |
| 6. | DA106 | Seminar | - | - | - | - | - |
| 7. | DA107 | Data Mining and Machine Learning | 4 | 2 | - | 100 | 100 |
| Total | | | 22 | 20 | 250 | 350 | 600 |

Second Semester

| Sr. No. | Course No. | Course Title | Hours / Week | Credits | SEE Marks | CIE Marks | Total |
|--------------|------------|---------------------------------------|--------------|---------|-----------|-----------|-------|
| 1. | DA201 | Data Visualization | 4 | 4 | 50 | 50 | 100 |
| 2. | DA202 | Ethics for Data Science | 4 | 4 | 50 | 50 | 100 |
| 3. | DA203 | Graphs - Algorithms and Mining | 4 | 4 | 50 | 50 | 100 |
| 4. | DA204 | Optimization Methods | 3 | 3 | 50 | 50 | 100 |
| 5. | DA205 | Big Data Systems | 3 | 3 | 50 | 50 | 100 |
| 6. | DA206 | Project | 4 | 2 | - | 100 | 100 |
| Total | | | 22 | 20 | 250 | 350 | 600 |

3. References:

- Wang, Baoying, Ruowang Li, and William Perrizo, eds. *Big data analytics in bioinformatics and healthcare*. Medical Information Science Reference, 2015.
- Chang, Hyejung. "Book review: Data-driven healthcare & analytics in a big data world." *Healthcare informatics research* 21.1 (2015): 61-62.
- Kocabaş, Övünç, and TolgaSoyata. "Medical data analytics in the cloud using homomorphic encryption." *Handbook of Research on Cloud Infrastructures for Big Data Analytics*. IGI Global, 2014. 471-488.
- Wang, Yingxu, and Victor J. Wiebe. "Big Data Analytics on the characteristic equilibrium of collective opinions in social networks." *Big Data: Concepts, Methodologies, Tools, and Applications*. IGI Global, 2016. 1403-1420.
- Groth, Robert. *Data mining: a hands-on approach for business professionals*. Santa Clara: Prentice Hall PTR, 1998.
- Srinivasa, K. G., et al. "Data analytics assisted internet of things towards building intelligent healthcare monitoring systems: IoT for healthcare." *Journal of Organizational and End User Computing (JOEUC)* 30.4 (2018): 83-103.
- Dietrich, Brenda L., Emily C. Plachy, and Maureen F. Norton. *Analytics across the enterprise: How IBM realizes business value from big data and analytics*. IBM Press, 2014.
- Shah, Tanveer H. "Big data analytics in higher education." *Maximizing social science research through publicly accessible data sets*. IGI Global, 2018. 38-61.
- Fried, Gil, and CeydaMumcu, eds. *Sport analytics: A data-driven approach to sport business and management*. Taylor & Francis, 2016.

PG Diploma in Emerging Engineering Pedagogy with AR/VR Systems

1. **Rationale:** We're living in a digital age where technology has had a transformative effect on the way we live and work. Slowly and steadily, technology has been making strides in revolutionizing methods of learning and teaching. Technology-enabled curriculum and smart boards have long replaced traditional blackboards and two-dimensional textbook images. As we move into the next generation of media transformation, AR (Augmented Reality) and VR (Virtual Reality) are becoming the hottest topics in education technology. By creating an immersive and interactive learning experience without the use of textbooks, **AR** and **VR** technology empowers learners to explore and learn at their own pace, thus stimulating learning and comprehension and enhances critical retention.
2. **Study and Evaluation Scheme:** Study and Evaluation Scheme:

First Semester

| Sr. No. | Course No. | Course Title | Hours / Week | Credits | SEE Marks | CIE Marks | Total |
|--------------|------------|--|--------------|---------|-----------|-----------|-------|
| 1. | AR101 | Principles of Effective Learner-Centred Teaching | 4 | 4 | 50 | 50 | 100 |
| 2. | AR102 | Planning and Designing / Redesigning a Course | 4 | 4 | 50 | 50 | 100 |
| 3. | AR103 | Creating an Active and Dynamic Classroom | 4 | 4 | 50 | 50 | 100 |
| 4. | AR104 | Fostering Collaborative Learning | 3 | 3 | 50 | 50 | 100 |
| 5. | AR105 | Effective Assessment of Learning Outcomes | 3 | 3 | 50 | 50 | 100 |
| 6. | AR106 | Seminar | - | - | - | - | - |
| 7. | AR107 | Mini Project | 4 | 2 | - | 100 | 100 |
| Total | | | 22 | 20 | 250 | 350 | 600 |

Second Semester

| Sr. No. | Course No. | Course Title | Hours / Week | Credits | SEE Marks | CIE Marks | Total |
|--------------|------------|------------------------------------|--------------|---------|-----------|-----------|-------|
| 1. | AR201 | Harnessing the Power of Technology | 4 | 4 | 50 | 50 | 100 |
| 2. | AR202 | Learning Analytics | 4 | 4 | 50 | 50 | 100 |
| 3. | AR203 | AR/VR in Teaching Learning | 4 | 4 | 50 | 50 | 100 |
| 4. | AR204 | ICT for Teaching Learning | 3 | 3 | 50 | 50 | 100 |
| 5. | AR205 | Seminar | 3 | 3 | 50 | 50 | 100 |
| 6. | AR206 | Project | 4 | 2 | - | 100 | 100 |
| Total | | | 22 | 20 | 250 | 350 | 600 |

3. References:

- Lou, Dan. "Two fast prototypes of web-based augmented reality enhancement for books." *Library Hi Tech News* (2019).
- Lim, Cheolil, and Taejung Park. "Exploring the educational use of an augmented reality books." *Proceedings of the Annual Convention of the Association for Educational Communications and Technology*. 2011.
- Altınpulluk, Hakan, and Mehmet Kesim. "The classification of augmented reality books: a literature review." (2016).
- Dünser, Andreas, et al. "Creating interactive physics education books with augmented reality." *Proceedings of the 24th Australian computer-human interaction conference*. 2012.
- Clark, Adrian, and Andreas Dünser. "An interactive augmented reality coloring book." *2012 IEEE Symposium on 3D User Interfaces (3DUI)*. IEEE, 2012.
- Ha, Taejin, Youngho Lee, and Woontack Woo. "Digilog book for temple bell tolling experience based on interactive augmented reality." *Virtual Reality* 15.4 (2011): 295-309.
- Grasset, Raphaël, Andreas Dünser, and Mark Billingham. "Edutainment with a mixed reality book: a visually augmented illustrative childrens' book." *Proceedings of the 2008 international conference on advances in computer entertainment technology*. 2008.
- Dias, Albertina. "Technology Enhanced Learning and Augmented Reality: An Application on Multimedia Interactive Books." (2009).
- McNair, Cheryl Lisa, and Marybeth Green. "Preservice teachers' perceptions of augmented reality." *Literacy Summit Yearbook* (2016): 74-81.

PG Diploma in 'Teaching in Digital Age'

Rationale:

The course will be of one year duration. Candidates with Post Graduate in any Discipline are eligible in the course. The course will equip the faculty with input to:

- Develop and integrate technology to support teaching learning;
- Assess & online-evaluate learning

Study & Evaluation Scheme:

All students will be required to qualify in 6 theory papers (24 credits) as per study and evaluation scheme during the course. There shall be at least ten hours of lectures/tutorials/practicals/drawing classes during the semester, for every hour of lecture/tutorial/practical per week. In addition, all students will be required to qualify project work (10 credits) in second semester.

| Code No | Course of Study | Hours | | | CREDI TS | MARKS | | |
|-------------------|---------------------------------------|-------|-----|-------|----------|---------------------|------------------------|-------|
| | | L | P/T | Total | | Internal Assessment | University Examination | Total |
| Semester I | | | | | | | | |
| TDA 101 | Understanding Teaching | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| TDA 102 | Fundamental Change in Education | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| TDA 103 | Understanding Technology in Education | 3 | 2 | 4 | 4 | 50 | 50 | 100 |

| | | | | | | | | |
|-----------------------|--------------------------------------|---|----|----|-----------|------------|------------|------------|
| TDA 104 | Assessment & Evaluation | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| Semester Total | | | | | 16 | 200 | 200 | 400 |
| Semester II | | | | | | | | |
| TDA 105 | Teaching with Technology: In Campus | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| TDA 106 | Teaching with Technology: Off Campus | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| TDA 107 | Project Work | - | 20 | 20 | 10 | 50 | - | 50 |
| Semester Total | | | | | 18 | 150 | 100 | 300 |
| Grand Total | | | | | 34 | 350 | 300 | 650 |

Detailed Contents:

- **Understanding Teaching** (Systematic approach to instruction, Understanding learners and Learning theories, Learning Outcomes, Motivating 21st Century Learner, Growth of Knowledge Society, etc.)
- **Fundamental Change in Education** {Education 4.0, Education tied up with market (employability concerns), Skills needed in digital age, Technology integration in teaching, etc.}
- **Understanding Technology in Education** (Media – concept, types, uses, selection and development, organizational issues etc.)
- **Assessment & Evaluation** {Evaluation – Concept, Purposes, Types, Characteristics (Validity & Reliability), Assessment of Cooperative & Collaborative Activities, Development of Tools for assessment, Obtaining & Providing Feedback in Online Learning environment, Setting Question Papers, etc.}
- **Teaching with Technology: In Campus** (Creating Tech-savvy classrooms, Virtual Classrooms/laboratories, Experiential Learning, Project & Problem Based Learning etc.)
- **Teaching with Technology: Off Campus** (Online Learning & Evaluation and teaching methods, Collaborative and Cooperative approaches in Online Learning, Use of Social Media, MOOCs – Concept and Development etc.)

References:

1. Gene E. Hall, Linda F. Quinn, Donna M. Gollnick (2019). Introduction to teaching making a difference in student learning (3rd edition). University of Nevada, Las Vegas, USA.
2. William J. Rothwell, Marsha King, Stephen B. King. Mastering the Instructional Design Process: A Systematic Approach 5th Edition (2015). ISBN-13: 978-1118947135 & ISBN-10: 9781118947135.
3. Esther Care, Patrick Griffin, Mark Wilson (2015). Assessment and teaching of 21st Century skills: Research and application. Springer publications.
4. Choo, S., Sawch, D., Villanueva, A., Vinz, R (2017). Educating for 21st century. Perspective, policies and practices around the world. Springers publication.
5. Joshua Kim, Edward Maloney (2020). Learning Innovation and the Future of Higher Education (Tech.edu: A Hopkins Series on Education and Technology)

6. **Bhan, S (2014). Understanding Learners - A handbook for Teachers (Understanding Learners A handbook for Teachers). Prasadpshycofoundation ISO 2001- 2009.**
7. Susan M. Brookhart (2013). How to create and use rubrics for formative assessment and grading. ACSD publications.
8. A.W. (Tony) Bates. Teaching in digital Age-Guidelines for designing teaching and learning, 2nd edition, University of British Columbia, Copyright Year: 2015, Last Update: 2019. Retrieved from <https://open.umn.edu/opentextbooks/textbooks/teaching-in-a-digital-age-guidelines-for-designing-teaching-and-learning-for-a-digital-age> on 22-06-2020.
9. Julie Dirksen(2016) .Design for How People Learn (2nd Edition) (Voices That Matter)ISBN-13: 978-0134211282.
10. Kathryn A. Newton, Mathias J. Sutton, and Duane D. Instructional Delivery Rationale for an On and Off-Campus Graduate Education Program Using Distance Education Technology. Dunlap Purdue University. Retrieved from <https://peer.asee.org/instructional-delivery-rationale-for-an-on-and-off-campus-graduate-education-program-using-distance-education-technology.pdf> on 22.06.2020.

PG Diploma in ‘Institutional Resources Management’

Rationale:

The course will be of one year duration. Candidates with Graduate in any Discipline are eligible in the course. Planning, availability and management of resources is one of the most important activities of any institute. The course will equip the faculty with input to:

- Plan and manage various institutional resources

Study & Evaluation Scheme:

All students will be required to qualify in 6 theory papers (24 credits) as per study and evaluation scheme during the course. There shall be at least ten hours of lectures/tutorials/practicals/drawing classes during the semester, for every hour of lecture/tutorial/practical per week. In addition, all students will be required to qualify project work (10 credits) in second semester.

| Code No | Course of Study | Hours | | | CREDI TS | MARKS | | |
|-----------------------|--|-------|-----|-------|-----------|---------------------|------------------------|------------|
| | | L | P/T | Total | | Internal Assessment | University Examination | Total |
| Semester I | | | | | | | | |
| IRM 101 | Institutional Resource Management | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| IRM 102 | Management of Information System | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| IRM 103 | Human Resource Management | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| IRM 104 | Financial Management | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| Semester Total | | | | | 16 | 200 | 200 | 400 |
| Semester II | | | | | | | | |
| IRM 105 | Manufacturing Resource Planning | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| IRM 106 | Project Management and Managerial Skills | 3 | 2 | 4 | 4 | 50 | 50 | 100 |

| | | | | | | | | |
|-----------------------|--------------|---|----|----|-----------|------------|------------|------------|
| IRM 107 | Project Work | - | 20 | 20 | 10 | 50 | - | 50 |
| Semester Total | | | | | 18 | 150 | 100 | 300 |
| Grand Total | | | | | 34 | 350 | 300 | 650 |

Detailed Contents:

- **Institutional Resource Management** – Fundamentals, Significance; Types - Human, Financial, Technical, Infrastructural and other resources;
- **Management of Information System - Knowledge Management / Technology Management;**
- **Human Resource Management** (Staff Development, Professional and Career development; best practices for hiring and rewarding employees, and for managing employee performance, Training Strategy; Systems approach to design of training programmes; Training Methods (On-the-Job and Off-the-Job); Managerial Skills, Evaluation of Training Programme, Performance Appraisal;);
- **Financial Accounting / Financial Management;**
- **Manufacturing Resource Planning / Enterprise Resource Planning / Service Resource Planning;**
- **Project Management and Managerial Skills**

References:

1. Arya, PP and Tandon, BB (2008). 'Human Resource Development', New Delhi: Deep and Deep Publications, 3rd revised edition.
2. Awasthappa, K (2005). 'Human Resource and Personnel Management', New Delhi: Tata Mc.Graw Hill Pub. Co. Ltd.
3. Bohlanda, GW and Snell, Scott A (2010). Managing Human Resources (15th edition) South-Western Cengage Learning.
4. Gupta, H (2011). Management Information System. Google Books.
5. Lynton, RP and Pareek, Udai (2009). 'Training for Development' New Delhi: Sage Publication.
6. Mager, RF and Pipe Peter 'HRD Training and Development' (Vol. 1 – 6) Mumbai: JAICO Pub. House, 1999.
7. Sousa, KA & Oz, E (2014). Management Information System. Cengage Learning.
8. Stoner, JAF (2004) Management, Progressive Books.
9. Sunny and Kim Bake (1998). 'Project Management (The Complete Idiots Guide)', New Delhi – Prentice Hall of India Pvt Ltd.
10. Werner, JM and De Simone, RL (2009). 'Human Resource Development' 5th Edition. South Western CENGAGE Learning.
11. Wilson Bob (1997). The Systematic Design of Training Courses. Vol. I, Parthenon Publishing
12. Wood, G, Brewster, C and Brookes, M (2014). Human Resource Management and the Institutional Perspective (Global HRM) 1st Edition. Routledge.
13. Drexl, A and Kimms, A (1998). Beyond Manufacturing Resource Planning (MRP II). Springer-Verlag Berlin Heidelberg.

PG Diploma in ‘Institute Project Planning & Management’

Rationale:

The course will be of one year duration. Candidates with Post Graduate in any Discipline are eligible in the course. The course will equip the faculty with input to:

- Identify a project, specify its goals and objectives, analyse the network and determine project completion time and indicate the critical path on the network

Study & Evaluation Scheme:

All students will be required to qualify in 6 theory papers (24 credits) as per study and evaluation scheme during the course. There shall be at least ten hours of lectures/tutorials/practicals/drawing classes during the semester, for every hour of lecture/tutorial/practical per week. In addition, all students will be required to qualify project work (10 credits) in second semester.

| Code No | Course of Study | Hours | | | CREDI TS | MARKS | | |
|-----------------------|--|-------|---------|-----------|-------------|----------------------------|-------------------------------|------------|
| | | L | P/ T | Tot al | | Internal Assessmen t | University Examinati on | Total |
| Semester I | | | | | | | | |
| IPM 101 | Dimensions of Institute Project Planning & Management | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| IPM 102 | Need & Goal Analysis and Project Schedule Development | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| IPM 103 | Resource, Budget and Risk Management | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| IPM 104 | Project Implementation and Evaluation | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| Semester Total | | | | | 16 | 200 | 200 | 400 |
| Semester II | | | | | | | | |
| IPM 105 | Managerial Skills | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| IPM 106 | Communication Skills and Project Report Writing | 3 | 2 | 4 | 4 | 50 | 50 | 100 |
| IPM 107 | Project Work | - | 20 | 20 | 10 | 50 | - | 50 |
| Semester Total | | | | | 18 | 150 | 100 | 300 |
| Grand Total | | | | | 34 | 350 | 300 | 650 |

Detailed Contents:

- Dimensions of Institute Project Planning & Management; Need Analysis, Goals and Objectives; Defining Checkpoints and Activities; Project schedule – bar charts, milestone charts and networks; PERT Networks; Implementation of Project; Managerial Skills, Project Evaluation etc.

References:

1. Adler, RB (1989). Communicating at work – Principles & Practices for Business & the professions. New York: Random House, 55-59p.
2. Chaturvedi, PD and Chaturvedi, M (2011). Business Communication – Concepts, cases and Applications. Delhi: Pearson.
3. Dalton, M; Hoyle, DG & Watts, MW (2000). Human Relations. Australia: South-Western Educational Publishing, 241-248p.
4. Hersey, P; Blanchard, KH & Johnson, DE (2000), Management of Organizational Behaviour, 7th Edition, New Delhi: Prentice Hall of India Pvt. Ltd.
5. Katz, Robert (1955). Skills of an Effective Administrator. Harvard Business Review, Vol. 33 (1), 33-42p.
6. Rue, LW & Byars, LL (1995). Management – Skills & Applications, 7th Edition. Chicago: Irwin, 87-88p.
7. Sunny and Kim Bake (1998). 'Project Management (The Complete Idiots Guide)', New Delhi – Prentice Hall of India Pvt Ltd
8. Wadkar, A (2016). Life Skills for Success. New Delhi: SAGE Publications India Pvt. Ltd., 93 – 108p.

Post Diploma in Digital Media and Social Journalism

Rationale:

The world is changing rapidly as a result of globalisation, digitisation, web connectivity and social media, making it an exciting time to study digital media and social journalism. The Post Diploma in “Digital Media and Social Journalism” has been designed with a strong emphasis on understanding the contemporary environment of multiplatform content development and the potential multi channel networks and their consumption for the betterment of society. The course will equip the learners with the skills and experience to become an expert in digital media and its application in social journalism. Through the course, the learners shall gain transferable skills for a digital career, with the flexibility to choose their own pathway in the demanding field of social journalism.

Detailed Contents:

Semester-I

6. Basics of Digital Media.
 - Concept of Digital media
 - Need & Impact
 - Advantages of Digital Media
 - Augmented reality
 - Virtual reality

7. Introduction to Journalism.

- Concept of Journalism
- Types of Journalism
- Introduction to Social Journalism
- Reporting for Social Journalism
- Communication Skills and Ethics
- Digital Public Relations

8. Digital Content Production Techniques

- Pre Production (Organizing Production, Script writing , Lighting)
- Videography and still photography
- Post Production (Video Editing and Image editing)

9. News Production & Reporting

- Interactive Story telling
- Public speaking & Communication
- Camera Facing Techniques
- Personality Development

Semester-II

6. Digital Publishing & Marketing

- Open standards in digital publishing
- Cross platform publication / E-Pub & kindle
- Tools & services for digital publishing
- Digital Marketing concept, strategy and implementation
- Website marketing and Email marketing, Social media marketing
- Search Engine Optimization(SEO)
- Integrating digital marketing with Traditional marketing

7. Communication & Public Relation in Journalism

- Management skills
- Communication skills & ethics
- Digital public relations

8. Laws & Ethics in Journalism and mass media

- Intellectual Property Rights
- Directive principles of state and national policies
- Accountability and independence media

9. Project work in Social Journalism/Digital Media

P.G. Diploma Electrical Engineering (Electric Vehicles)

Rationale

The development of new systems of intelligent, environmentally friendly and integrated transport systems is one of the most important challenges in the 21st century, above all in terms of emissions and the type of energy used. The social interest and industrial business generated by electric vehicles increase the demand for professionals qualified in all the related areas of technology.

The progressive implementation of electric vehicles will increase the need for engineers with specific knowledge in this ambit. Therefore, the principal objective of this advanced diploma program is to produce specialised engineers in collaboration with industry to give them hands on practical exposure on the various aspects of Electric Vehicles.

STUDY & EVALUATION SCHEME

P.G. Diploma Electrical Engineering (Electric Vehicles)

REGULAR PROGRAMME

Semester 1

| CODE | SUBJECT | SCHEDULE FOR TEACHING | | | CREDITS | MARKS | | |
|-------|---|-----------------------|---|-------|---------|---------------------|------------------------|-------|
| | | L | P | TOTAL | | Internal Assessment | University Examination | TOTAL |
| 1EV01 | Electric Vehicle Technology | 4 | - | 4 | 4 | 50 | 50 | 100 |
| 1EV02 | EV System Design and Architecture | 4 | - | 4 | 4 | 50 | 50 | 100 |
| 1EV03 | Energy Storage Systems for Electric Vehicles | 4 | - | 4 | 4 | 50 | 50 | 100 |
| 1EV04 | Drives and their Control for Electrified Transportation Systems | 4 | - | 4 | 4 | 50 | 50 | 100 |
| 1EV05 | Industrial Training – 1 | - | 4 | 4 | 2 | 50 | - | 50 |

| | | | | | | | | |
|---------------|--|---|---|---|-----------|------------|------------|------------|
| 1EV06 | Electric Vehicles Development Laboratory | - | 4 | 4 | 2 | 50 | - | 50 |
| TOTAL: | | | | | 20 | 300 | 200 | 500 |

• **Semester 2**

| CODE | SUBJECT | SCHEDULE FOR TEACHING | | | CREDITS | MARKS | | |
|---------------|---|-----------------------|----|-------|-----------|---------------------|------------------------|--------------|
| | | L | P | TOTAL | | Internal Assessment | University Examination | TOTAL |
| 1EV07 | Vehicle Dynamics and Traction Systems | 4 | - | 4 | 4 | 50 | 50 | 100 |
| 1EV08 | Electric Vehicles and its Integration to Grid | 4 | - | 4 | 4 | 50 | 50 | 100 |
| 1EV09 | Industrial Training – 2 | - | 4 | 4 | 2 | 50 | - | 50 |
| 1EV10 | Electric Vehicles Charging Station Laboratory | - | 4 | 4 | 2 | 50 | - | 50 |
| 1EV11 | Project | - | 20 | 20 | 8 | 100* | 100 | 200** |
| TOTAL: | | | | | 22 | 300 | 200 | 500 |

* Internal assessment is based on the following criterion:

| Grade | Condition |
|-------|--|
| A+ | Publication from Thesis in SCI indexed journal |
| A | Publication from Thesis in Scopus indexed journal |
| B+ | Publication from Thesis in UGC journal OR Scopus indexed conference proceedings |
| B | Publication from Thesis in International Conference |
| C+ | Publication from Thesis in National Conference |

** Final Grade will be average of the grades of internal assessment and university viva-voce examination

Annexure-III

(92 Pages)

Research Publications

NITTTR Chandigarh after being declared Deemed to be University shall endeavour to enhance the quality and quantity of publications. NITTTR shall confer research leading degrees and follow the Research and Innovation with and for the Society. Institute will enhance the alignment of research and innovation to the values and expectations of society, with a particular implicit feedback from the stakeholders.

NITTTR after being declared deemed to be university shall strive to develop an ecosystem which promotes advancement of knowledge and the dissemination and application of these advances, and through the development of informed and inquiring minds in an environment imbued with discovery and creativity.

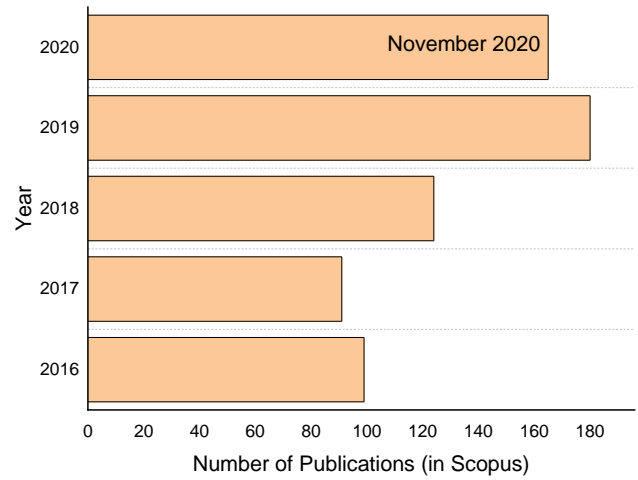
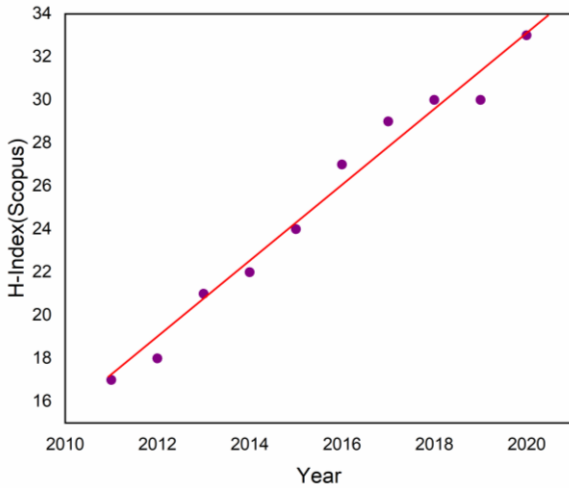
Research and development activities in technology and technical education form an important aspect of the NITTTR's programmes. During the last five years institute faculty has published a handsome number of publications in international/national journals and conferences.

| Year | Publications | |
|---------|--------------------------------------|---|
| | Journals (National/International) | Conferences (National/International) |
| 2015-16 | 152 | 73 |
| 2016-17 | 159 | 119 |
| 2017-18 | 162 | 119 |
| 2018-19 | 227 | 55 |
| 2019-20 | 232 | 44 |

The perspective plan shall focus on significant enhancement of quality publications as an outcome of the research initiatives. This shall be done by taking the following initiatives.

- ✚ Motivate faculty and students to publish more and more research papers in journals (SCI/SCIE/SSCI/A&HCI/Scopus) where peers in the top 100 universities of the country publish.
- ✚ Promote collaborative research and innovation activities at national and international level.
- ✚ Admit Post Doctorate Fellows.
- ✚ Admit 50 number of Ph.D. students (under QIP, National Fellowship, Industry Fellowship, Exchange Students, Self-Sponsored) per year by offering them stipend for high-end research.
- ✚ Secure funding for research and infrastructure development.

Last Five-Year publications data, citations, h-index is shown in the following graphics:



NITTR Chandigarh

National Institute of Technical Teachers Training and Research, Chandigarh
No verified email

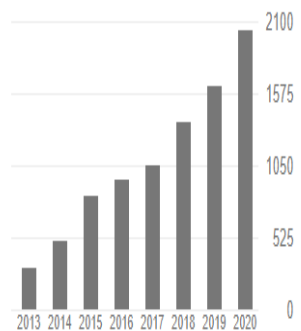
FOLLOW

Cited by

VIEW ALL

| | All | Since 2015 |
|-----------|------|------------|
| Citations | 9488 | 7915 |
| h-index | 39 | 35 |
| i10-index | 242 | 187 |

| TITLE | CITED BY | YEAR |
|--|----------|------|
| A review on various electrochemical techniques for heavy metal ions detection with different sensing platforms BK Bansod, T Kumar, R Thakur, S Rana, I Singh Biosensors and Bioelectronics 94, 443-455 | 314 | 2017 |
| Image segmentation techniques 1 R Dass, S Devi | 258 | 2012 |
| A review of metaheuristic scheduling techniques in cloud computing M Kalra, S Singh | 246 | 2015 |



**RESEARCH PUBLICATIONS BY INSTITUTE FACULTY
(NATIONAL/INTERNATIONAL JOURNALS IN THE LAST 5 YEARS)**

| Details of the Paper Published | Author (s) Name |
|--|---|
| "Improvement in the linear and nonlinear optical properties of Mn-doped GeSe ₂ chalcogenide thin films for all optical applications", Applied Physics A, 126, (2020) 173 | Pankaj Sharma, K. A. Aly, Dinesh Ch. Sati & A. Dahshan |
| "First Principles Investigation on Armchair Zinc Oxide Nanoribbons as Uric Acid Sensors", Journal of Molecular Modeling;(2020) 26:4 | Paramjot Singh, Deep Kamal Kaur Randhawa, B.C. Choudhary, Gurleen Kaur Walia, Navjot Kaur |
| "Microstructure and Electrochemical Performance of La ₂ ZnMnO ₆ Nanoflakes Synthesized by Facile Hydrothermal Route", Applied Physics A (SCI I.F. 1.810), 126, 11, (2020) | Jashandeep Singh, Amit Kumar, Uttam Kumar Goutam and Ashok Kumar |
| "Solvothelmal synthesis dependent structural, morphological and electrochemical behaviour of mesoporous nanorods of Sm ₂ NiMnO ₆ ", Ceramics International (SCI I.F. 3.830), 46, 11041, (2020) | Jashandeep Singh and Ashok Kumar |
| "Wet Chemical Synthesis and Electrochemical Performance of Novel Double Perovskite Y ₂ CuMnO ₆ Nanocrystallites", Materials Science in Semiconductor Processing (SCI I.F. 3.085), 107, 104826, (2020) | Farha Naaz Mansoorie, Jashandeep Singh and Ashok Kumar |
| "Role of surfactant in optimization of 3D ZnO floret as photoanode for dye sensitized solar cell", Applied Nanoscience (SCI I.F. 2.880), 10, 1035 (2020) | Sonia Siwatch, Virender Singh Kundu, Ashok Kumar and Suresh Kumar |
| "Ethylene glycol/ citric acid stabilized wet chemically synthesized Y ₂ CoNiO ₆ , and its structural, dielectric, magnetic and electrochemical behavior", Journal of Materials Science: Materials in Electronics (I.F.2.220) (accepted March 17, 2020) | Maret Ickler, Manju Devi, Irina Rogge, Jashandeep Singh and Ashok Kumar |
| "Investigation of structural, morphological, and electrochemical properties of mesoporous La ₂ CuCoO ₆ rods fabricated by facile hydrothermal route", Int J Min Met Mater. (I.F. 1.713)(accepted February 09, 2020) | Jashandeep Singh and Ashok Kumar |
| Chlorophyll Estimation using Multi-Spectral Unmanned Aerial System based on Machine Learning Techniques, Remote Sensing Applications: Society and Environment (RSASE) Elsevier Journal, Available online 15 May 2019, doi.org/10.1016/j.rsase.2019.100235 (SCI). | Gaurav Singhal, Babankumar Bansod, Lini Mathew, Jonali Goswami, B.U.Choudhary, P.L.N Raju |
| Recent Trends of Control Strategies for Doubly Fed Induction Generator Based Wind Turbine Systems: A Comparative Review, Archives of Computational Methods in Engineering, October, 2019. (SCI Impact Factor- 7.242). | Shivaji Karad, Ritula Thakur |
| "A survey of Key bootstrapping protocols based on Public Key Cryptography in the Internet of Things", 2019 , IEEE Access, SCI Indexed, Vol 7, Iss: 1, pp 27443-27464 10.1109/ACCESS.2019.2900957 | Manisha Malik, Maitreyee Dutta And Jorge Granjal |
| "S-Ddos: Apache Spark Based Real-Time Ddos Detection System" Journal of Intelligent of Fuzzy Systems, IOS Press (Accepted, Sci-E, Impact Factor : 1.637) | N.V Patil, C. Rama Krishna And K. Kumar |
| "A Real-Time Twitter Trend Analysis and Visualization Framework," International Journal on Semantic Web and Information Systems (IJSWIS) 15 (2019): 2, accessed (September 15, 2020), doi:10.4018/IJSWIS.2019040101 | Murthy, Jamuna S. and Siddesh G.M., and Srinivasa K.G. |

| | |
|---|--|
| “Conventional Machine Learning and Deep Learning Approach for Multi-Classification of Breast Cancer Histopathology Images—a Comparative Insight”, <i>Journal of Digital Imaging</i> , 33, 632–654, January, 2020. | Shallu Sharma & Rajesh Mehra |
| “Effect of layer-wise fine-tuning in magnification-dependent classification of breast cancer histopathological image”, <i>The Visual Computer</i> , 36, 1755–1769 October, 2019. | Shallu Sharma & Rajesh Mehra |
| Agamreet Kaur, Rajesh Mehra, Amit Saini “Hetero-Dielectric oxide engineering on dopingless gate all around nanowire MOSFET with Schottky contact source/drain” <i>AEU - International Journal of Electronics and Communications</i> , Volume 111, November 2019, 152888. | Agamreet Kaur, Rajesh Mehra, Amit Saini |
| “Investigation of Organic LED Materials Using a Transparent Cathode for Improved Efficiency”, <i>Journal of Electronic Materials</i> Volume 48(7) , 4409–4417, April 2019. | Rana, R., Mehra, R. |
| “Implications of Pooling Strategies in Convolutional Neural Networks: A Deep Insight”, <i>Foundations of Computing and Decision Sciences</i> , 44(3), 303-330, August, 2019. | Sharma, S., Mehra, R. |
| Artificial Intelligence based Fault Diagnosis for Condition Monitoring of Electric Motors, <i>International Journal of Pattern Recognition and Artificial Intelligence</i> , Vol.34, No.13, 2020. (DOI: https://doi.org/10.1142/S0218001420590430) (SCI-E) | Amandeep Sharma, Lini Mathew, Shantanu Chatterji, Deepam Goyal, |
| Real Time Simulation of Hybrid Power Flow Controller, <i>International Journal of Grid and Distributed Computing</i> Vol. 13, No. 1, pp. 388-399, March 2020. (ESCI) | Anjali A. Bhandakkar, Lini Mathew, |
| Real-Time Simulation of TCSC, <i>International Journal of Future Generation Communication and Networking</i> Vol. 13, No. 1, pp. 903-914, February 2020. (ESCI) | Anjali A. Bhandakkar, Lini Mathew, |
| “Energy efficient compression sensing-based clustering framework for IoT-based heterogeneous WSN” <i>Springer Journal of Telecommunication Systems</i> , Vol.74, pp.311-330, March 2020. | Rachit Manchanda, kanika Sharma |
| Scale-free PSO for in-run and infield inertial sensor calibration, <i>Measurement</i> , Vol. 147, July 2019, available on-line. (IF = 3.364) | Shashi Poddar, Amod Kumar |
| Real time estimation and suppression of hand tremor for surgical robotic applications <i>Microsystem Technologies</i> , January 2020, DOI 10.1007/s00542-019-04736-1 (IF = 1.61) | Akhlesh Kumar. Sanjeev Kumar, Ajeet Kaushik, Amod Kumar & J. S. Saini |
| Development of a Hybrid SIMBO-ANN Algorithm for Optimization of SRR parameters to enhance the performance of PIFA, <i>Journal of Scientific & Industrial Research</i> , Vol. 78, November 2019, pp. 727-732. | Garima Saini Dr. S S Pattnaik |
| Impact of High-k Gate dielectric and Work functions variation on Electrical Characteristics of VeSFET, <i>Advances in Intelligent Systems and Computing</i> (Springer book series) | Gurpurneet Kaur, Sandeep Singh Gill, Munish Rattan |
| Carbon Nano Tube based sensor design for NEMS/MEMS applications, In Raj, B., Khosla, M., & Singh, A. (Ed.), <i>Major Applications of Carbon Nanotube Field-Effect Transistors (CNTFET)</i> (pp. 37-53). IGI Global. http://doi:10.4018/978-1-7998-1393-4.ch003 | Rekha Devi, Sandeep Singh Gill |
| Development of range free three dimensional localisation in wireless sensor networks, <i>International Journal of Sensor Networks (IJSNET)</i> , Vol. 31, No. 1, 2019 | Shashi Bhushan Kotwal, Sandeep Singh Gill, Kuldeepak Singh Saini |
| “Conventional Machine Learning and Deep Learning Approach for Multi-Classification of Breast Cancer Histopathology Images—a Comparative Insight”, <i>Journal of Digital Imaging</i> , 33, 632–654 (2020).Indexing: SCIE, Scopus. | Shallu Sharma & Rajesh Mehra |
| “Effect of layer-wise fine-tuning in magnification-dependent classification of breast cancer histopathological image”, <i>The Visual Computer</i> , 36, 1755–1769 (2020). | Shallu Sharma & Rajesh Mehra |

| | |
|---|---|
| Agamreet Kaur, Rajesh Mehra, Amit Saini “Hetero-Dielectric oxide engineering on dopingless gate all around nanowire MOSFET with Schottky contact source/drain” AEU - International Journal of Electronics and Communications, Volume 111 , November 2019, 152888. | Agamreet Kaur, Rajesh Mehra, Amit Saini |
| “Non-Contact Fault Diagnosis of Bearings in Machine Learning Environment”, IEEE Sensors Journal, doi: 10.1109/JSEN.2020.2964633 [IEEE] | Goyal, D., Dhama, S.S., Pabla, B.S. |
| “Improvement in performance of cryogenically treated tungsten carbide tools in face milling of Ti-6Al-4V alloy”, Materials and Manufacturing Processes, doi: 10.1080/10426914.2019.1615079, pp.1-10 [Taylor and Francis] | Saini, A., Pabla, B.S. and Dhama, S.S. |
| “Processing, tool wear measurement using machine vision system and optimization of machining parameters of boron carbide and rice husk reinforced aa 7075 hybrid composite” Materials Research Express, Vol. 6(8), pp. 1-18 [IOP] | Verma, N., Vettivel, S.C., Rao, P.S., & Zafar, S. |
| “Support Vector Machines Based Non-contact Fault Diagnosis System for Bearings”, Journal of Intelligent Manufacturing, doi: 10.1007/s10845-019-01511-x [Springer] | Goyal, D., Choudhary, A. Dhama, S.S., Pabla, B.S. |
| “Preparation and characterization of electrodeposited Ni–TiC, Ni–TiN, and Ni–TiC–TiN composite coatings on tungsten carbide cutting tool”, Proceedings of the Institution of Mechanical Engineers, Part J: Journal of Engineering Tribology, p.1350650119841214 [Sage] | Saini, A., Pabla, B.S. and Dhama, S.S. |
| “Effect of extrusion parameters on primary recycled ABS: mechanical, rheological, morphological and thermal properties”, Materials research express, Vol. 7, 2020, doi.org/10.1088/2053-1591/ab6b5e | Vinay Kumar, Rupinder Singh, I.P.S. Ahuja |
| “On flexural and pull out properties of 3D printed PLA based hybrid composite matrix”, Materials research express, Vol. 7, 2020, doi.org/10.1088/2053-1591/ab66f4 | Sudhir Kumar, Rupinder Singh, T.P.Singh, Ajay Batish |
| “On compressive and morphological features of 3D printed almond skin powder reinforced PLA matrix”, Materials research express, Vol. 7, 2020, doi.org/10.1088/2053-1591/ab5e61 | Rupinder Singh, Ranvijay Kumar, Mohit Singh, Pawanpreet |
| “Investigations for mechanical, thermal and magnetic properties of polymeric composite matrix for four dimensional printing applications” Jol. of Brazilian Society of Mechanical Sciences and Engg., Vol. 42, 2020, DOI: 10.1007/s40430-020-2251-4, (Springer publications) | Sudhir Kumar, Rupinder Singh, TP Singh, Ajay Batish |
| “Investigations for hardness of investment casted implants fabricated after vapor smoothing of FDM replicas”, Jol. of Brazilian Society of Mechanical Sciences and Engg., Vol. 42, 2020, DOI:10.1007/s40430-020-2265-y, (Springer publications) | Daljinder Singh, Rupinder Singh, K.S.Boparai |
| “On mechanical and thermal properties of cryo-milled primary recycled ABS”, Sadhana, , Vol.45, 2020, doi.org/10.1007/s12046-020-1317-4, (Springer Publications) | Vinay Kumar, Rupinder Singh, I.P.S. Ahuja |
| “Processing Techniques of Polymeric materials and their reinforced composites”, Advances in Materials and Processing Technologies, Vol. 6, No.3, 2020, DOI: 10.1080/2374068X.2020.1728989, (Taylor and Francis publications) | Ranvijay Kumar, Rupinder Singh, IPS Ahuja, |
| “Multifactor optimization for development of hybrid aluminum matrix composites”, Indian Jol. of Engg and Material Science, Vol. 27, 2020 | Swarandeep Singh, Rupinder Singh, S. S. Gill |
| Epilepsy classification using optimized artificial neural network, Neurological Research, DOI: 10.1080/ 01616412.2018.1508544 Impact Factor 1.449 | Jagrati Saini, Maitreyee Dutta |
| A Survey of Key Bootstrapping Protocols Based on Public Key Cryptography in the Internet of Things, IEEE Access, DOI: 10.1109/ACCESS.2019.2900957, Volume 7, February, 2019 | Manisha Malik, Maitreyee Dutta, And Jorge Granjal |

| | |
|--|---------------------------|
| “A Review on Durability Properties of Densified Small Particles base d Concrete”, International Journal for Research in Applied Science & Engineering Technology ISSN: 2321- 9653, Vol. 7 Issue V, May, 2019 | Dr. Sanjay Kumar Sharma |
| Soil Stabilization using Brick Kiln Dust and waste Coir Fibre International Journal of Recent Technology and Engineering ISSN: 2277-3878, Vol.8 July 2019. | Er. Vinod Kumar Santhowal |
| “Management of Municipal Solid Waste and Production of Biodegradable Packaging Material: A Double Edged Green Technology Approach”, International Journal of Basic and Applied Research ISSN:22493352/22780505 Vol. 9, Issue 7 July 2019 | Dr. Sanjay Kumar Sharma |
| “Effect of using Waste Plastic in Geopolymer Concrete”, Journal of emerging technologies and innovative research (JETIR) ISSN-2349-5162, Vol.6, Issue 6 June 2019 | Dr. Hemant Sood |
| “Carbon Fibres As A Self-Sensing Material For Health Monitoring Of Concrete Structures”, Journal of emerging technologies and innovative research (JETIR) ISSN-2349-5162 Vol.6, Issue 6, 10 June 2019 | Dr. Hemant Sood |
| “Strengthening of concrete using glass fiber reinforced polymer sheet”, Journal of emerging technologies and innovative research (JETIR) ISSN :2349-5162 vol.6, Issue 6, June 2019 | Dr. Sanjay Kumar Sharma |
| i) “Performance Based Seismic Design of RCC Building”, International Journal of Civil Engineering Research ISSN: 2278-3652 Vol. 9 Number 1 (2018) (ii) “Pushover Analysis of RCC Building”, International Journal of Civil Engineering Studies ISSN:0975-6469 Volume 10, Number 4 (2018) | Er. Himmi Gupta |
| “Effect of Addition of Plastic in Bituminous Mixes Prepared with Modified Bitumen”, ELSEVIER Scopus International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN:2278-3075 Vol.-8 Issue-9, July 2019 (ii) “Review on Effect of addition of Plastic in Bituminous Mixes prepared with CRMB”, International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES) ISSN:2455-2585 Vol.-5, Issue 06, June 2019 | Er. Ajay Kumar Duggal |
| “Accident Trend in India: Issues and Challenges”, Journal of Emerging Technologies & Innovative Research (JETIR) ISSN-2349-5162 Vol. 6, Issue 6, June 2019 | Dr. Hemant Sood |
| “Study of Level of Service (LOS) Criteria for Measuring Traffic Congestion – A Critical Review”, Journal of Emerging Technologies & Innovative Research (JETIR) ISSN-2349-5162 Vol. 6, Issue 6, June 2019 | Dr. Hemant Sood |
| “A Review on Effect on Addition of Medium Steel Fibers on Dense Bituminous Macadam”, Journal of Emerging Technologies & Innovative Research (JETIR) ISSN-2349-5162 Vol. 6, Issue 6, June 2019 | Er. Ajay Kumar Duggal |
| “Soil Stabilization of Clayey Soil using Rice Husk Ash and Polypropylene Fiber”, Journal of Emerging Technologies & Innovative Research (JETIR) ISSN-2349-5162 Vol. 6, Issue 6, June 2019 | Er. Vinod Kumar Santhowal |
| “A Review on Low Temperature Stiffness of Bitumen Binder & its Correlation with Stability”, Journal of Emerging Technologies & Innovative Research (JETIR) ISSN-2349-5162 Vol. 6, Issue 6, June 2019 | Er. Ajay Kumar Duggal |
| “Waste Water Treatment of Industries Using Physico Chemical Technique : A Review”, Journal of Emerging Technologies & Innovative Research (JETIR) ISSN-2349-5162 Vol. 6, Issue 6, June 2019 | Dr. Sanjay Kumar Sharma |
| “A Review on Strengthening of High Strength Concrete with using Fiber Wrapping System”, Journal of Emerging Technologies & Innovative Research (JETIR) ISSN-2349-5162 Vol. 6, Issue 6, June 2019 | Dr. Sanjay Kumar Sharma |
| “Stability Analysis of Failed Slope at Chakki Mod, Along Kalka-Shimla Highway, Himachal Pradesh Using Midas GTS NX® Software”, Journal of | Er. Vinod Kumar Santhowal |

| | |
|---|---|
| Emerging Technologies & Innovative Research (JETIR) ISSN-2349-5162 Vol. 6, Issue 6, June 2019 | |
| "A Critical Review on Enhancing Soil Properties Using Quarry Dust & Sisal Fiber", Journal of Emerging Technologies & Innovative Research (JETIR) ISSN-2349-5162 Vol. 6, Issue 6, June 2019 | Er. Vinod Kumar Santhowal |
| "A Study on Physical of Coconut Coil Fiber Sein forced Concrete and Ordinary Concrete", Journal of Emerging Technologies & Innovative Research (JETIR) ISSN-2349-5162 Vol. 6, Issue 6, June 2019 | Dr. Sanjay Kumar Sharma |
| "A Critical Review on Comparative Study on Hot Bituminous Mixes by Drum Mix & Batch Mix Plant", Journal of Emerging Technologies & Innovative Research (JETIR) ISSN-2349-5162 Vol. 6, Issue 6, June 2019 | Er. Ajay Kumar Duggal |
| "Mechanical Characterization of the Granite Rock and Study of its Interfacial Behavior in Cement Mortar", 4th Indian Conference on Applied Mechanics (Acceptance): To be Printing in Special Issue | Dr. Sanjay Kumar Sharma |
| "To Study the Effect of Varying Proportion of Rice Husk Ash on the Properties of Fly Ash Based Geopolymer Mortar: A Review", Journal of Emerging Technologies & Innovative Research (JETIR) ISSN-2349-5162 Vol. 6, Issue 6, June 2019. | Dr. Sanjay Kumar Sharma |
| "A Critical Review on Enhancing Soil Properties Using Cement Kiln Dust & Polypropylene Fiber", Journal of Emerging Technologies & Innovative Research (JETIR) ISSN-2349-5162 Vol. 6, Issue 6, June 2019 | Er. Vinod Kumar Santhowal |
| "A review on analysis of Black Spots of Highways and \cities in India", International Journal of technical Innovation in Modern Engineering & Sciences Volume 5 Issue 3 | Er. Ajay Kumar Duggal |
| "Influence of Casting and Curing Temperature on Compressive Strength of Concrete", Journal of Emerging Technologies & Innovative Research (JETIR) ISSN-2349-5162 Vol. 6, Issue 6, June 2019 | Dr. Hemant Sood |
| "Spam Detection in Social Networking Sites using Artificial Intelligence Technique", International Journal of Innovative Technology and Exploring Engineering, SCOPUS indexed, Vol 8, Iss 853, July, 2019, pp: 20-25 | Amit Pratap Singh, Maitreyee Dutta |
| "Precise Positioning at Indian Region with Multi Constellation GNSS Receiver SP80, " International Journal of Advanced Studies of Scientific Research" vol 3, Iss 82018, Indexed in Elsevier-SSRN | Prashant Joshi, Dr. Maitreyee Dutta, Vivek Bansal |
| "Bi-Lingual (English, Punjabi) Sarcastic Sentiment Analysis by using Classification Methods", International Journal of Innovative Technology and Exploring Engineering, SCOPUS indexed, Vol 8, Iss 9, July, 2019, pp: 1383-1388 | Ishana Attri, Maitreyee Dutta |
| "Improved Framework for Bug Severity Classification using N-gram Features with Convolution Neural Network", International Journal of recent Technology and Engineering (SCOPUS Indexed), Vol 8, Iss 3, ISSN: 2277-3878, September, 2019 | Sarbjeeet Kaur, Dr. Maitreyee Dutta |
| "Review of Blind Deconvolution Technique for image Restoration", published in International Journal on Emerging Technologies 10(2): 333-344 (2019), SCOPUS Indexed | Ramteke Mamta G, Maitreyee Dutta |
| "Research on Enhancing RPL for Improved Performance in IoT Networks", published in International Journal of Innovative Technology and Exploring Engineering, Volume-8 Issue-12, October 2019, SCOPUS INDEXED | Hangkum Sao Chang, Maitreyee Dutta |
| "Threshold Based Method for Detection of Distributed Deniel of Service Attack in IoT", International Journal of Recent Technology and Engineering", Vol 8, Iss 4, November 2019 | Johnson Joseph, Maitreyee Dutta |
| "New Cepstrum Based Image Restoration Algorithm for Grayscale Images", published in International Journal of Innovative Technology and Exploring Engineering, SCOPUS indexed, Vol 8, Iss 11, September 2019 | Ramteke Mamta G, Maitreyee Dutta |

| | |
|---|---|
| "Apache Hadoop based Distributed Denial of Service Detection Framework," Springer CSIS Series (ISSN No. 1865-0929)- 4th International Conference Information, Communication & Computing Technology (ICICCT 2019), India International Centre, New Delhi, India, 11 May 2019. [UGC Approved Journal - 2019 (Journal No. - 16246): Accepted for publication] | Nilesh Vishwasrao Patil, C. Rama Krishna, and Krishan Kumar, |
| "Analysis of various students performance Prediction Techniques" , proceedings of 3rd International Conference on Intelligent Computing & Control System, Madurai, India , May 15 -19, 2019 | Abinav Jain, Shano Solanki |
| "IoT Based Data Storage for Cloud Computing Applications" in proceedings of "International conference on Artificial Intelligence and Data Engineering (AIDE), NMAMIT, Karnataka 23-24 May 2019 (to be published in AISC series, Springer) | Ankita Shukla, Priyatam Reddy Somagattu, Vishal Krishan Singh, Mala Kalra |
| "Sentiment Analysis of Train Derailment in India: A Case Study from Twitter Data", IEEE Sponsored Second International Conference on Intelligent Communication and Computational Techniques, Manipal University Jaipur, India, September 28-29, 2019 (Accepted for Oral Presentation on June 16, 2019) | Vartika, C. Rama Krishna, Ravinder Kumar and Yogita |
| "E-Had: A Distributed and Collaborative Detection Framework for Early Detection of DDoS Attacks", Elsevier Journal of King Saud University - Computer and Information Sciences, doi: https://doi.org/10.1016/j.jksuci.2019.06.016 (accepted for publication on 28 June 2019)(Indexed in: SCOPUS, ESCI) | Nilesh Vishwasrao Patil, C. Rama Krishna, Krishan Kumar, and Sunny Behal |
| "Mitigating Economic Denial of Sustainability (EDoS) in Cloud Environment using Genetic Algorithm and Artificial Intelligence", International Journal of Innovative Technology and Exploring Engineering [Accepted, SCOPUS Indexed]. | S. Nautiyal, C. Rama Krishna and S. Wadhwa, |
| "VM Allocation in Heterogeneous Cloud for Load Balancing based on VM Classification", International Conference on Inventive Computation Technologies (ICICT), | B. Mulla, C. Rama Krishna and R. Kumar Tickoo |
| "DDoS Attack Detection and Prevention using AODV Routing Mechanism and FFBP Neural Network in a Manet", International Journal of Recent Technology and Engineering [Accepted, SCOPUS Indexed] | J. Batra and C. Rama Krishna |
| "An Efficient Indian Sign Language Recognition System using Sift Descriptor", International Journal of Engineering and Advanced Technology, SCOPUS Indexed] | J. Kaur and C. Rama Krishna |
| "Face-Iris Multimodal Biometric System using Feedforward Backpropagation Neural Network", is published in International Journal of Innovative Technology and Exploring Engineering(IJITEE),ISSN: 2278-3075, Volume-8 Issue-8S3, June 2019 | Deepali Singhal, Amit Doegar |
| "Real Time Communication between Nodes using LoRaWAN for Emergency Alert in Elevator", International Journal of Engineering and Advanced Technology. [Scopus Indexed- Accepted on 31st July 2019] | Anupriya, C. Rama Krishna, Ajay Godhara |
| "Load Balancing Algorithm for Efficient VM Allocation in Heterogeneous Cloud" International Journal of Computer Networks & Communications (IJCNC). [Scopus Indexed- Accepted on 21st August 2019] | Badshaha Mulla, C. Rama Krishna and Raj Kumar Tickoo |
| " Hybridization of Feature Level Fusion with Ant Colony Optimization in Multimodal Biometrics", International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 8958, Volume-8 Issue-6, August 2019 (Scopus Indexed) | Sakuntla Meena, Amit Doegar |
| "An intelligent water drops-based approach for workflow scheduling with balanced resource utilisation in cloud computing, International Journal of Grid and Utility Computing, Vol. 10, No. 5, pp. 528 - 544, 2019 (Scopus Indexed), DOI: 10.1504/IJGUC.2019.101995. | Mala Kalra, Sarbjeet Singh |

| | |
|--|---|
| “Classification of Action Based Video Using Heterogeneous Feature Extraction and SVM,” International Journal of Innovative Technology and Exploring Engineering (IJITEE), Volume-8, Issue-11 September 2019. DOI: 10.35940/ijitee.K2089.0981119 (Scopus) | Chandrawal kaur, Amit Doegar |
| “Hybridization of Feature Level Fusion with Ant Colony Optimization in Multimodal Biometrics”, International Journal of Engineering and Advanced Technology (IJEAT), Volume-8 Issue-6, August 2019. (Scopus) | Sakuntla Meena, Amit Doegar |
| “Object-based and Rule-based Classification of Synthetic Aperture Radar Images”, International Journal of Innovative Technology and Exploring Engineering (IJITEE)”, Volume-8 Issue-Number- 429, Page No.- 2458-2463. 10, Aug 2019. (Scopus) | Aishwarya Rastogi, Amit Doegar |
| “Ensemble Classification Method for Credit Card Fraud Detection”, International Journal of Recent Technology and Engineering (IJRTE), Vol. 8, No. 3, pp. 423-427, September 2019. (Scopus Indexed) | Inderpreet Kaur, Mala Kalra |
| Optimized focused web crawler with natural language processing based relevance measure in bioinformatics web sources. Cybernetics and Information Technologies, 19(2), 146-158. 2019 (Scopus Indexed) | Sekhar, S. M., Siddesh, G. M., Manvi, S. S., & Srinivasa, K. G. |
| TwitSenti: A Real-Time Twitter Sentiment Analysis and Visualization Framework. Journal of Information & Knowledge Management, 18(02), 1950013, 2019. | Murthy, J. S., Siddesh, G. M., & Srinivasa, K. G. |
| Development of Community Based Intelligent Modules Using IoT to Make Cities Smarter. International Journal of Fog Computing (IJFC), 2(2), 1-12, 2019 | Kallimani, J. S., Sailusha, C., Lathar, P., & Srinivasa, K. G. |
| Data Analytics on Agrometeorological Parameters for Building a Utility System for Farmer Community, International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-8 Issue-2, July 2019 (Scopus Indexed) | Sowmya BJ, Gautam Mundada, Pranav Hegde, Seema S, K G Srinivasa |
| An Insightful Review on Educational Big Data Analytics in Cloud-based e-Learning System, International Journal of Advanced Science and Technology (IJAST), Vol. 28, No. 16, PP. 332-344, 2019 (Scopus Indexed) | AK G Shidaganti, Prakash S, Srinivasa K G |
| An Image Processing and Machine Learning Approach for Early Detection of Diseased Leaves. International Journal of Cyber-Physical Systems (IJCPS), 1(2), 56-73, 2019 | Sowmya, B. J., Shetty, C., Seema, S., & Srinivasa, K. G. |
| Performance Analysis of Intrusion Detection System using Feature Selection and Feature Reduction Method, International Journal of Advanced Science and Technology, Vol. 29, No. 5, PP. 3496-3511, 2020 (Scopus Indexed) | Karthik K N, Sowmya BJ, Seema S, Srinivasa K G |
| “Optimized Feature Extraction Based Artificial Intelligence Technique for Empirical Analysis of Stock Market Data”, International Journal of Innovative Technology and Exploring Engineering (IJITEE), ISSN: 2278-3075, Volume-8, Issue-10, pp. 527-532, Aug 2019, Scopus Indexed. | Vani Kansal, Rakesh Kumar |
| “Classifying White Blood Cells in Blood Smear Images using a Convolutional Neural Network”, International Journal of Innovative Technology and Exploring Engineering (IJITEE), ISSN: 2278-3075, Volume-8, Issue-9S, pp. 825-829, July 2019, Scopus Indexed. | Gulshan Sharma and Rakesh Kumar |
| “Trust Based Technique for the Mitigation of Version Number Attack in Internet of Things”, International Journal of Recent Technology and Engineering(IJRTE), ISSN: 2277-3878, Volume-8, Issue-3, pp. 1197-1203, September 2019, Scopus Indexed. | Chandni and Rakesh Kumar |
| Energy Efficient Dynamic Cluster Head and Routing Path Selection Strategy for WBANs, Wireless Personal Communications, 113, pp. 33–58, 2020. | Roopali and Rakesh Kumar |

| | |
|--|---|
| "Synergy of Bis(Sulfanylidene)Tungsten and Spiro-Ometad for an Efficient Perovskite Solar Cell", International Journal of Engineering and Advanced Technology (IJEAT),Volume-9 Issue-1, pp.4011-4016, October 2019. | Srishtee Chaudhary, Rajesh Mehra |
| "IoT Based Full Protection Covers for Parked Car at Remote Stations" International Journal of Innovative Technology and Exploring Engineering (IJITEE), Volume-8 Issue-11, pp. 4185 - 4189, September 2019. | Kirti Masown, Rajesh Mehra |
| "Iris Recognition using Convolutional Neural Network Design" International Journal of Innovative Technology and Exploring Engineering (IJITEE), Volume-8 Issue-9, pp. 672 - 678, July 2019. | Gajanan Choudhari, Rajesh Mehra |
| "Multi-modal Iris Recognition System based on Convolution Neural Network" International Journal of Innovative Technology and Exploring Engineering (IJITEE), Volume-8 Issue-10, pp. 798 - 803, August 2019.. | Gajanan Choudhari, Rajesh Mehra, Shallu |
| "Perovskite Solar Cell design using Tin Halide and Cuprous Thiocyanate for Enhanced Efficiency ", International Journal of Engineering and Advanced Technology (IJEAT),Volume-8 Issue-6, pp.2817 - 2825, August 2019 . | Shiva Sharma, Rajesh Mehra, |
| "Recovering Data For Optical Head Tracker Using Auto-Regression" International Journal of Scientific & Technology Research, Volume 9, Issue 04, pp. 2897 - 2902, April 2020. | Saket Kumar, Rajesh Mehra |
| "Comparative Evaluation of Tin Perovskite based Solar Cell" Trends in Opto-Electro & Optical Communication, Volume 9, No. 3, pp. 15 - 18, Sep - Dec, 2019. | Chandni Devi, Rajesh Mehra |
| "Face Spoofing Detection using Enhanced Local Binary Pattern", Scopus Indexed International Journal of Engineering and Advanced Technology, Vol. 9, No. 2, pp. 3365-3371, December 2019. | Karuna Grover, Rajesh Mehra |
| "Biometric Face Anti-Spoofing And Context-Based Detection Techniques : A Review", Journal of Emerging Technologies and Innovative Research, Vol. 6, No. 4, pp. 812-816, April 2019. | Karuna Grover, Rajesh Mehra |
| "ConvolutionalNeuralNetworksBasedSceneRecognitionUsingSignificantFeatureApproach", International journal of Innovative Technology and Exploring Engineering (IJITEE), Vol.9, Issue3, pp.1705-1711, January2020. | Priya Singla, Rajesh Mehra |
| "Recognize Various Scenes using Classification methods inMillion Images Dataset: AReview",inJournalofEmergingTechnologiesandInnovativeResearch(JETIR), Vol.6,Issue6,pp.240-246,June2019. | Priya Singla, Rajesh Mehra |
| Using WebQuest Based Instruction to enhance students' Critical Thinking. Issues and Ideas in Education. Vol. 8, No. 1, March, 2020 | Ms. Richa Bansal and Dr. Sunil Dutt |
| Impact of Webquest based Instruction on students' Attitude towards Learning Science. International Journal of Multidisciplinary Educational Research. Vol. 8, Issue 4(3), April, 2019 | Ms. Richa Bansal and Dr. Sunil Dutt |
| Effect of Online and Face to Face Collaborative Learning Strategies on Achievement in English. THINK INDIA (Quarterly Journal), Vol. 22, Issue-4-October-December, 2019 () | Ms. Suruchi and Dr. Sunil Dutt |
| Concept Mapping as An Instructional Strategy for teaching of Punjabi Language Grammar. International Journal of Engineering, Applied and Management Sciences Paradigms. Vol. 54, Issue 1, April, 2019 | Ms. Neelam, Dr. Sunil Dutt and Dr. Madhu Chitkara |
| Design and Development of PV Solar Panel Data Logger, International Journal of Computer Sciences and Engineering, Vol.7, Issue 4, April 2019 | Tarun Singh, Ritula Thakur |
| EMG Signal Based Pattern Recognition of Grasping Movement Using MODWT and Weighted K- Nearest Neighbour, International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8 Issue-10, August 2019. (Scopus) | Shivi Varshney, Ritula Thakur Rajvardhan Jigyasu |

| | |
|--|--|
| Design and Simulation of a Novel Nine Level Inverter Topology for Motor Application, International Journal of Innovative Technology and Exploring Engineering' at Volume-8 Issue-11, September 2019. (Scopus) | Ruchika Sharma, Shimi S.L., |
| Symmetric Cryptography and Hardware Chip Implementation on FPGA, Proceedings of Intelligent Communication Control and Devices (ICICCD 2018), Advances in Intelligent Systems and Computing, Springer, Vol.989, 2019. (Scopus) | Priyanshi Vishnoi, S.L.Shimi Adesh Kumar |
| Induction Motor Fault Classification using Pattern Recognition Neural Network, , International Journal of Innovative Technology and Exploring Engineering (IJITEE), ISSN:2278-3075, Volume-8 Issue-9, July, 2019 (Scopus), | Shaina Grover, Amandeep Sharma, Lini Mathew, Shantanu Chatterji |
| A Comparative Analysis of PID and FO-PID Controller on PMDC Generator, International Journal of Innovative Research in Science, Engineering and Technology, Vol.8, Issue 7, July 2019 | Manik Dogra, Lini Mathew |
| Integrated Simulation of Pacemaker and Heart Model with VISSIM, International Journal of Recent Technology and Engineering, Volume-8 Issue-2, July 2019. Page No.: 1387-1391. (Scopus), | Nitika Khurana, Ritula Thakur |
| Integrated Simulation of Pacemaker and Heart Model for Optimization of Rhythm Therapy, International Journal of Research, Vol. 8, Issue 6, June 2019. | Nitika Khurana, Ritula Thakur, |
| Methods of Short Term Load Forecasting: A Systematic Review, IEEE 2nd International Conference on Power Energy, Environment and Intelligent Control, G.L. Bajaj Institute of Technology & Management, Greater Noida, 18-19 October, 2019 | Dhruv Upadhaya, Navneet K Singh Ritula Thakur |
| A Case Study of Optimal Voltage Levels for DC Home in Appliances point of view, International Journal of Information Technology and Electrical Engineering, Volume 8, Issue 3, June 2019 (UGC) | Neikhrove Pfuno, Lini Mathew |
| A Smart Monitoring and Controlling Based on Internet of Things for Agriculture Application, International Journal of Scientific Research and Review, Volume 07, Issue 05, pp. 2247- 2253, May 2019. (UGC Journal No.: 64650). | Neha Kamboj, Ritula Thakur |
| A Review on Different Fault Diagnosis Methods of Induction Motor, Journal of Engineering Technologies and Innovative Research, Volume 6, Issue 6, June 2019, (UGC Journal No.63975, ISSN: 2349-5162) | Vikas Kumar Singh, Amandeep Sharma, Lini Mathew |
| Advantages of Sliding Mode Control in dc-dc Converter, Journal of Emerging Technologies and Innovative Research (JETIR), Volume 6, Issue 6, pages 234-237 June 2019 (UGC) Journal No.63075, ISSN: 2349-5162 Impact Factor 5.87. | Priyanka, Lini Mathew |
| Sliding Mode Control of dc-dc Buck Converter using Typhoon Hardware in Loop Software, International Journal of Engineering and Advanced Technology (IJEAT) Volume-9 Issue-2, December 2019, page 5022-5028. ISSN: 2249-8958 | Priyanka, Lini Mathew |
| Performance Improvement of Three Phase Squirrel Cage Induction Motor operating under rated voltages- A design consideration for rural areas, Advances in Intelligent Systems and Computing, Vol. 989, pages.1-11, Jan.2020. https://doi.org/10.1007/978-981-13-8618-3_1 Indexed in Scopus. | Raj Kumar Saini, Devender Kumar Saini, Rajeev Gupta, Piush Verma, R.P.Dwivedi, Neeraj Gandotra, Robin Thakur, Ashwani Sharma |
| Predictive Model for Reservoir Level of Peruvannamuzhi Dam in India, International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-9 Issue-5, March 2020. (Scopus) | Shyju. S, Lini Mathew |
| Real-Time Simulation of Static VAR Compensator and Static Synchronous Compensator, International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-8 Issue-6, March 2020. (Scopus) | Anjali A. Bhandakkar, Lini Mathew |

| | |
|--|---|
| A new design for low rating three phase induction motor with improved performance operating under rated voltage-a design consideration for rural areas, Journal on Electrical Engineering, Vol.13, No.2, pages.11-17, December 2019. | Raj Kumar Saini, Devender Kumar Saini, Rajeev Gupta, Pioush Verma, R.P.Dwivedi, |
| Removal of Initial Phase Transient Current in DC-DC Boost Converter using Modified Switched Inductor, International Journal of Innovative Technology and Exploring Engineering, Volume-8, Issue-10, August 2019 | Preeti Gupta, Shimi S.L |
| Wind Power Generation with Doubly Fed Induction Generator (DFIG) – An Extensive Review, Journal of the Gujarat Research Society (JGRS), ISSN: 0374-8588, Vol. 21, Issue 16, pp. 1432-1437, Dec 2019. | Raj Kumar Yadav, Ritula Thakur, |
| A review on advance type of development wind turbine generators in power generation, International Journal of Modern Communication Technologies & Research (IJMCTR) ISSN: 2321-0850, Volume-8, Issue-2, February 2020 | Raj Kumar Yadav, Ritula Thakur, Raghu Nandan Singh Hada, |
| A Review on Wind Energy Conversion System using Double Fed Induction Machine (DFIM) , International Journal of Modern Communication Technologies & Research (IJMCTR) ISSN: 2321-0850, Volume-8, Issue-3, March 2020. | Raj Kumar Yadav, Ritula Thakur, |
| “Investigation of Organic LED Materials Using a Transparent Cathode for Improved Efficiency”, Journal of Electronic Materials Volume 48(7) , 4409–4417, April 2019. | Rana, R., Mehra, R. |
| “Implications of Pooling Strategies in Convolutional Neural Networks: A Deep Insight”, Foundations of Computing and Decision Sciences, 44(3), 303-330 (2019). | Sharma, S., Mehra, R. |
| A Review on Fuzzy based techniques for Energy Efficient Cluster Head Selection, “Journal of Emerging Technologies and Innovative Research, Vol.6, pp.22-25, June 2019 | Abhishek Rai, Kanika Sharma |
| A Fuzzy Based Techniques for Energy Efficient Cluster Head Selection for Wireless Sensor Network “International Journal of Engineering and Advanced Technology, Vol.8, pp.-2495-2499, August 2019 | Abhishek Rai, Kanika Sharma |
| A deep insight to heterogeneous routing protocols for harsh environment in Wireless Sensor Network, “Journal of Emerging Technologies and Innovative Research, Vol.6, no.6, pp. 565-570, June, 2019 | Pratima Malhotra and Kanika Sharma |
| Improved Multiple Gateway Node based Routing Architecture for heterogeneous Wireless Sensor Network ‘Elsevier International Journal of Innovative Technology and Exploring Engineering, Vol.8,no.10, pp.2175-2180, August 2019. | Pratima Malhotra and Kanika Sharma |
| Study of Hotspot mitigating Techniques in Wireless Sensor Networks, “Journal of emerging Technologies and Innovative Research, vol.6, no.6, pp. 249-252, June 2019 | Anjali Thakur, Kanika Sharma |
| “Energy Efficient Dynamic Multi-Hop Routing Technique in Wireless Sensor Networks” International Journal of Engineering and Advanced technology,ISSN:2249-8958, Vol.8,Issue 6, Aug.2019,pp:2942-2949 | Anjali Thakur, Kanika Sharma |
| H-Best Particle Swarm Optimization Based Localization Algorithm for Wireless Sensor Network “International Journal of Engineering and Advanced Technology (IJEAT), Volume-9 Issue-1, pp-2769-2778 October 2019 | Yadevendra Kamal, Kanika Sharma |
| Review to the optimized localization for wireless sensor network, “International Journal of Emerging Technologies and Innovative Research, ISSN : 2349-5162, Vol.6, Issue 6, Page no. 765-770, June-2019 | Yadevendra Kamal, Kanika Sharma |
| Energy Efficient Inter and Intra Cluster Movement of Mobile Sink in Wireless Sensor Network, “Scopus International Journal of Engineering and Advanced Technology (IJEAT), ISSN : 2249-8958, Volume-8, issue-6, August 2019 | Nisha Sharma, Kanika Sharma |

| | |
|---|--|
| Study of Routing Schemes and its Contribution in Evolution of Sink, International Journal of Emerging Technologies and Innovative Research (JETIR), (ISSN-2349-5162), Volume 6, Issue 6, Page No. 457-462, June 2019 | Nisha Sharma, Kanika Sharma |
| Several Energy Efficient Routing Methods, architecture and System models used in WSN, "Journal of Emerging Technologies and Innovative Research, Vol.6, Issue No. 5, pp.27-32, May 2019 | Rohini, Kanika Sharma |
| Chain Based Routing Algorithm using Hybrid Optimization for Wireless Sensor network, "International Journal of Scientific and Technology Research , Volume 8, Issue 11, November 2019 | Rohini, Kanika Sharma |
| "Dynamic Multilevel Priority Packet Scheduling Using Hybrid Seec", International Journal of Scientific and Technology research, Vol.8, Issue 11, Nov.2019,pp:1149-1154. | Sonam Gupta, Kanika Sharma |
| "Routing Algorithm using Fuzzy Logic Based Clustering with Mobile sink for wireless sensor network", International Journal of Recent Technology and Engineering, ISSN:2277-3878, vol.8, Issue 4, Nov.2019, pp. 4000-4005 | Vinod, Kanika Sharma |
| Dual Band Slotted Filtering Antenna For LTE-Advanced Applications, International Journal of Scientific & Technology Research , Vol. 8, Issue 8, August 2019, pp. 1463-1467, ISSN 2277-8616, Scopus | GurpreetKour, Garima Saini |
| Different Substrate Material for Designing a Passive UHF RFID Tag Antenna, International Journal of Innovative Technology and Exploring Engineering, Vol.8, Issue 9S, pp. 572-580, July 2019, ISSN 2278-3075, Scopus | P. Limameren Chang, Garima Saini |
| Multipolarised Near Field RFID Antenna for Mobile Devices, International Journal of Electronics and Engineering, Vol. 11, Issue 2, pp. 41-50, June – Dec 2019, ISSN 0973-7383 | Gaurav Gupta, Garima Saini |
| Various Techniques of Interference Management in Heterogeneous Network : A Review, International Journal of Scientific Research in Science and Technology , Vol. 6, Issue 3, pp. 310-328, ISSN 2395-6011 | BaljotKaur, Garima Saini |
| Enhancing Cell Throughput & Area Spectral Efficiency Using Two Level Soft Frequency Reuse Technique", International Journal of Innovative Technology and Exploring Engineering, Vol. 8, Issue 9, pp. 1524-1530, July 2019, ISSN 2278-3075, Scopus | BaljotKaur, Garima Saini |
| Design of Normal Mode Helical Antenna For UHF RFID Applications International Journal of Technical Innovation in Modern Engineering & Science, Vol. 5, Issue 7, pp.749-753, July 2019, ISSN 2455-2585. UGC journal | Namita Sharma, Garima Saini |
| Broadband Stacked Antenna Design with Hybrid Structure for C-band Communication, International Journal of Innovative Technology and Exploring Engineering, Vol. 8, Issue 10, pp. 3510-3516, August 2019, ISSN 2278-3075, Scopus. | Swati Kandoria, Garima Saini |
| Antenna Array Design Using Hybrid Feed for High Frequency Application, International Journal of Engineering and Advanced Technology, Vol. 8, Issue 6, August 2019, ISSN 2249-8958, Scopus | SumitTyagi, Garima Saini |
| An Analytical Review on Broadband Antenna and Recent Advances, Journal of Emerging Technologies and Innovative Research, Vol. 6, Issue 6, June 2019, ISSN 2349-5162, UGC Journal | Swati Kandoria, Garima Saini |
| A Review on Hybrid Feed Micro strip Antenna Array, Journal of Emerging Technologies and Innovative Research, Vol. 6, Issue 6, June 2019, ISSN 2349-5162, UGC Journal | SumitTyagi, Garima Saini |
| Design and Performance Analysis of Application Specific Integrated Circuit for Internet of Things Application, Sensor Letter ASP, Vol.18, PP. 31-38, Jan 2020 | Vivek Pogra, S K ishvakarma, and Balwinder Raj |
| Vertical Tunnel FET : Design Optimization with Introduced SiGe Layers", National Conference on Biomedical Engineering Dept. of ECE, NITTTR Chandigarh, 22-24 Jan 2020. | Shailendra Singh and Balwinder Raj |

| | |
|---|---|
| A review of Non-conventional Analog circuit design techniques for low voltage low power operation, International Journal of research in Advent technology, Vol 7, No 5, May 2019 | Kiranjeet Kaur, Sandeep Singh Gill, Navneet Kaur |
| Whale Optimization Algorithm for Performance Improvement of Silicon-On-Insulator FinFET, International Journal of Artificial Intelligence (Scopus), Volume 18, Number 1, March 2020 | Gurpuneet Kaur, Sandeep Singh Gill, Munish Rattan |
| Stress and Deformation Analysis of Piezoresistive square diaphragm nano pressure sensor, Sensor Letters, Vol 17, No 9, September 2019, Scopus Indexed | Rekha Devi, Sandeep Singh Gill |
| "Synergy of Bis(Sulfanylidene)Tungsten and Spiro-Ometad for an Efficient Perovskite Solar Cell", International Journal of Engineering and Advanced Technology (IJEAT), Volume-9 Issue-1, pp.4011-4016, October 2019. | Srishtee Chaudhary, Rajesh Mehra |
| "IoT Based Full Protection Covers for Parked Car at Remote Stations" International Journal of Innovative Technology and Exploring Engineering (IJITEE), Volume-8 Issue-11, pp. 4185 - 4189, September 2019. | Kirti Masown, Rajesh Mehra |
| "Iris Recognition using Convolutional Neural Network Design" International Journal of Innovative Technology and Exploring Engineering (IJITEE), Volume-8 Issue-9, pp. 672 - 678, July 2019. | Gajanan Choudhari, Rajesh Mehra |
| "Multi-modal Iris Recognition System based on Convolution Neural Network" International Journal of Innovative Technology and Exploring Engineering (IJITEE), Volume-8 Issue-10, pp. 798 - 803, August 2019.. | Gajanan Choudhari, Rajesh Mehra, Shallu |
| "Implications of Pooling Strategies in Convolutional Neural Networks: A Deep Insight", Foundations of Computing and Decision Sciences, 44(3), 303-330 (2019). | Sharma, S., Mehra, R. |
| "Perovskite Solar Cell design using Tin Halide and Cuprous Thiocyanate for Enhanced Efficiency", International Journal of Engineering and Advanced Technology (IJEAT), Volume-8 Issue-6, pp.2817 - 2825, August 2019 . | Shiva Sharma, Rajesh Mehra, |
| "Recovering Data For Optical Head Tracker Using Auto-Regression" International Journal of Scientific & Technology Research, Volume 9, Issue 04, pp. 2897 - 2902, April 2020. | Saket Kumar, Rajesh Mehra |
| "Comparative Evaluation of Tin Perovskite based Solar Cell" Trends in Opto-Electro & Optical Communication, Volume 9, No. 3, pp. 15 - 18, 2019. | Chandni Devi, Rajesh Mehra |
| "Face Spoofing Detection using Enhanced Local Binary Pattern", Scopus Indexed International Journal of Engineering and Advanced Technology, Vol. 9, No. 2, pp. 3365-3371, December 2019. | Karuna Grover, Rajesh Mehra |
| "Biometric Face Anti-Spoofing And Context-Based Detection Techniques : A Review", Journal of Emerging Technologies and Innovative Research, Vol. 6, No. 4, pp. 812-816, April 2019. | Karuna Grover, Rajesh Mehra |
| "Convolutional Neural Networks Based Scene Recognition Using Significant Feature Approach", International journal of Innovative Technology and Exploring Engineering (IJITEE), Vol.9, Issue3, pp.1705-1711, January 2020. | PriyaSingla, Rajesh Mehra |
| "Recognize Various Scenes using Classification methods in Million Images Data set: A Review", in Journal of Emerging Technologies and Innovative Research (JETIR), Vol.6, Issue6, pp.240-246, June2019. | PriyaSingla, Rajesh Mehra |
| Paper on "Information-adjusted noise model in Indian Stock Market: An Empirical Study" Journal of Engineering and Technology Education, UGC Approved, Jan-June 2019, Issue no 1, Vol 13, Chandigarh, ISSN No. 2229-631 X | Ms. Savita and Dr. SK Dhameja |
| Paper on "An Implementation of the Information -Adjusted Noise Model to The Indian Stock Market", Journal: Our Heritage, UGC Approved, ISSN: 0474-9030, Vol-68-Issue-48-January-2020, pp 64-72 | Ms. Savita and Dr. SK Dhameja |
| Paper on "Impact of the Karma Yoga Practices Adopted by the Teachers in Higher Education on their Transformational Leadership Behaviour- A Study | Ms.Divya Sharma and Dr. SK Dhameja |

| | |
|--|--|
| in Selected Universities of Delhi-NCR”, International Journal of Advanced Science and Technology, Vol. 29, No. 7s, (2020), pp. 4597- 4608, ISSN: 2005-4238 IJAST (Scopus Indexed) | |
| Paper on “Transformational Leaderships of the Educators in Indian Higher Education: An empirical study”, The International journal of analytical and experimental modal analysis, Volume XII, Issue II, February/2020, ISSN NO: 0886-9367 (page 2022-34). UGC Care Approved Group II Journal | Ms.Divya Sharma and Dr. SK Dhameja |
| Paper on “Factors Affecting Employee Retention in Insurance Sector at Different Career Stages”, The International journal of analytical and experimental modal analysis, Volume XII, Issue II, February/2020, ISSN NO: 0886-9367, (page 1838-69). UGC Care Approved Group II Journal | Ms.ShikhaPatheja and Dr. SK Dhameja |
| Paper on “Impact of HR practices on organization performance: Review of literature”, Test-Engineering and Management Journal, Volume 82, Page Number: 13670 – 13675, Publication Issue: January-February 2020, ISSN: 0193-4120 P. Scopus Indexed | Ms.ShivaniDhand and Dr. SK Dhameja |
| “Development of IIoT based condition monitoring system for rotating machine elements”, International Journal of Scientific & Technology Research | Gautam, A., Goyal, D., & Pabla, B.S. |
| “Optimization of ECM parameters for Machining Ti-6Al-6V-2Sn”, International Journal of Scientific Technology and Research | Sharma, P., & Banwait, S.S. |
| “Cloud based status monitoring of earthmoving machinery”, International Journal of Scientific Technology and Research | Paul, N., & Dhami, S.S. |
| “Characterization of ABS for Enhancement of Mechanical Properties”, International Journal of Innovative Technology and Exploring Engineering, Vol. 8(10), pp. 2164-2167. | Saroha, V., Pabla, B.S. & Bhogal, S.S. |
| “Design Optimization of a Centrifugal Oil Cooling Blower Casing Using Modal & Harmonic Analysis”, International Journal of Scientific & Technology Research, Vol. 8(11), pp. 3487-3492. | Gora, R., Dhami, S.S., and Goyal, D. |
| “Effects of forced cooling in laser forming”, International Journal of Innovative Technology and Exploring Engineering, Vol. 8(10), pp. 3782-3787. | Kumar, S., & Dhami, S.S. |
| “Evaluation of mechanical properties of different bamboo species for structural applications”, International Journal of Innovative Technology and Exploring Engineering, Vol. 8(11), pp. 2927-2935. | Singh, K., Garg, H., & Pabla, B.S. |
| “Finite element analysis of different fused deposit materials utilized in fabrication of elbow orthosis”, International Journal of Innovative Technology and Exploring Engineering, Vol. 8(12), pp. 4847-4850. | Koundal, N., & Banwait, S.S. |
| “Estimation of injection moulding process for a thin fresnel lens by plastic flow simulation”, International Journal of Innovative Technology and Exploring Engineering, Vol. 8(10), pp. 3276-3282. | Kumar, A., Garg, H., & Pabla, B.S. |
| “Thermal image based fault diagnosis of gears using support vector machines”, International Journal of Innovative Technology and Exploring Engineering, Vol. 9(1), pp. 155-160. | Kumar, A., Goyal, D., & Pabla, B.S. |
| “Vibration analysis and fault identifications of rolling elements bearings – a review”, International Journal of Mechanical and Production Engineering Research and Development, Vol. 9(4), pp. 1133-1142. | Minhas, N., Nikhil, & Banwait, S.S. |
| “Optimization of process parameters during electrochemical machining”, International Journal of Innovative Technology and Exploring Engineering, Vol. 8(12), pp. 2683-2687 | Aakash, & Banwait, S.S. |
| “Optimization of Cutting Parameters for Minimal Surface Roughness in Single Point Diamond Turning of Ti6Al4VELI”, International Journal of Innovative Technology and Exploring Engineering, Vol. 8(12), pp. 3222-3226 | Chandra, N., Dhami, S.S. |

| | |
|---|---|
| Investigations on the feasibility of Jatropha curcas oil based biodiesel for sustainable dielectric fluid in EDM process; Materials Today: Proceedings | Khan, Mohd Yunus; Rao, P Sudhakar; Pabla, BS; |
| Hybridization of Electrical Discharge Machining Process; International Journal of Engineering and Advanced Technology (IJEAT) | Khan, Mohd Yunus; Rao, P Sudhakar; |
| Processing, tool wear measurement using machine vision system and optimization of machining parameters of boron carbide and rice husk ash reinforced AA 7075 hybrid composite; Materials Research Express | Verma, Nishant; Vettivel, SC; Rao, PS; Zafar, Sunny; |
| Electrical discharge machining: vital to manufacturing industries; Int. J. Innov. Technol. Explor. Eng. | Khan, Mohd Yunus; Rao, P Sudhakar; |
| Optimization of Process Parameters of Electrical Discharge Machining Process For Performance Improvement; International Journal of Innovative Technology and Exploring Engineering (IJITEE) | Khan, Mohd Yunus; Rao, P Sudhakar; |
| “Electrical Discharge Machining of Carbon Fiber Reinforced Plastics: A Review”; Journal of Material Science and Mechanical Engineering (JMSME), | Rao, PS; Singh, S; Pandey, M; Pandey, VP; |
| Tribological study of mechanically milled graphite nanoparticles codeposited in electroless Ni-P coatings; Metal Powder Report | Thakur, IS; Pandey, VS; Rao, PS; Tyagi, S; Goyal, Deepam; |
| Design Considerations for Connecting Rod; International Journal of Engineering and Advanced Technology (IJEAT) | Sriharsha, B.; Rao, PS; |
| Impact Of Extrusion Process On Product Quality; International Research Journal of Engineering and Technology (IRJET) | Kumar, Sunil; Rao, PS; |
| Optimization Of Machining Parameters Of Electrochemical Machining-A Review; International Journal Of Technical Innovation In Modern Engineering & Science (IJTIMES) | Bansal, Rahul; Rao, P Sudhakar; Singh, Amritbir; |
| Recent Developments in Electro Chemical Machining-A Review; International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES) | Kumar, Ashish; Rao, PS; |
| Hydraulic and Thermal Analysis of Corrugated and Smooth Double Pipe Heat Exchanger using Computational Fluid Dynamics; Journal of Emerging Technologies and Innovative Research (JETIR) | Sood, Shubham; Rao, P Sudhakar; |
| Optimization Of Machining Parameters During Cnc Milling Of Incoloy 800, International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES) | Singh, Balwant; Rao, P Sudhakar; |
| Study Of Different Machining Process On Metal Matrix Composites, International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES) | Paliwal, Shivangi; Rao, P Sudhakar; |
| Optimization Of Machining Parameters Using Rotary Ultrasonic Machining Of Brittle Material: A Review, International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES) | Mehta, Ankush; Rao, P Sudhakar; Singh, Bibanddeep; |
| Biodynamic Response of Femur Bone; International Journal of Innovative Technology and Exploring Engineering (IJITEE) | Gangwar, Arunkumar; Rao, PS; |
| International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES); HEAT AND MASS TRANSFER | Garg, Vikas; Rao, P Sudhakar; |
| Three-Dimensional Dual-Band Dielectric Resonator Antenna for Wireless Communication, IEEE Access, vol. 8, pp. 71593 - 71604, 2020 | S. Mishra, S. Das, S.S. Pattnaik, S. Kumar and B. K. Kanaujia |
| Three dimensional cylindrical design multiple-input multiple-output/diversity antenna with high isolation for wireless communication applications, International Journal of RF and Microwave Computer-Aided Engineering. 2019 | S. Mishra, S. Das, S.S. Pattnaik, S. Kumar, B. K. Kanaujia |
| Wide CPW Fed Multiband Wearable Monopole Antenna with Extended Grounds for GSM/WLAN/WiMAX Applications, International Journal of Antennas and Propagation, 2019, Article ID 4264513, pp.1-14. | D. Mandal and S.S. Pattnaik |

| | |
|--|---|
| Low-profile circularly polarized planar antenna for GPS L1, L2, and L5 bands, Microwave and Optical Technology Letters, 2019, pp. 1–10 | S. Mishra, S. Das, S.S. Pattnaik, S. Kumar, B. K. Kanaujia |
| Impact Analysis of Mobile Phone Electromagnetic Radiations on Human Electroencephalogram, Sadhana, vol. 44, no. 134, pp. 1-12, May 2019. | Suman Pattnaik, Balwinder Singh Dhaliwal and S S Pattnaik |
| A Modified Two-Step ANN Ensemble Approach to Improve Generalization and its Application in Fractal Antenna Design, Journal of Circuits, Systems and Computers, Accepted 2019 | Balwinder S. Dhaliwal, Gaganpreet Kaur, Navreet Saini, Shyam Sundar Pattnaik and Simranjit Kaur Josan |
| Development of a Hybrid SIMBO-ANN Algorithm for Optimisation of SRR parameters to enhance the performance of PIFA, Journal of Scientific and Industrial Research, Vol. 78, November 2019, pp. 727-732 | Garima Saini, S S Pattnaik |
| “Application of Neural Network Models for Mathematical Programming Problems: A State of Art Review” Published in Archives of Computational methods in Engineering. Online Published https://doi.org/10.1007/s11831-018-09309-5 | K.C. Lachhwani |
| “Dynamic Strain response of TT-phase-shifted FBG sensor with phase-sensitive detection”, OSA Continuum Vol-1, No.4 dated 15 Dec, 2018, OSA Continuum 1172-1184 | Bhargab Das, Deepa Srivastava, Umesh Kumar Tiwari and B.C. Choudhary |
| “A Review of Assessment of Embodied Energy of Buildings and Application of Artificial Neural Network”, International Journal of Technical Innovation in Modern Engineering & Science Volume 05, Issue 02, Feb 2019 e-ISSN: (2455-2585) UGC approved Journal Paper ID: 150212135616 | Abhilash Mukherjee/ Himmi Gupta |
| “Embodied Energy Assessment of Construction Material in India Using Artificial Neural Network”, International Journal of Technical Innovation in Modern Engineering & Science Volume 05, Issue 02, Feb 2019 e-ISSN: (2455-2585) UGC approved Journal Paper ID: 150212142443 | Abhilash Mukherjee/ Himmi Gupta |
| “High Performance Fiber Reinforced Concrete and its application in the Anchorage Zone of Post Tensioned Concrete Girders - A Review | Himmi Gupta, Sanjay Sharma, H K Sharma |
| “A Review on Correlation of Traffic Volume with Accidents”, International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES) e-ISSN:2455-2585, Volume 4, Issue 7, July-2018 (HS/Rahul Singh) | Hemant Sood/ Rahul Singh |
| “A Review on Comparison of the Efficiency Scheduling Techniques for the Construction Project”, International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES) e-ISSN:2455-2585, Volume 4, Issue 7, July 2018 (HS/Shashank Yadav). | Hemant Sood / Shashank Yadav |
| “Effect of Elevated temperature on Compressive strength of self Compacting Concrete using Fly Ash, Silica Fume, Matakaolin and Alccofine”, International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), e-ISSN:2455-2585, Volume4, Issue 07, July 2018.(HS/Jaspreet) | Hemant Sood/ Jaspreet |
| “Black Spots Identification on Pinjore to Baddi Road”, International Journal of Pure and Applied Mathematics (IJPAM) (HS/Chetna)-Scopus Indexed. | Hemant Sood/ Chetna |
| “Utilization of Reclaimed Asphalt Pavement in Dry Lean Concrete Subbase Layer of Rigid Pavement”, International Journal of Technical Innovation in Modern Engineering & Science, IJTIMES, Volume 04, Issue 07, July 2018.(HS/Shubham) | Hemant Sood/ Shubham |

| | |
|--|--|
| “Analyzing RCC Frame Structure with and without Struts and Shear Walls”, International Journal of Technical Innovation in Modern Engineering & Science, IJTIMES, Volume 04, Issue 06, June 2018.(HS/Sunil) | Hemant Sood/ Sunil |
| “Analyzing G+15 Building with and without Struts and Shear Walls”, International Journal of Technical Innovation in Modern Engineering & Science, IJTIMES, Volume 04, Issue 06, June 2018.(HS/Sunil) | Hemant Sood/ Sunil |
| “Effect of Partial Replacement of cement with Metakaolin on Properties of Concrete using Treated Waste Water”, accepted for Publication in the Proceedings of UKIERI Concrete Congress: Concrete-The Global Builder (05-08th March 2019) (HS/Sanjeev Salot) | Hemant Sood/ Sanjeev Salot |
| “Effect of Treated Waste water on strength characteristics of concrete of grade M40 by using PPC”, International Journal of Research and Analytical Reviews (IJRAR) e-ISSN 2348-1269, Volume 5, Issue 3, August 2018 (HS/Bharti Devi) | Hemant Sood/ Bharti Devi |
| “Development and Corroboration of Crash Prediction Model”, International Journal of Pure and Applied Mathematics (Scopus Indexed) (Journal 23425, ISSN No. 13118080) 2018 (HS/Navdeep) | Hemant Sood/ Navdeep |
| “Evaluation of properties of concrete using Rice Husk Ash and Polypropylene Fibre”, International Journal of Technical Innovation in Modern Engineering and Science; ISSN 2455-2585, UGC Approved, Volume 04, Issue 10, October 2018.(HS/SuryaKant Jaryal) | Hemant Sood /SuryaKant Jaryal |
| “Review on Effect of Elevated Temperature and Sudden cooling on Strength properties of Hybrid Fibre Reinforced Concrete”, International Journal of Technical Innovation in Modern Engineering & Science; e-ISSN: 2455-2585, Volume 4, Issue 09, September-2018. (HS/Rahul Kumar) | Hemant Sood/ Rahul Kumar |
| “Review on Mechanical Properties of Geopolymer Mortar Reinforced with Natural Fibre”, International Journal of Technical Innovation in Modern Engineering & science Volume 4, Issue 12, December 2018 (HS/Abishek) | Hemant Sood /Abishek |
| “Development of Geopolymer Mortar with Alkaline Solution”, International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES), Volume 4, Issue 12, December-2018 (HS/Shalini) | Hemant Sood /Shalini |
| “ Partial Replacement of Sand with stone dust in concrete of Variable Grades”, International Journal of Engineering Science and Computing (IJESC), Volume 8, Issue 12, December 2018 (HS/Dinesh chand) | Hemant Sood /Dinesh Chand |
| “Analyzing the effect of Different Cross-Sections of Column in High-Rise Building”, International Journal of Technical Innovation in Modern Engineering & Science Volume 04, Issue 12, Dec 2018 e-ISSN: (2455-2585) UGC approved Journal Paper ID: 151225151031 | Gurpyar Singh/ Himmi Gupta/ Hemant Sood |
| “Review of Effect of Cross-Sectional Change of Column on its Structural Behaviour” International Journal of Technical Innovation in Modern Engineering & Science Volume 04, Issue 12, Dec 2018 e-ISSN: (2455-2585) UGC approved Journal Paper ID: 151202130012 | Gurpyar Singh/ Himmi Gupta/ Hemant Sood |
| “Effect of waste Glass Powder in concrete by Partial Replacement of Cement”, SSRG International Journal of Civil Engineering, Volume 4 Issue 12 December 2017 (HS/Vipan Kumar) | Hemant Sood / Vipan Kumar |
| “ Analysing effect of Waste Glass Powder in concrete by Partial Replacement of Cement”, International Journal of Engineering Science and Computing, Volume 8 Issue 8 August 2018 (HS/Vipan Kumar) | Hemant Sood/ Vipan Kumar |
| “Effect of use of Recycled Coarse Aggregate in concrete”, International Journal of Engineering Science and Computing, Volume 8 Issue 12 December 2018 (HS/Jagdish Kanungo) | Hemant Sood/ Jagdish Kanungo |
| “Effect of Induced Carbonation on Hardened Properties of M30 and M35 Grade Concrete using Ordinary Portland Cement”, International Journal of | Hemant Sood/ Poonam Kumari |

| | |
|---|----------------------------------|
| technical Innovation in Modern Engineering & Science, Volume 4, Issue 12, December-2018 (HS/Poonam Kumari) | |
| “Effect of Admixture on the Strength Properties of Concrete Using Treated Waste water with variable Size of Aggregates”, International Journal of Technical Innovation in Modern Engineering & Science, Volume 05, Issue 01, January 2019 (HS/Manish Thakur) | Hemant Sood/ Manish Thakur |
| “A Comparatives Study Of Seismic Analysis of Low-Rise And Medium-Rise Building As Per IS: 1893-2002 And IS:1893-2016”, in International Journal of Technical Innovation In Modern Engineering & Science, ISSN:2455-2585 Vol. 04, Issue 09, September-2018 | Sanjay Kumar Sharma |
| “Analysis of Non Engineered Construction of Houses in rural Himachal”, in International Journal of Engineering Research & Technology ISSN:2278-0181 Vol. 06, Issue 11 | Sanjay Kumar Sharma |
| “Impact of Modern Construction Practices as Compare to traditional Construction for Sustainable rural houses in the Northern Eastern Part of Rajasthan”, in International Journal of Engineering Research & Technology ISSN:2278-0181 Vol. 06, Issue 11, 2018. | Sanjay Kumar Sharma |
| “Analysis of Traditional and Existing Construction Practices for Sustainable Rural Houses in the Southern Western Part of Rajasthan”, in International Journal of Engineering Research & Technology ISSN:2278-0181 Vol. 06, Issue 11, 2018. | Sanjay Kumar Sharma |
| “Sustainable Development: A Key to achieve Slum free Cities in India”, in International Journal of Research and Analytical Reviews e ISSN 2348 – 1269, Print ISSN 2349-5138 Vol. 5, ISSUE 4, 2018. | Sanjay Kumar Sharma |
| “Defining design criteria of net zero energy building for composite climatic zone”, in International Journal of Research and analytical reviews ISSN:2348-1269 Vol. 06, Issue 1 January, 2019. | Sanjay Kumar Sharma |
| “NZEB: A Case Study of Indira Paryavaran Bhawan”, in International Journal for Research in Engineering Application & Management (IJREAM) ISSN : 2454-9150 Vol-04, Issue-10, January, 2019. | Sanjay Kumar Sharma |
| “High Performance Fiber Reinforced Concrete and its application in the Anchorage Zone of Post Tensioned Concrete Girders - A Review”, in International Journal of Research and Analytical Reviews e-ISSN: (2348-1269) Print ISSN 2349-5138 UGC approved Journal No. 43602 Paper ID: IJRAR900276, Vol. 6, Issue 1, Jan – Mar 2019 | Sanjay Kumar Sharma |
| “Enhancing Mechanical and Durability Properties of Geo polymer Concrete with Mineral Admixture”, in journal(Scopus) of Computers and Concrete, Vol. 21, No. 3 (2018) Impact factor : 1.889 (2018) | Sanjay Kumar Sharma |
| “Modern Thickness Design Aspects Of Cement Concrete Pavement” Interdisciplinary National Conference on Frontiers in Materials Research & Applications (FMRA-2017) held on 21 December, 2017 at Shaheed Bhagat Singh State Technical Campus, Ferozpur, Proceedings shall be published by Excel India Publishers, New Delhi (HS/ Shivani) | Hemant Sood |
| “Performance Evaluation of Bandwidth for Virtual Machine Migration in Cloud Computing,” Inderscience, International Journal of Communication Networks and Distributed Systems, vol.5, no. 3, pp. 139-152, 2018. | A. Bhardwaj and C. Rama Krishna |
| "Time-Lay and RSA Technique for Efficient Data Transmission in Internet of Things", International Journal of Management Technology and Engineering, vol. 8, no. 12, pp. 1366-1374, 2018. | Ramneek Kaur and C. Rama Krishna |
| “Performance Analysis of IPv6 and NDN Internet Architecture in IoT Environment”, In Emerging Research in Electronics, Computer Science and Technology, Springer Lecture Notes in Electrical Engineering, vol. 545, 2018. | Sharma A., C Rama Krishna |

| | |
|---|--|
| <p>“CNN Based Image Forgery Detection Using Pre-trained AlexNet Model (March 19, 2019). International Journal of Computational Intelligence & IoT, Vol. 2, No. 1, 2019. Available at SSRN: https://ssrn.com/abstract=3355402</p> | <p>Doegar, Amit and Dutta, Maitreyee and Gaurav, Kumar</p> |
| <p>“Energy Optimized Cluster Based Heterogeneous Routing protocol for Wireless Sensor Network,” Journal of Telecommunication, Electronic and Computer Engineering (JTEC), ISSN: 2180-1843, EISSN: 2289-8131, Vol. 10, Issue 4, pp. 43-49, 2018, Scopus Indexed</p> | <p>Garima and Rakesh Kumar</p> |
| <p>“Simulation of Language Competition by Bilingual Agents,” International Journal of Knowledge and Learning (IJKL), Inderscience, Online ISSN: 1741-1017, Print ISSN: 1741-1009, Volume-12, Issue-4, pp. 362-378, 2018, Scopus Indexed.</p> | <p>Rakesh Kumar and Shiv Kishan Dubey</p> |
| <p>“Adaptive Clustering Strategy for Heterogeneous and Dynamic Data for IoT Scenario”, International Journal of Pure and Applied Mathematics (IJPAM), ISSN 1311-8080, EISSN: 1314-3395, Vol.-119, Issue-14, pp. 67-74, 2018, Scopus Indexed.</p> | <p>Priya Dogra and Rakesh Kumar</p> |
| <p>“An Approach to Mitigate Malware Attacks using Netfilter's Hybrid Frame in Firewall Security,” International Journal of Open Source Software and Processes (IJOSSP), IGI-Global, ISSN: 1942-3926, EISSN: 1942-3934, Volume-9, Issue-1, pp. 32-61, 2018, Scopus Indexed</p> | <p>Nivedita Nahar, Prerna Dewan and Rakesh Kumar</p> |
| <p>“A Hybrid Approach for Facial Expression Recognition Using Extended Local Binary Patterns and Principal Component Analysis”, International Journal of Electronics, Communications, and Measurement Engineering (IJECME), ISSN: 2578-7551(Print), ISSN: 2578-7543(Online), Vol. 8, Issue-2, 2019.</p> | <p>Gopal Krishan Prajapat and Rakesh Kumar</p> |
| <p>Co-author of one research paper entitled ‘Identification of Obstacles in Implementation of Total Quality Management (TQM) in Building Construction Industry in India- An Empirical Study published in International Journal of Recent Technology & Engg. in Vol.7, issue-6 March, 2019</p> | <p>SK Gupta</p> |
| <p>“Condition Monitoring and Fault Diagnosis of Induction Motors: A Review”, Archives of Computational Methods in Engineering, pp 1–18, September, 2018</p> | <p>Anurag Choudhary, Deepam Goyal, Sudha Letha Shimi, Aparna Akula</p> |
| <p>“Analysis of water quality parameters by hyperspectral imaging in Ganges River”, Spatial Information Research, Volume 26, Issue 2, pp 203–211, April 2018. (Springer Journal)</p> | <p>Baban Kumar Bansod, Rangoli Singh, Ritula Thakur</p> |
| <p>“Smart Grid Security with Cryptographic Chip Integration”, Energy Web and Information Technologies, 24th November, 2018</p> | <p>Priyanshi Vishnoi, Shimi S. L., Adesh Kumar</p> |
| <p>“Group Search Optimization With Multi Objective Generation For Power Dispatch Problem”, International Journal of Research and Analytical Reviews, E-ISSN 2348-1269, P- ISSN 2349-5138, Volume.5, Issue 4, Page No pp.505-514, November, 2018</p> | <p>Manish Kumar Jain Shimi S. L</p> |
| <p>"Group Search Optimization for Multi Objective Power Dispatch - Review", International Journal of Research and Analytical Reviews, E-ISSN 2348-1269, P- ISSN 2349-5138, Volume.5, Issue 3, Page No pp.892-898, September 2018</p> | <p>Manish Kumar Jain, Shimi S.L, Prashant Joshi,</p> |
| <p>“Maximum Power Point Tracking in PV System- An Overview”, International Journal of Research and Analytical Reviews (IJRAR), E-ISSN 2348-1269, P- ISSN 2349-5138, Volume.5, Issue 4, Page No pp.220-225, December 2018</p> | <p>Md. Naqui Akhtar, Shimi S. L, Manish Kumar Jain</p> |
| <p>“A Comparative Study for NN Based Hybrid Model With P&O for Tracking Maximum Power Point In PV System”, International Journal of Research</p> | <p>Md. Naqui Akhtar, Shimi S. L, Manish Kumar Jain,</p> |

| | |
|---|--|
| and Analytical Reviews (IJRAR), E-ISSN 2348-1269, P- ISSN 2349-5138, Volume.5, Issue 4, Page No pp.250-260, December 2018 | |
| “DC Link Voltage Control of UPQC Using Hysteresis Controller”, International Journal of Emerging Technologies and Innovative Research, ISSN:2349-5162, Vol.5, Issue 11, page no. pp264-271, November 2018 | Alok Tripathi, Shimi S. L, Ashish Srivastava |
| “Advantages of UPQC on Power Quality Problems: A Review- AlokTripathi”, International Journal of Emerging Technologies and Innovative Research (www.jetir.org), ISSN:2349-5162, Vol.5, Issue 12, page no.684-686, Dec. 2018 | Alok Tripathi, Shimi S. L, Deepak Pandey |
| “Importance of An Embedded System Based Low Cost Universal Interfacing Kit: An Overview”, International Journal of Emerging Technologies and Innovative Research (www.jetir.org), ISSN:2349-5162, Vol.5, Issue 12, page no.536-538, Dec. 2018 | Sukhdev Kushwaha, Shimi S. L |
| “Design and Implementation of An Embedded System Based Low Cost Universal Interfacing Kit”, International Journal of Emerging Technologies and Innovative Research, ISSN:2349-5162, Vol.6, Issue 1, page no.291-297, January 2019 | SukhdevKushwaha, Shimi S. L |
| “A literature review on high boost dc-dc converter”, International Journal of Research in Advent Technology, Vol 7, No. 1 | Vinod Srivastava, Shimi S. L, Abhishek Kumar Gupta |
| “Analysis of water quality parameters by hyperspectral imaging in Ganges River”, Spatial Information Research, Volume 26, Issue 2, pp 203–211, April 2018. (SpringerJournal) | Baban Kumar Bansod, Rangoli Singh, Ritula Thakur |
| “Enhanced Howland-based constant current source for soil ECa measurement”, International Journal of Instrumentation Technology (IJIT), Vol. 2, No. 1, pp. 78–89, 2018 | Ritula Thakur, Baban Kumar Bansod |
| “A Study on Various Machine Learning Techniques for ECG Signal Analysis”, International Organization of Scientific Research Journal of Engineering (IOSR-JEN), Vol.8, pp.48-53, April 2018 | Sunita Kumari, Lini Mathew |
| “A Review on Brain Computer Interface of Muscle Movement Classification for The Upper Limbs”, International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES), vol. 4, no.12, pp. 415-420, December-2018. | Rudhra Kumar Mishra and Lini Mathew |
| “A Review of Techniques for Tremor Suppression in Robotics Surgery”, International Journal of Research in Engineering, IT and Social Sciences (IJREISS), ISSN-2250-0588 (Online), UGC approved Journal No. 42301, Volume-8, Special Issue, June 2018, page 81-93. | Amrita Singh, Poonam Syal, Sanjeev Kumar |
| “Haptic Feedback in Surgical Robotic Applications – A Review”, International Journal of Research in Engineering, IT and Social Sciences (IJREISS), ISSN-2250-0588 (Online), UGC approved Journal No. 42301, Volume-8, Special Issue, June 2018, P 94-104. | Vikram Singh, Poonam Syal, Sanjeev Kumar |
| “Smart Lighting and Interior Blinds Control through IoT”, International Journal of Computer Sciences and Engineering, UGC approved Journal No. 63193, ISSN: 2347-2693 (E) Vol. 6, Issue 5, May, 2018, pp 1018-1023 | Deepak Makkar, Poonam Syal |
| “Implementation of Current Sensing Technique for Providing Force Feedback in Robotic Surgical Application”, International Journal of Research in Electronics & Computer Engineering (IJRECE)UGC Approved journal, ISSN (Online): 2348-2281; ISSN (Print): 2393-9028 Vol. 6 Issue 3 (July - September 2018) | Vikram Singh, Poonam Syal, Sanjeev Kumar; |
| “Optimal Placement of Solar based DG in Distribution System for minimizing losses and THD using PSO Technique”, IOSR Journal of Engineering (IOSRJEN) , UGC approved Journal – Sr. No. 4814 ISSN (e): 2250-3021, ISSN (p): 2278-8719 Vol. 08, Issue 12 , December 2018 , pp - 25-32 | Md. Firoz Ansari and Poonam Syal |

| | |
|--|--|
| “NZEB: A Case Study of Indira Paryavaran Bhawan”, International Journal for Research in Engineering Application & Management (IJREAM) ISSN : 2454-9150 Vol-04, Issue-10, Jan 2019 | Balkar Singh, Sanjay Sharma, Poonam Syal |
| “Defining Design Criteria of Net Zero Energy Building for Composite Climate Zone”, International Journal of Research and Analytical Reviews (IJRAR) January 2019, Volume 6, Issue 1, www.ijrar.org | Balkar Singh, Sanjay Sharma, Poonam Syal |
| “Brain Computer Interface based Control Techniques and their Applications : A Review”, Journal of Engineering & Technology Education, Vol.12, No.1, January – June, 2018, ISSN 2229 – 631X. | Prateek Virdi, Poonam Syal, Preeti Kumari |
| “Implementation of Three Element Boiler um Level Control Strategy Without Cascade Control and Feed Forward Signal”, International Journal of Research in Advent Technology, Vol.6, No.10, October 2018 | Ashvani Kumar Shukla, Ritula Thakur, |
| “Support Vector Machine based Classification Improvement for EMG Signals using Principal Component Analysis”, Journal of Engineering and Applied Sciences, 13: 6341-6345. 2018 | Vivek Ahlawat, Ritula Thakur and Yogena Narayan |
| “An Intelligent Model for Indian Soil Classification using various Machine Learning Techniques International Journal of Computational Engineering Research”, Vol.8, Issue 9, pp. 33-41, 2018. (UGC) | Chandan Taluja, Ritula Thakur |
| “Recent Trends of Machine Learning in Soil Classification: A Review”, International Journal of Computational Engineering Research, Vol.8, Issue 9, pp.25-32, 2018. (UGC) | Chandan Taluja, Ritula Thakur |
| “Study of Greenhouse Environment Monitoring and Controlling System”, International Journal of Research and Analytical Reviews (IJRAR) (EISSN 2348-1269, P- ISSN 2349-5138), Volume 6, Issue 1, January 2019. (UGC Journal) | Abhishek Kumar Mishra, Ritula Thakur |
| “Comparative Analysis of Smart Waste Bin Models using Arduino and NodeMCU as IOT platform, Journal of Emerging Technologies and Innovative Research (JETIR) (ISSN2349-5162) January 2019, Volume 6, Issue 1. | MrinalMitra, Ritula Thakur |
| “A Study on Electromyography based brain human peripheral interface”, International Journal of Research and Analytical Reviews (IJRAR) (EISSN 2348-1269, P-ISSN 2349-5138), Volume 5, Issue 4, December 2018 | Shubhra Singh, Ritula Thakur |
| “Performance Analysis of Static and Dual Axis Auto Sun Tracking Photovoltaic Solar Panel”, International Journal of Technical Innovation in Modern Engineering & Science, Volume 5, Issue 01, January-2019 | Tarun Singh, Ritula Thakur |
| “Configuration of Analog to Digital Converter as data acquisition system for C2000 Delfino Microcontroller”, Journal of Engineering & Technology Education, Volume 12, No. 1, January-June, 2018 | Ritula Thakur, Sameer Singh |
| “A Review on Active Filter for Power Quality Improvement”, International Journal of Technical Innovation in Modern Engineering & Science, Vol.4, No.8, August 2018 | Sanjeev Kumar, Ritula Thakur |
| “A Review on Smart Waste Management System”, International Journal of Research and Analytical Reviews (IJRAR) (E-ISSN 2348-1269, P-ISSN 2349-5138), Volume 5, Issue 4, December 2018 | Mrinal Mitra, Ritula Thakur |
| “Unified Power Quality Conditioner (UPQC)-An Extensive Review”, International Journal for Research in Engineering Application & Management (IJREAM), Vol-04, Issue-09, pp.40-46, December 2018. | Vipin Kumar Mishra, Ritula Thakur |
| “Bidirectional dc to dc Converters: An Overview of various Topologies, Switching Schemes and Control Techniques”, International Journal of Engineering & Technology, 7(4.5)2018, pp 360-365 (Scopus Indexed) | Deepak Ravi, Bandi Mallikarjuna Reddy, Shimi S. L, Paulson Samuel |
| “Modelling and Analysis of Novel Topology for Multilevel Inverter With Reduce Number of Switches”, International Journal of Engineering & Technology, 7 (4.5) (2018) 379-385. (Scopus Indexed) | Rohit Kumar, Shimi S. L, Shivena Kaura |

| | |
|---|---|
| “Bidirectional dc to dc Converters: An Overview of various Topologies, Switching Schemes and Control Techniques”, International Journal of Engineering & Technology, Vol, 7, Issue 4.5, pp. 360-365, 2018. (Scopus Indexed) | Deepak Ravi, Bandi Mallikarjuna Reddy, Shimi S. L, Paulson Samuel |
| “Modelling and Analysis of Novel Topology for Multilevel Inverter with Reduce Number of Switches”, International Journal of Engineering & Technology, Vol, 7, Issue 4.5, pp. 360-365, 2018. (Scopus Indexed) | Rohit Kumamr, Shimi S. L, Shivena Kaura |
| “A Review of Techniques for Tremor Suppression in Robotics Surgery”, International Journal of Research in Engineering, IT and Social Sciences (IJREISS), ISSN-2250-0588 (Online), UGC approved Journal No. 42301, Volume-8, Special Issue, June 2018, page 81-93. | Amrita Singh, Poonam Syal, Sanjeev Kumar |
| “Haptic Feedback in Surgical Robotic Applications – A Review” International Journal of Research in Engineering, IT and Social Sciences (IJREISS), ISSN-2250-0588 (Online), UGC approved Journal No. 42301, Volume-8, Special Issue, June 2018, P 94-104. | Vikram Singh, Poonam Syal, Sanjeev Kumar |
| “Smart Lighting and Interior Blinds Control through IoT”, International Journal of Computer Sciences and Engineering, UGC approved Journal No. 63193, ISSN: 2347-2693 (E) Vol. 6, Issue 5, May, 2018, pp 1018-1023 | Deepak Makkar, Poonam Syal |
| “Implementation of Current Sensing Technique for Providing Force Feedback in Robotic Surgical Application”, International Journal of Research in Electronics & Computer Engineering (IJRECE)UGC Approved journal, ISSN (Online): 2348-2281; Issn (Print): 2393-9028 Vol. 6 Issue 3 (July - September 2018) | Vikram Singh, Poonam Syal, Sanjeev Kumar; |
| “Optimal Placement of Solar based DG in Distribution System for minimizing losses and THD using PSO Technique”, IOSR Journal of Engineering (IOSRJEN) , UGC approved Journal – Sr. No. 4814 ISSN (e): 2250-3021, ISSN (p): 2278-8719 Vol. 08, Issue 12 , December 2018 , pp - 25-32 | Md. Firoz Ansari and Poonam Syal |
| “Brain Computer Interface based Control Techniques and their Applications: A Review”, Journal of Engineering & Technology Educatiion, Vol.12, No.1, January – June, 2018, ISSN 2229 – 631X. | Prateek Viridi, Poonam Syal, Preeti Kumari |
| “Method for Non-Invasive Hemoglobin Determination”, International Journal of Scientific Research and Review, Vol.7, Issue 3, March 2019 | Akansha Deep,Yogesh Kumar, Poonam Syal, Sanjeev Kumar |
| “A Review on Interference Mitigation Technique for Two Tier Macro-Femto Network”, International Journal of Research In Electronics and Computer Engineering, Vol. 6, Issue 2, pp. 1914- 1919, APR-JUNE 2018, ISSN:2348-2281, UGC Journal No. 44816 | Jyoti Bala, Garima Saini |
| “Performance Analysis of Fractional Frequency Reuse Schemes Works”, International Journal of Electronics Engineering, Volume 10, Issue 2, pp. 393-398, June 2018-Dec 2018, ISSN:0973-7383 UGC Journal No. 2946 | Girisha Kumar, Garima Saini |
| “Various Handover Techniques for Heterogeneous Networks: A Survey”, International Journal of Research In Electronics And Computer Engineering, Vol. 6, Issue 2, pp. 1909 - 1913, APR-JUNE 2018, ISSN:2348-2281, UGC Journal No. 44816. | Konika Mahajan, Garima Saini |
| “Planar Antennas for UHF RFID Reader Applications-A Review”, International Journal of Electronics Engineering, Volume 10, Issue 1, pp. 136-139, Jan 2018 -June 2018, ISSN:0973-7383, UGC Journal No. 2946 | Naveen Kumar, Garima Saini |
| “Interference Mitigation Technique for Two Tier Macro-Femto Network using Grey Wolf Optimization”, International Journal of Electronics Engineering, Volume 10, Issue 2, pp. 372-377, June 2018-Dec 2018, ISSN:0973-7383, UGC Journal No. 2946 | Jyoti Bala, Garima Saini |
| “Vertical Handover Technique for LTE-A Heterogeneous Network by using Expectation Maximization Algorithm”, International Journal of Electronics | Konika Mahajan, Garima Saini |

| | |
|--|---|
| Engineering, Volume 10, Issue 2, pp. 378-384, June 2018-Dec 2018, ISSN:0973-7383, UGC Journal No. 2946 | |
| "Compact UHF Patch Antennas for RFID Reader Applications", Journal of Advance Research in Dynamical & Control Systems, Vol. 10, Special Issue-09, pp. 2477-2483, 2018, ISSN - 1943-023x, Scopus Indexed. | Naveen Kumar, Garima Saini |
| "Design Analysis of 2.4GHz PIFA using ABS Material", Vol. 10, Journal of Advance Research in Dynamical & Control Systems Special Issue-09, pp. 2386-2391, 2018, ISSN - 1943-023x, Scopus Indexed. | Arshpreet Kaur, Garima Saini |
| "Implementation of fractional Frequency Reuse Schemes in LTE-A Network", Lecture Notes in Networks and Systems, Springer, Volume 46, pp. 313-321, 2019, Scopus Indexed. | Girisha Kumar, Garima Saini |
| "A Novel Wineglass Shaped Wide Band Antenna for TV White Space Communication", International Journal of Engineering & Technology, 7(45), pp. 324-328, 2018, Scopus Indexed. | Ghulam Ahmad Raza, Garima Saini, Naveen Kumar |
| "Multi-Level Fractional Frequency Reuse Schemes for 5G Networks", Journal of Advance Research in Dynamical & Control Systems , Vol. 10, Special Issue-06, pp. 2027-2033, 2018, ISSN - 1943-023x, Scopus Indexed | Girisha Kumar, Garima Saini |
| "Method & Implementation of Optimal Routing Mechanism with Wakeup Schedule in WSN", Journal of Emerging Technologies and Innovative Research (JETIR), ISSN: 2349-5162, Vol. 5, No. 7, pp. No.521-528, July 2018. (UGC Journal No. 63975) | Sushila, Kanika Sharma |
| "Balanced and Energy-Efficient Wireless Sensor Network Using A-Star Algorithm", Journal of Emerging Technologies and Innovative Research (JETIR), ISSN: 23495162, Vol. 7, No. 5, pp. No.380-385, July 2018. (UGC Journal No. 63975) | Harsh Sharma, Kanika Sharma |
| "Wireless Nano-sensors: A Review", Journal of Emerging Technology and Innovative Research (JETIR), ISSN-2349-5162, Vol. 5, No. 6, pp. 70-74, June 2018. (UGC Journal No. 63975) | Pooja Kataria, Kanika Sharma |
| "Improved Pulse Based Localization Algorithm for Wireless Nano-sensor Network", International Journal of Electronics and Engineering (IJEE), ISSN-2349-5162, Vol.5, No. 6, pp. 70-74, June 2018. (UGC Journal No. 2946) | Pooja Kataria, Kanika Sharma |
| "Algorithm for Improved Normalized Residual Energy in Wireless Nano - Sensor networks", International Journal of Electronics and Engineering (IJEE), ISSN-2455-2585, Vol.4, No. 10, pp. 272-282, October 2018. (UGC Journal No. 47719) | Pooja Kataria, Kanika Sharma |
| "A Review on Cluster Based Routing Protocols for Wireless Sensor Network", International Journal of Research In Electronics and Computer Engineering, Vol. 6, Issue 2, pp. 1896-1900, June 2018, ISSN: 2393-9028 (print)/ISSN: 2348-2281 (online). (UGC Journal No. 44816) | Shilpa Mohina, Kanika Sharma |
| "Cluster Head Selection using Gradient Descent Algorithm For Wireless Sensor Network", International Journal of Technical Innovation in Modern Engineering and Science, Vol. 4, Issue 9, pp. 62-69, September 2018, ISSN: 2455-2585. (UGC Journal No. 47719) | Shilpa Mohina, Kanika Sharma |
| "Efficient Clustering Algorithm Based on Gradient Descent Approach for Wireless Sensor Network", UGC Approved International Journal of Electronics and Engineering (IJEE), ISSN: 0973-7383, Vol.10, No. 2, pp. 385-392, June 2018. | Shilpa Mohina, Kanika Sharma |
| "Grid Based Clustering Protocol In Wireless Sensor Network: A Review", Journal of Emerging Technology and Innovative Research (JETIR), ISSN-2349-5162, Vol. 5, No. 7, pp. 441-444, July 2018. (UGC Journal No. 63975) | Monika Chauhan, Kanika Sharma |
| "Improved Grid Based Clustering and Combinational Routing for Wireless Sensor Network", UGC Approved International Journal of Electronics and Engineering (IJEE), ISSN-2349-5162, Vol.10, No. 2, pp. 336-341, July 2018. (UGC Journal No. 2946) | Monika Chauhan, Kanika Sharma |

| | |
|--|--|
| "INPMAC: An Improved Node Power Based MAC Protocol with Adaptive Listening Period", International Journal of Technical innovation in Modern Engineering and Science, ISSN-2349-5162, Vol.4, No. 7, pp. 1322-1327, July 2018. (UGC Journal No. 47719) | Vishakha, Kanika Sharma |
| "A Review on Energy Efficient MAC Protocols in Wireless Sensor Network", Journal of Emerging Technology and Innovative Research (JETIR), ISSN-2455-2585, Vol. 5, No. 7, pp. 607-611, July 2018. (UGC Journal No. 63975) | Vishakha, Kanika Sharma |
| "Enhancing the Lifetime of EADUC using PSO for Wireless Sensor Networks", International Journal of Electrical, Electronics and Computer Science Engineering, E-ISSN: 2348-2273 P-ISSN: 2454-1222, Vol. 5, No. 3, pp. 100-105, June 2018. | Ankita Mahajan, Kanika Sharma |
| "Low noise amplifier using Darlington pair at 90 nm Technology" Scopus Indexed International Journal of Electrical and Computer Engineering, 8(4), pp. 2054-2062, 2018. | Singh R, Rajesh Mehra |
| "Automatic Magnification independent classification of breast cancer tissue in histological images using deep convolution neural network" Scopus Book Chapter on Communications in Computer and Information Science, pp. 772-781, 2019. | Shallu, Rajesh Mehra |
| "Qualitative Analysis of Darlington feedback amplifier at 45 nm Technology" Scopus Indexed Bulletin of Electrical Engineering and Informatics, 7(1), pp. 21-27, 2018. | Singh R, Rajesh Mehra |
| "Role and Contribution of Commercial Banks in Fulfilling Funding Requirement of MSMEs of Himachal Pradesh", International Journal for Research in Engineering Application & Management, Vol IV, No-7, October 2018, PP422-431 | Gupta Varsha, Saini JS and Chaddha Sanjeev |
| "MSME Financing: Growth and Challenges", International Journal for Research in Engineering Application & Management Vol IV, No-7, Oct. 2018, PP 716-727 | Gupta Varsha, Saini JS and Chaddha Sanjeev |
| "A Study of Effect of Training & Development on the Organizational Commitment: A Case Study of Selected Banks in India", International Journal of Management Studies, Volume V, Issue-4(8), October, 2018, pp 64-73. | Prabhjot Kaur, Jasmer Singh Saini & Mukesh Chauhan |
| "A Study of Effect of Performance Appraisal on the Organizational Commitment: A Case Study of Selected Banks in India", International Journal of Management Studies, Volume-V, Issue-4(9) October, 2018, pp 38-47. | Prabhjot Kaur, Jasmer Singh Saini & Mukesh Chauhan |
| "Job Satisfaction and its determinates: A Review Paper", International Journal of Applied Sciences (UGC Approved Journal), Vol V, Issue 1, November, 2018 | Madhulika & SK Dhameja |
| Problem Based Learning Strategy for development of Skills – A Review for development of Skills – A Review (i-manager's Journal of Educational Technology, Vol. 15; No. 1, April – June, 2018) | Preeti Thakur, Sunil Dutt, A Chauhan |
| Problem Based Learning for development of Skills – A Review (i-manager's Journal of Educational Technology, Vol. 15; No. 2, July – Sept, 2018) | Preeti Thakur, Sunil Dutt, A Chauhan |
| "Defending DDoS in the Insecure Internet of Things: A Survey", © Springer Nature Singapore Pte Ltd. 2018, Artificial Intelligence and Evolutionary Computations in Engineering Systems, Advances in Intelligent Systems and Computing 668, https://doi.org/10.1007/978-981-10-7868-2_22 , pp 223-233, Scopus indexed. | Manisha Malik, Kamaldeep Maitreyee Dutta |
| "PSO based Blind Deconvolution Technique of Image Restoration using Cepstrum Domain of Motion Blur", ©Springer International Publishing AG 2018, Book on Computational Vision and Bio Inspired Computing, Chapter 84, Lecture Notes in Computational Vision and Biomechanics 28, Chapter | G. Ramteke Mamta, Maitreyee Dutta |

| | |
|--|--|
| 84, Lecture Notes in Computational Vision and Biomechanics https://doi.org/10.1007/978-3-319-71767-8_81 , pp 947-958, ISBN: 978-3-319-71766-1, Scopus indexed. | |
| "Face recognition from a group photograph using skin color models with PCA", Journal of Emerging Technologies and Innovative Research, July, 2018, Vol. 5, Iss 7, pp 54-63, Scopus indexed. | Manish Chauhan, Maitreyee Dutta |
| "Precise Positioning at Indian Region with Multi Constellation GNSS Receiver SP80", International Journal of Advanced Studies of Scientific Research, ISSN 2460-4010, Pg 11-17, ELSEVIER SSRN Library, Scopus indexed. | Prashant Joshi, Maitreyee Dutta, Vivek Bansal |
| "CNN based Image Forgery Detection using pre-trained AlexNet Model", ELSEVIER-SSRN Library (ISSN: 1556-5068), International Journal of Computational Intelligence and IoT Vol. 2, No. 1, 2018, Scopus indexed. | Amit Doegar, Maitreyee Dutta, Gaurav Kumar |
| "A Review of Passive Image Cloning Detection Approaches", Springer Lecture Notes in Networks and Systems 46, 469-478, Scopus indexed. | Amit Doegar, Maitreyee Dutta, Gaurav Kumar |
| "Bio-inspired low elastic biodegradable Mg-Zn-Mn-Si-HA alloy fabricated by spark plasma sintering", Materials and Manufacturing Processes, 2019/3 | Chander Prakash, Sunpreet Singh, BS Pabla, Sarbjeet Singh Sidhu, MS Uddin, |
| "Hybrid data fusion approach for fault diagnosis of fixed-axis gearbox", Structural Health Monitoring, July, 2018 | Vanraj, SS Dhama, BS Pabla |
| "Optimization of Machining Parameters During CNC Milling of Incoloy 800", International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 5, Issue 4, April 2019, Page No. 894-901. | Balwant Singh and P. Sudhakar Rao |
| "Optimization of Cutting Temperature and MRR During CNC Milling of Incoloy 800 Using DOE Technique", International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 5, Issue 4, April 2019, Page No. 1069-1076. | Balwant Singh and P. Sudhakar Rao, |
| "Review on Real Time Control of Lathe Machine During Turning Operations", International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 5, Issue 4, April 2019, Page No. 47-51. | Santosh Gangwar and P. Sudhakar Rao |
| "Neural Network Based Modelling for Prediction of Response Variables in Machining Processes: A Review", International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 5, Issue 4, April 2019, Page No. 52-57. | Sumit Kumar and P. Sudhakar Rao |
| "Minimum Quality Lubrication (MQL) During Conventional Machining Operations: A Review", International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 5, Issue 4, April 2019, Page No. 41-46. | Sukhdev Gangwar and P. Sudhakar Rao |
| "Heat and Mass Transfer Modelling of Lyophilization Process for Food Materials-A Review", International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 5, Issue 4, April 2019, Page No. 860-863. | Vikas Garg and P. Sudhakar Rao |
| "Developments in Work-holding Devices – A Review", International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES), 2019 | Deepam Goyal, SS Dhama, BS Pabla |
| Rajeev Kumar Dang, B. S. Pabla, "Condition Monitoring of Rotating Machines: A Review", World Scientific news- An International journal, 2018 | S. S. Dhama, Deepam Goyal, Anurag Chaudhary |
| "Optimization of face milling process parameters using response surface methodology", International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES), 2018 | B. S. Pabla, Vineet Kumar, Deepam Goyal |

| | |
|--|--|
| “Spark Plasma Sintering of Mg-Zn-Mn-Si-HA Alloy for Bone Fixation Devices: Fabrication of Biodegradable Low Elastic Porous Mg-Zn-Mn-Si-HA Alloy”, Handbook of Research on Green Engineering Techniques for Modern Manufacturing, 2018 | M. S. Uddin BSP, Chander Prakash, Sunpreet Singh, Ahmad Majdi Abdul-Rani |
| “Development of surface properties on Ti6Al4V by electric discharge machining”, International Journal of Research in Engineering and Innovation (IJREI), 2018 | Harmesh Kansal Rananjay Lamba, Pabla BS |
| Robin Singh, “Development of low-cost non-contact structural health monitoring system for rotating machinery”, Royal Society Open Science, 2018 | BS Pabla, SSD Vanraj |
| “Optimization of parameters in cylindrical and surface grinding for improved surface finish”, Royal Society Open Science, 2018 | Dinesh Kumar Patel, Deepam Goyal, B. S. Pabla |
| “Cost Estimation for Rapid Manufacturing-Laser Sintering Production for Low to Medium Volumes Production Economics: Evaluating Costs of Operations in Manufacturing and Service Industries”, 2018 | B.S Pabla, Anoop Desai, Aashi Mital |
| “Development of Flexible Machine Controller for Electrical Discharge Machine”, American Journal of Mechanical Engineering, May 2018, Vol. 6, Issue 2, pp. 48-53. | Manish Pawade/ SS Banwait |
| “Performance Evaluation of Flexible Machine Controller for Electrical Discharge Machine” Journal of Emerging Technologies and Innovative Research, June 2018, Vol. 5, Issue 6, pp. 43-48. | Manish Pawade/ SS Banwait |
| “Study on Mechanical Behaviour of Boron Carbide and Rice Husk Ash Based Aluminium Alloy 6061 Hybrid Composite”, International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 4, Issue 6, June 2018, Page No. 1-9. | Shipra Verma and P. Sudhakar Rao, |
| “Friction Stir Processing of Zamak Z5 Zinc Alloy Sheets”, International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 4, Issue 6, June. 2018, Page No. 1-4. | Asaf Hanief Kohli, P. Sudhakar Rao & Joy Prakash Misra, |
| “Study on Fabrication and Mechanical Behavior of Boron Carbide and Rice Husk Ash Based Aluminium Alloy 6061 Hybrid Composite”, International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 4, Issue 6, June 2018, Page No. 1-9. | Shipra Verma and Sudhakar Rao, |
| “Study and Effect of Process Parameters of Electrodeposited Ti-O ₂ -HAP Composite Coated Ti-6Al-4V Substrate”, International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 4, Issue 6, June 2018, Page No. 1-9. | Vinod Kumar, P. Sudhakar Rao & Sukhdev Singh Bhagol |
| “Effect of Process Parameters on Micro-Hardness of Electrodeposited Ti-O ₂ -HAP Composite Coating on Ti-6Al-4V using Taguchi Method”, International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 4, Issue 6, June 2018, Page No. 1-10. | Vinod Kumar, P. Sudhakar Rao and Sukhdev Singh Bhagol |
| “Optimization of Process Parameters on Micro-Hardness of Electrodeposited Ti-O ₂ -HAP Coating on Ti-6Al-4V Substrate using Taguchi Method”, International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 4, Issue 6, June 2018, Page No. 1-10. | Vinod Kumar, P. Sudhakar Rao and Sukhdev Singh Bhagol |
| “Preparation and Properties of Electrodeposited Ti-O ₂ -HAP Composite Coating”, International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 4, Issue 6, June 2018, Page No. 1-9. | Vinod Kumar, P. S. Rao and Sukhdev Singh Bhagol |
| “Adaptive Speed Control of Lathe Machine by Simulation for VFD Application Using MATLAB”, International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 4, Issue 6, June 2018, Page No. 1-5. | Santosh Gangwar and P. Sudhakar Rao |

| | |
|--|---|
| “Electrical Discharge Machining of Carbon Fiber Reinforced Plastics: A Review”, Journal of Material Science and Mechanical Engineering (JMSME), Vol. 5, Issue 3, Jul-Sep. 2018, Page No. 115-125. | Shruti Singh, P. Sudhakar Rao, Manas Pandey and Vishwa Prakash Pandey |
| “A Calculation Procedure and Optimization for Pass Scheduling in Rolling Process: A Review”, Journal of Material Science and Mechanical Engineering (JMSME), Vol. 5, Issue 3, Jul-Sep. 2018, Page No. 126-130. | Vishwa Prakash Pandey, P. Sudhakar Rao, Shruti Singh and Manas Pandey, |
| “Application of RRT in Medical Science: A Review”, Journal of Basic and Applied Engineering Research, Vol. 5, Issue 5, Jul-Sep. 2018, Page No. 445-451. | Manas Pandey, P. Sudhakar Rao, Shruti Singh and Vishwa Prakash Pandey |
| “Study on Mechanical Behavior of Aluminum Alloy 6061 Based Composite: A Review”, IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), Vol. 15, Issue 4, V III, Jul-Aug. 2018, Page 16-20 | Shipra Verma and P. Sudhakar Rao |
| “Influence of Reinforced Particles on Mechanical Properties of Fabricated Al/(SiC/Gr)-Metal Matrix Composite”, International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 4, Issue 10, Oct. 2018, Page No. 310-318. | Ankush Thakur and P. Sudhakar Rao |
| “A Review on Coating of Nano Titanium Dioxide with Dip-Coating Method”, International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 4, Issue 10, Oct. 2018, Page No. 214-218. | Aakash and P. Sudhakar Rao |
| “Cladding of Mild Steel Plates Using GMAW Process”, International Journal of Emerging Technologies in Engineering Research (IJETER), Vol. 6, Issue 10, Oct. 2018, Page No. 1-10. | Varsha Chaubey, P. Sudhakar Rao and Sanjay Kumar Gupta |
| “Study the Effects of Process Parameters during Electric Discharge Machining of Titanium Alloy (Ti-6246)”, International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 4, Issue 11, Nov. 2018, Page No. 131-136. | Abhishek Thakur and P. Sudhakar Rao |
| “A Review of Electrical Discharge Machining on Titanium based Alloy”, International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 4, Issue 11, Nov. 2018, Page No. 172-175. | Abhishek Thakur and P. Sudhakar Rao |
| “Effect of Process Parameters on Dilution in Cladding of Stainless Steel on Mild Steel Plate Deposited by GMAW”, International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 4, Issue 11, Nov. 2018, Page No. 176-182. | Varsha Chaubey, P. Sudhakar Rao and Sanjay Kumar Gupta |
| “A Review on Research Trends in Electrochemical Discharge Machining”, International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 4, Issue 12, Dec. 2018, Page No. 466-470. | Ashish Rao and P. S. Rao |
| “A Review on Different Types of Manufacturing Methods of Carbon Fibres”, International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 4, Issue 12, Dec. 2018, Page No. 702-708. | Sanjay Kumar and P. S. Rao |
| “Review Paper on Reverse Engineering for Medical Application”, International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 4, Issue 12, Dec. 2018, Page No. 524-527. | Vivek Deswal and P. Sudhakar Rao |
| “Review on Abrasive Jet Machining of Titanium Alloys”, International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 4, Issue 12, Dec. 2018, Page No. 471-474. | Chanakant Chaturvedi and P. Sudhakar Rao |
| “A Review on Electro Discharge Machining of Metal Matrix Composite”, International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 4, Issue 12, Dec. 2018, Page No. 410-414. | Mumtaz Rizwee and P. Sudhakar Rao |

| | |
|---|--|
| “Review paper on Extrusion of Al-Alloy Series”, International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 4, Issue 12, Dec. 2018, Page No. 589-595. | Sumit Swapnil Minz and P. Sudhakar Rao |
| “Performance of Coated Carbide Tools During CNC Machining- A Review”, International Journal of Research and Scientific Innovation (IJRSI), Vol. V, Issue XII, Dec. 2018, Page No. 78-80. | S. Parkash and P. S. Rao |
| “A Review on Material and Ballistic Energy Absorption of Body Armour”, International Journal of Research and Scientific Innovation (IJRSI), Vol. V, Issue XII, Dec. 2018, Page No. 93-99. | Nikky and P. Sudhakar Rao |
| “A Review on Ultrasonic Machining of Titanium Alloys”, International Journal of Research and Scientific Innovation (IJRSI), Vol. V, Issue XII, Dec. 2018, Page No. 81-87 | Arun Kumar Singh and P. Sudhakar Rao |
| “A Review on Current Research Trends in Micro-EDM”, International Journal of Research and Scientific Innovation (IJRSI), Vol. V, Issue XII, Dec. 2018, Page No. 88-92. | Yashpal Singh and P. S. Rao |
| “Rapid Prototyping Technology: Applications, Advantages and Limits- A Review”, International Journal of Technical Innovation in Modern Engineering and Science, Vol. 4, Issue 12, Dec. 2018, Page No. 568-572. | B. Sriharsha and P. S. Rao |
| “Green Manufacturing Technology- Solution for Environment Impact and Waste”, International Journal of Technical Innovation in Modern Engineering and Science, Vol. 4, Issue 12, Dec. 2018, Page No. 532-535. | Ravi Kumar and P. S. Rao |
| “Review Paper on Forging Process Using FEA”, International Journal of Technical Innovation in Modern Engineering and Science, Vol. 4, Issue 12, Dec. 2018, Page No. 555-557. | Neeraj and P. Sudhakar Rao |
| “Review Paper on Abrasive Machining Process”, Journal of Mechatronics and Automation, Vol. 5, Issue 3, 2018, Page No. 1-6. | Ravikant and P. Sudhakar Rao |
| “Characterization and Experimental Analysis of Boron Carbide and Rice Husk Ash Reinforced AA7075 Aluminium Alloy Hybrid Composite”, Journal of Alloys and Compounds, Vol. 741, 2018, Page No. 981-998. (Name not mentioned). | Nishant Verma and S.C. Vettivel, |
| “Review on Hybrid Aluminium Metal Matrix Composites”, International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 5, Issue 01, Jan. 2019, Page No. 166-170. | Vandana Yadav and P. Sudhakar Rao |
| “Investigation of Physical and Mechanical Properties of Hybrid Nickel Powder and Silicon Carbide Reinforced Aluminium Alloy Composites”, International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 5, Issue 02, Jan. 2019, Page No. 8-14. | Vandana Yadav and P. Sudhakar Rao, |
| “Sliding Wear Behaviour of Hybrid Nickel Powder and Silicon Carbide Reinforced Aluminium Alloy Composites”, International Journal of Technical Innovation in Modern Engineering and Science (IJTIMES), Vol. 5, Issue 02, Jan. 2019, Page No. 1-7. | Vandana Yadav and P. Sudhakar Rao |
| “Hydraulic and Thermal Analysis of Corrugated and Smooth Double Pipe Heat Exchanger using Computational Fluid Dynamics”, Journal of Emerging Technologies and Innovative Research (JETIR), Vol. 6, Issue 1, Jan. 2019, Page No. 110-120. | Shubham Sood and P. Sudhakar Rao |
| “A Review on Friction Stir Welding of Aluminum Alloys”, International Journal of Research in Engineering, Science and Management, Vol. 2, Issue 1, Jan. 2019, Page No. 69-71. | Sharda Sharma and P. Sudhakar Rao |
| “Computer Aided Green Manufacturing: A Review”, International Journal of Research in Engineering, Science and Management, Vol. 2, Issue 1, Jan. 2019, Page No. 72-75. | Pushpender Kumar and P. Sudhakar Rao |
| “A Review on Current Research Trends in Wire Electrical Discharge Machining (WEDM)”, International Journal of Research in Engineering, Science and Management, Vol. 2, Issue 1, Jan. 2019, Page No. 13-17. | Sanjay Kumar and P. Sudhakar Rao |

| | |
|---|---|
| "Impact of Extrusion Process on Product Quality", International Research Journal of Engineering and Technology (IRJET), Vol. 6, Issue 1, Jan. 2019, Page No. 115-124. | Sunil Kumar and P. S. Rao |
| Copyright of "MATLAB Codings for Solving Multi-level Multiobjective Linear Fractional Programming Problems based on modified Fuzzy Goal Programming Approach" by Kailash Lachhwani and Suresh Nehra, IIT Kharagpur. Copyright No. L-69182/2017 of registration at Office of the Registrar of Copyrights, Copyright office, Department of Higher Education, MHRD, Govt. of India, New Delhi. | KC Lachhwani Suresh Nehra |
| Patent on "Energy Efficient and Intelligent Cluster Type Heterogeneous System for Grid based Wireless Sensor Networks," Indian Patent Office Journal, Dated 02/03/2018, No. Part 1, Page No. 7775. | Rajvir Singh C. Rama Krishna |
| "Copyright Protection of Digital Images using Unseen Visible Watermarking" Journal of Emerging Technologies and Innovative Research, Volume 4, Issue 12, pp. 107-109, December 2017. | Nirbhay Kumar Singh, Geetanjali, Rajesh Mehra, Shallu |
| Correlation of Accident with Traffic Volume of NH-1, International Journal of Engineering Technology, Science & Research, Vol.4. Issue 7, July, 2017 | Hemant Sood Navdeep Mor |
| Assessment of Level of Service Concept in Urban Roads, International Journal for Scientific Research & Development (IJSRD), Vol. 5, Issue-6, 01.09.2017 | AK Duggal Aditi Sharma |
| Analytical and visual Approach towards faster deterioration of Parking Areas - International Journal for Scientific Research & Development (IJSRD), Vol. 5, Issue-4, June, 2017 | AK Duggal Nivedita Shukla |
| A Review on Warm Mix Asphalt - International Journal for Scientific Research & Development (IJSRD), Vol. 6, Issue-1, 2018 | AK Duggal Arpan Chhaba |
| Effect of Aging on Various Types of Bituminous Pavements - International Journal for Scientific Research & Development (IJSRD), Vol. 1, Issue-6, June, 2017 | AK Duggal Nivedita Shukla |
| A Review on Black Spots Study of Highways in India - International Journal of Innovative Research in Science Engineering & Technology (IJIRSET), Vol. 6, Issue-6, June, 2017 | AK Duggal/ Neha Bhagria |
| Analysis of Black Spots in the Chandigarh City- International Journal of Innovative Research in Science Engineering & Technology (IJIRSET), Vol.6, Issue 7, July, 2017 | AK Duggal/ Neha Bhagria |
| Role of Filler in the enhancement of Properties of Bituminous Mixes - International Journal of Research in Applied Science & Engineering Technology (IJRASET), Vol. 5, Issue-VIII, August, 2017 | AK Duggal/ Ankita Dhiman |
| Review on Reutilization of Plastic Waste in Paving Mixes - International Journal of Research in Applied Science & Engineering Technology (IJRASET), Vol. 5, Issue-VIII, August, 2017 | AK Duggal/ Shivani Thakur |
| Effect of Alccofine on Strength Characteristics of Concrete of Different Grades – A Review -International Research Journal of Engineering & Technology, Vol. 4, Issue, May, 2017 | Hemant Sood/ Malvika Gautam |
| A Review on Influence of Fog on Road Crash - International Research Journal of Engineering & Technology, June 2017. | Hemant Sood/ Amandeep Singh |
| Rubber Modified Concrete – A Green Approach for Sustainable Infrastructural Development - International Research Journal of Engineering & Technology, Vol. 4, Issue 6, June, 2017 | Hemant Sood/ Manoj Chuhan |
| Analysing the Effect of Cross – Sectional Column on Symmetrical RCC Frame Structure - International Research Journal of Engineering & Technology. Vol. 6, Issue 6, June, 2017 | Hemant Sood/ Harman |

| | |
|--|--|
| Improving the Strength of Rubber Modified Concrete using Synthetic Resin, International Research Journal of Engineering & Technology, Vol. 5, Issue 7, July, 2017 | Hemant Sood/ Manoj Chuhan |
| Effect of Treated Waste Water on Flexural & Split Tensile Strength of Concrete of Variable Grades, International Research Journal of Engineering & Technology, Vol. 4, Issue 6, June, 2017 | Hemant Sood/ Syantha Ghosh |
| Effect of Granite Powder and Polypropylene Fiber on Compressive, Split Tensile & Flexure Strength of Concrete at High Temperature – International Research Journal of Engineering & Technology – Vol. 4, Issue 7, July, 2017 | Hemant Sood/ Harjeet Singh |
| Comparative Study of Sisal Fiber and Glass Fiber Reinforced Concrete – A Review – International Journal for Research in Applied Sc. & Engineering Technology, Vol. 5, Issue 8, August, 2017 | Hemant Sood/ Saurabh Sood |
| Experimental Investigation of Mechanical Properties of Hybrid Sisal – Glass Fiber Reinforced Concrete – International Journal for Research in Applied Sc. & Engineering Technology, Vol. 5, Issue 8, August, 2017 | Hemant Sood/ Saurabh Sood |
| A Review Study of Strength Properties of Hybrid Fiber Reinforced Concrete using PPC, International Research Journal of Engineering & Technology, Vol. 4, Issue 8, August, 2017 | Hemant Sood/ Avinash Thakur |
| Study of Strength Properties of Hybrid Fiber Sisal/Polypropylene Reinforced Concrete using PPC, International Journal for Research in Applied Science & Engineering Technology, Vol. 5, Issue 8, August, 2017 | Hemant Sood/ Avinash Thakur |
| A Review Study on the Effect of Addition of Crumb Rubber and Rice Husk Ash in Concrete - International Research Journal of Engineering & Technology, Vol. 4, Issue 8, August, 2017 | Hemant Sood/ Nikhil Brari |
| Effect of Addition of Granite Powder and Polypropylene Fiber in Concrete - A Review – International Journal for Research in Applied Science & Engineering Technology, Vol. 5, Issue 8, August, 2017 | Hemant Sood/ Harjeet Singh |
| Improvement in Tensile Strength of Concrete using Steel and Polypropylene Fibers - International Journal Engg. Science & Computing, Vol. 7, Issue 11, Nov, 2017 | Hemant Sood/ Monika Sharma |
| Comparison of Sugarcane Bagasse Ash, Fly Ash & Rice Husk Ash on M – 25 Grade of concrete – International Journal of Engg. & Technical Research, Vol. II, Issue X, Nov, 2017 | Hemant Sood/ Priyanka Kumari |
| Effect of using Curing Methods on Various Concrete Grades – International Journal of Engineering Science & Computing, Vol. 4, Issue 12, Dec, 2017 | Hemant Sood/ Rajesh Sharma |
| Effects of Recycled Waste Tire Rubber as Coarse Aggregate on the performance of Concrete, International Journal of Engineering and Techniques- Volume 4 Issue 1, January-February 2018. | Sanjay Sharma Imran Khan, Mir Aijaz, |
| A Review on Self compacting concrete, International Journal for research in Applied Science & Engineering Technology volume 5, Issue XI, November 2017 | Sanjay Sharma, Shashank Dwivedi, |
| Carbon Footprint Assessment of RBI Grade 81 Stabilized Pavements using Life Cycle Approach - Indian Journal of Science & Technology. ISSN:0974-6846, DOI:10.17485/ijst/2017/V10i26/115438, July, 2017 | Hemant Sood/ Pardeep Gupta & Gaurav Gupta |
| Effect of Treated Waste Water on Cement Concrete Workability Journal of Engineering & Technology Education, NITTTR, Chandigarh, Vol. 11, No. 1, Jan-June, 2017 | Hemant Sood/ Kamal Kishore |
| For Impact on Road Work: A Case Study of Mohali District – Journal of Engineering & Technology Education – Vol.11, Issue 2, July – Dec., 2017. | Amandeep Singh Navdeep |

| | |
|---|--|
| "An Efficient Approach for Secure Information Retrieval on Cloud," Journal of Intelligent and Fuzzy Systems, IOS Press, vol. 34, no. 3, pp. 1345-1353, 2018 [SCIE, Thomson Reuters Impact Factor: 1.426] | Rohit Handa, C. Rama Krishna and Naveen Aggarwal |
| "My Smartphone Kit: Design and Development of an Integrated Platform for Innovation and Product Design in Engineering Education," Wiley Journal on Computer Applications in Engineering Education, Vol. 26, Issue. 3, pp. 642-654, 2018. [SCIE, Thomson Reuters Impact Factor: 1.153] | S.R.N. Reddy, Jasleen Kaur, Suresh Chande, Rama K. Challa |
| "Efficient Multistage Bandwidth Allocation Technique for Virtual Machine Migration in Cloud Computing," Journal of Intelligent and Fuzzy Systems, IOS Press, 2018. [SCIE, Thomson Reuters IF-1.426, Accepted on 13th February 2018] | A. Bhardwaj and C. Rama Krishna |
| "Capacity Enhancement using MU-MIMO in Vehicular Ad hoc Network," International Journal of Applied Engineering and Research, vol. 12, no. 16, pp. 5872-5883, 2017. [SCOPUS indexed and UGC Approved Journal - 2018 (Journal No. - 64529)] | Khurana M, Rama Krishna C & Panda SN |
| "Performance Evaluation of Bandwidth for Virtual Machine Migration in Cloud Computing," International Journal of Knowledge Engineering and Data Mining, Inderscience, 2018. [Accepted][UGC Approved Journal No. 47797] | A. Bhardwaj and C. Rama Krishna |
| "Two-level Security Framework for Virtual Machine Migration in Cloud Computing," Journal on Information Technology, Vol.7, No. 1, pp.34-44, February 2018. [ICI indexed] | Yashveer Yadav, C. Rama Krishna |
| "Prevention of DDoS and EDoS using Hybrid Filtering Technique in a Cloud Environment," International Journal of Pure and Applied Mathematics, Vol. 114, No. 12, pp. 383-392, 2017. [UGC Approved Journal No. 23425] | Shruti Wadhwa, Poonam Saini, Rama Krishna Challa |
| "A Survey on Security Architecture and Key Management Systems in a Wireless Sensor Network," International Journal of Computer Science and Network Security, vol. 17, no. 4, pp. 263–273, April 2017. | Sunil Kumar, C. Rama Krishna, and A. K. Solanki |
| "Error Prone Transmission System to Resist Data Loss in a Wireless Sensor Network," International Journal of Computer Network and Information Security, Vol.9, No.11, pp.17-26, November 2017. | Sunil Kumar, C. Rama Krishna, and A. K. Solanki |
| "An Approach to Mitigate Malware Attacks using Netfilter's Hybrid Frame in Firewall Security," International Journal of Open Source Software and Processes (IJOSSP), IGI-Global, ISSN: 1942-3926, EISSN: 1942-3934, Volume-9, Issue-1, pp. 32-61, 2018, Scopus Indexed | Nivedita Nahar, Prerna Dewan and Rakesh Kumar |
| "Ubiquitous Health Monitoring Using WBANs: A Comprehensive Review," Wireless Networks, Springer, Print ISSN: 1022-0038, Online ISSN: 1572-8196, 2018, SCI, Scopus Indexed, IF=1.6 | Roopali and Rakesh Kumar |
| "Windowing Based Threshold Technique To Play The Simple Breakout Game At Neutral Attention Level," International Journal of System of Systems Engineering, Inderscience, Online ISSN 1748-068X, Print ISSN 1748-0671, Volume-8, Issue-2, pp. 147-173, 2017, Scopus Indexed. | Gauttam Jangir and Rakesh Kumar |
| 'Identification of Critical Factors for Implementation of TQM in Building Construction Industry' published in International Journal for Research in Applied Science & Engineering, ISSN:2321-9653, Vol.6, March, 2018 | SK Gupta |
| sEMG signal classification using Discrete Wavelet Transform and Decision Tree classifier International Journal of Control Theory and Applications, Vol.10, No.6 pp.511-524, 13, 2017 (Scopus Indexed) ISSN 0974-5572. | Yogendra Narayan, Lini Mathew, S.Chatterji |
| PID Controller for Two Tank Liquid Level Process Using LabVIEW International Journal of Technical Research & Science, Vol.2 No.2454-2024 pp.413-417, July 2017 | Nayanmani Deka, Lini Mathew |
| ZIGBEE Based Real Time Monitoring and Controlling for Precision Agriculture Using LabVIEW International Journal of Technical Research & Science, Vol.2 No.2454-2024 pp.413-417, July 2017 | Shivangi Gupta, Lini Mathew |

| | |
|---|--|
| Sign Language Recognition Using Image Processing International Journal of Advanced Research in Computer Science and Software Engineering Vol.7, No.2277-128, pp.142-145 August, 2017 | Kamal Preet Kaur, Lini Mathew |
| LabVIEW Implementation of WSN for Real Time Monitoring in Precision Agriculture International Journal of Computer Applications, Vol.171, No.4, pp.36-40, August, 2017 | Shivangi Gupta, Lini Mathew |
| Literature Survey on Hand Gesture Techniques for Sign Language Recognition International Journal of Technical Research & Science, Vol.2, No.2454-2024, pp.431-433, August, 2017 | Kamalpreet Kaur, Lini Mathew |
| Reduction of Fault Time in Smart Grid System Using Fuzzy Logic Controller International Journal of Advance Research in Science and Engineering, Vol.6, No.10, pp.525-533, October, 2017 | Kitty Tripathi, Lini Mathew |
| A review on different technique for optimal placement of DG in distribution system International Journal of Advance Engineering and Research Development, (UGC approved) Vol.5, Issue 2 e-ISSN-2348-4470, p-ISSN-2348-6406, February 2018 | Md.Firoz Ansari, Poonam Syal, Lini Mathew |
| An overview of Industrial Vision Systems International Journal of Advance Research and Innovative Ideas in Education, Vol.3, pp.201-207, April, 2017 | Aparna, Ritula Thakur |
| Design and implementation of moving work piece sorting system based on LabVIEW International Journal of Advance Research and Innovative Ideas in Education, Vol.3, pp.284-295, April 2017 | Aparna, Ritula Thakur |
| An overview of ZigBee Technology and its Industrial Applications International Journal of Advance Research and Innovative Ideas in Education, Vol.3, Issue 4, 2017 | Ram Nath, Ritula Thakur |
| Design and development of Gesture Recognition based robotic arm using ARDUINO Controller International Research Journal of Management Science & Technology, Vol.8, Issue 10, pp.111-122, 2017 | Rizwanullah Siddiqui, Ritula Thakur |
| Flex Sensors based Robotic ARM for Disabled Persons: mA Review International Journal of Emerging Technologies in Engineering Research (IJETER), Volume 5, Issue 9, September 2017 | Rizwanullah Siddiqui, Ritula Thakur |
| A comparison between satellite based and drone based remote sensing technology to achieve sustainable development: a review Journal of Agriculture and Environment for International Development, 111 (2): 383 - 407, 2017 | Baban kumar Bansor, Rangoli Singh, Ritula Thakur |
| Design of Nano Grid using Solar and Hydro System for Smart Homes International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering, Vol.5, Issue 5, May 2017, ISSN (Online) 2321 – 2004 ISSN (Print) 2321 – 5526. DOI 10.17148/IJIREEICE.2017.5545 | Shiwani Goyal, Shimi S.L. |
| Nano Grid Based Smart Homes with Electricity Production & Trading Facility International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering, Vol.5, Issue 5, May 2017. ISSN (Online) 2321 – 2004 ISSN (Print) 2321 – 5526. DOI 10.17148/IJIREEICE.2017.5545 | Shiwani Goyal, Shimi S.L. |
| Voice Operated Intelligent Fire Extinguisher Vehicle with Water Jet Spray, International journal of Innovative Research in Electrical Electronics Instrumentation and Control Engineering, Vol.5 Issue 10, October 2017, ISSN (Online) 2321 – 2004 (Print) 2321 – 5526, DOI:10.17148/IJIREEICE.2017.51002 | Meena Kumari, Shimi S.L. |
| Voice Operated Intelligent Fire Extinguisher Vehicle International journal of Innovative Research in Electrical Electronics Instrumentation and Control Engineering, Vol.5, Issue 10, October 2017, ISSN (Online) 2321 – 2004 ISSN (Print) 2321 – 5526. DOI:10.17148/IJIREEICE.2017.51003 | Meena Kumari, Shimi S.L. |

| | |
|---|---|
| From Apposite Preference to Specific Application: An Overview of Microcontroller Unit International Journal of Technical Research & Science, Vol.2, Issue 8, September 2017. ISSN No.2454 – 2024 | Snehil Mishra, Shimi S.L. |
| Design and Implementation of PID and Adaptive Tuned PID Controller for Industrial Application International Journal of Technical Research & Science, Vol.2, Issue 9, September 2017, ISSN No.2454 – 2024 | Snehil Mishra, Shimi S.L. |
| Real Time ECG Analysis for Prediction of Sudden Cardiac Death Using PCA Interpretation International Journal of Engineering Science Invention (IJESI), Volume 7, Issue 2, PP.54-66, February 2018. ISSN (Online) 2319 – 6734, ISSN (Print): 2319 -6726 | Bhasker Pandey, Shimi S.L. |
| Analysis and Comparative Classification of EMG Signals International Journal of Creative Research Thoughts, Vol.6, Issue 1, pp.382-388, February 2018, ISSN: 2320-2882 | Gopal Tiwari, Shimi S.L |
| Sudden Cardiac Death Risk Estimation Algorithms; A Review IOSR Journal of Engineering (IOSRJEN), Vol.08, Issue 3, pp.18-22, March 2018. ISSN (e): | Bhasker Pandey ¹ , Shimi S.L. |
| IoT Based Parameter Monitoring of Three Phase Induction Motor International Journal of Creative Research Thoughts, Vol 45, Issue 5, March 2018. | Shefali Jamwal and Shimi S.L |
| Increasing Trends of Wearables and Multimodal Interface for Human Activity Monitoring – A Review Biosensors and Bioelectronics, Elsevier, Vol.90, pp 298-307, April 2017, DOI: 10.1016/J.bios. 2016.12.001 (SCI Indexed, Impact Factor=7.78) | Preeti Kumari, Lini Mathew, Poonam Syal |
| Techno Economic Feasibility Analysis of Different Combinations of PV-Wind-Diesel-Battery Hybrid system for Telecommunication Applications in Different Cities of Punjab, India Renewable and Sustainable Energy Reviews, Elsevier Vol.76, pp 577-607, April 2017, DOI: 10.1016/J.rser.2017.03.076(SCI Indexed, Impact Factor = 9.122) | Mohd.Junaid Khan, Amit Kumar Yadav, Lini Mathew |
| A review on various electrochemical techniques for heavy metal ions detection with different sensing platforms Biosensors and Bioelectronics, 2017 Vol.94, pp.443-455 | Babankumar, Tejinder Kumar, Ritula Thakur |
| Calibration of Capacitive Cell for Measuring Moisture Content in Grains International Journal of Pure and Applied Physics, Vol.13, Issue, 1, pp.146-149, 2017 | Harinder Singh, Baban kumar S Bansod, Ritula Thakur, Tejbir Singh, Jeewan Sharma |
| Analysis of water quality parameters by hyperspectral imaging in Ganges River Spatial Information Research https://doi.org/ 10.1007/s41324-018-0164-4 (Springer Journal) | Babankumar Bansod, Rangoli Singh, Ritula Thakur |
| Analysis and Fabrication of Micro-Device as Liquid Sensor Journal of Applied Computing, 2(1): 1-4, 2017, E-ISSN 2456-5059 | Vandana Sharma, Shimi S.L., Sandeep Arya |
| Design and fabrication of micro-channels based fluid viscosity sensor ISSS J Micro Smart Syst, Springer, July 2017, DOI 10.1007/s41683-017-0012-0 | Sandeep Arya, Vandana Sharma, S.L.Shimi |
| Outcome Based Assessment of Engineering Undergraduate Final Year Projects for Tire-2 Institute Springer AISC – ISSN No.-2194-5357) 27th-28th Feb., 2018 | Gopal Tiwari, Ram Singh, Vinay Chandan, S.L.Shimi, Manish Jain |
| “Review of Different Approaches for Face Detection “International Journal of Latest Engineering Research and Applications (IJLERA) Volume – 02, Issue – 12, December – 2017, PP 01-10, ISSN: 2455-7137. | Susamma Mathew, Shiwani Vashist, Shallu Sharma, Rajesh Mehra |
| “A Survey on lossless compression Algorithms for Medical Images”, International Journal of Electrical Electronics & Computer Science Engineering, Volume 4, Issue 6, pp. 96-102, December 2017, ISSN No. 2348-2273. | Vivek Kumar, D.Sriramulu, Rajesh Mehra, Shallu |

| | |
|---|--|
| "Palm Print Recognition and Authentication Using Hough Transform For Biometric Application" International Journal for Research in Applied Science & Engineering Technology (IJRASET) Volume 5 Issue XII December 2017, ISSN: 2321-9653 | Ranjeet Singh Chauhan, Jagriti Kumari, Rajesh Mehra, Shallu |
| "Image Compression and Denoising using Wavelet Transform" International Journal of Modern Electronics and Communication Engineering(IJMECE), Volume No. - 5, Issue No. – 6, November 2017, ISSN: 2321-2152 | Bhupender Singh, Parul Sharma, Rajesh Mehra, Shallu Sharma |
| "Review of Tunnel FET", UGC approved International Research Journal of Engineering and Technology, Vol 4, Issue 3, pp. 1195-1199, July 2017 | Prabhat Tamak, Rajesh Mehra |
| "Design of Double Gate Heterojunction TFET for low power application", UGC approved International Journal of Scientific Research and Development, Vol. 5, Issue 06. pp. 40-44, August 2017 | Prabhat Tamak, Rajesh Mehra |
| "Speed and Area Efficient Reconfigurable Viterbi Decoder using Hybrid Approach", International Journal for Scientific Research & Development," Vol. 5, Issue-02, pp. 1575-1577, April 2017 | Dinesh Kumar Rajesh Mehra |
| "A Power Efficient Schmitt Trigger Latch Design Using CNTFET Technology", International Journal of Advancement in Engineering Technology, Management and Applied Science, Vol. 4, Issue 10, pp.62-67, October 2017. | Raj Kumari, Rajesh Mehra |
| "Optimized Design of Switched Capacitor Integrator", International Journal of Engineering Research and Applications, Volume 8, Issue 1, Part-III, pp. 85-90, January 2018. | Pragati Sheel, Rajesh Mehra |
| "Techniques to improve Darlington pair amplifier applications for high data rate communication system", International Journal of Electronics and Communication Engineering and technology (IJECET), Vol. 8, Issue 5, pp. 7-17, October 2017. | Rashmi Singh, Rajesh Mehra |
| "Design a Darlington amplifier with improved gain and slew rate", International journal of electronics and communication technology (IJECT), Vol. 8, Issue 4, pp.13-16, October 2017. | Rashmi Singh, Rajesh Mehra |
| "Low Leakage and PDP Optimized FinFET based ST SRAM Design," UGC Approved in International Journal on Recent and Innovation Trends in Computing and Communication (IJRTCC). Vol. 5, No. 7, pp. 116-120, July 2017. | Ayushi Gagneja and Rajesh Mehra |
| Recent Advances in Photovoltaic Technology based on Perovskite Solar Cell- A Review", UGC approved in International Research Journal of Engineering and Technology, Vol.4, Issue 7, pp.1284-1296, July 2017. | Navneet Kour, Rajesh Mehra |
| "Comparative Study of Solar Cell Devices using Lead and Tin based Perovskite Material Through Numerical Simulation", UGC approved International Research Journal of Engineering and Technology, Vol.5, Issue 5, pp.1289-1292, July 2017. | Navneet Kour, Rajesh Mehra |
| "Energy Efficient CNTFET based Full Adder using Hybrid Logic", UGC Approved Journal, International Journal on Recent and Innovation Trends in Computing and Communication(IJRTCC), Vol.5, No. 7, pp 98-103, July 2017. | Priya Kaushal and Rajesh Mehra |
| "Energy Efficient Clustering Based on Expectation Maximization for Homogeneous Wireless Sensor Network", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 06, No.08, pp. 16530-16536, August 2017. | Neha Sharma, Kanika Sharma |
| "Energy Efficient Grid Based Routing Algorithm Using Centrality and BFO for Wireless Sensor Network", International Journal of Innovative Research in Science, Engineering and Technology (IJRSET), Vol.6, No. 8, pp 16579-16586, August 2017. | Priya Rana, Kanika Sharma |

| | |
|--|--|
| “Energy Efficient Multi Hop Cross Layer Design for Large Scale Wireless Sensor Networks”, International Journal of Latest Trends in Engineering and Technology (IJLTET), vol. 8, Issue 4-1, pp 81-87, August 2017. | Bharti Goyal, Kanika Sharma |
| “Design of a Compressive Data Gathering Scheme with an Energy Efficient Reconstruction Algorithm for WSN”, UGC Approved International Journal of Latest Trends in Engineering and Technology (IJLTET)”, Vol.8 Issue (4-1) 5, pp. 097-103, 2017. | Aman Jindal, Kanika Sharma |
| “Improved LEACH Protocol based on K- Means Clustering Algorithm for Wireless Sensor Network”, International Journal of Electronics & Communication Technology (IJECT), Vol.8,No.4, pp 28-32, Oct- Dec 2017. | Pratiksha Saheb, Kanika Sharma |
| “A Compact Dual Element PIFA Array for Wireless MIMO Advance TDD LTE Applications” , International Journal of Advancement In Engineering Technology, Management And Applied Sciences Volume 04, Issue 09, pp. 85-93, September 2017, ISSN:2349-3224, UGC Journal No:63082 | Manish Kumar Soni, Garima Saini |
| “Design Of Reconfigurable Notch Band Antenna for UWB Application Using P-I-N diodes”, International Journal of Emerging Trends and Technology In Computer Science, Volume 6, Issue 5, pp. 245-252, September 2017, ISSN:2278-6856, UGC Journal – 48939 | Praveen Kumar Chakravarti, Garima Saini |
| “Evaluation of SAR on Human Phantom Due to Circular SRR Loading”, International Journal of Advanced Research in Science and Engineering, Vol. No. 06, Issue No.09, pp. 1384-1390, September 2017, ISSN: 2319-8354, UGC Journal No: | Garima Saini, Shyam Sunder Pattnaik |
| “A Review of Wearable/Body Worn Antennas for Body-Centric Wireless Communication (BWC)”,International Journal of Advancement In Engineering Technology, Management and Applied Science, Volume 04, Issue 10, pp. 31-44, October 2017, ISSN:2349-3224, UGC Journal No: 63082 | Ajeet Thakur, Garima Saini |
| “A Design Concept of Printed Inverted F-Antenna for Smart Watch Applications”, International Journal of Electrical Electronics And Computer Science Engineering, Volume 4, Issue 5, pp. 62-65, October 2017, ISSN:-2348-2273, UGC Journal No. 44927 | Ajeet Thakur, Garima Saini |
| “Calculation of Bandwidth And Gain or Improving the Performance of Planar Inverted F-Antenna Using ANN”, International Journal of Advance Research Trends In Engineering and Technology, Vol. 4, Issue 11, pp. 1-7, November 2017,ISSN:2394-3785 | Monica Singhal, Garima Saini |
| “A Compact Dual Element PIFA Array For Wireless LTE Portable Devices” ,International Journal For Research In Applied Science and Engineering Technology, Volume 5, Issue XI, pp. 1795-1801 November 2017, ISSN:2321-9653, UGC Journal No. 44382 | Manish Kumar Soni, Garima Saini |
| “Reconfigurable Microstrip Patch Antenna Using Single Switch For Wideband Applications”, International Journal of Emerging Technologies in Engineering Research, Volume 5, Issue 10, pp. 6-9, October 2017, ISSN:2454-6410, UGC Journal No. 44955, Thomson Reuters Research ID - H-8878-2016 | Naman Thakur, Garima Saini |
| “3-D Printed Antennas: A Review”, International Journal of Engineering Science and Computing, Volume 8, Issue No. 3, pp. 16582-16586, March 2018, ISSN: 2321-3361 | Arashpreet Kaur, Garima Saini |
| “Deep insights into the advancements and applications of perovskite based photovoltaic cells” Elsevier SCI Published in Journal of Energy Chemistry, ISSN No. 2095-4956 | Chandni Devi, Rajesh Mehra, |
| “Efficient Design of Perovskite Solar Cell using mixed Halide and Copper Oxide”, SCI Published in Chin. Phys. B, Vol. 27, No. 1, pp. 018801-1 – 018801-7. | Navneet Kour, Rajesh Mehra, Chandni |

| | |
|---|---|
| "Reconfigurable Low Pass FIR Filter Design using Canonic Signed Digit for Audio Applications" Indian Journal of Science and Technology, Vol 10(16), April 2017, ISSN (Print) : 0974-6846 | Preethi M. Nair, Rajesh Mehra and Chandni |
| Comparative analysis of Wavelet Curvelet Techniques for Noise Removal", Journal of Emerging Technologies and Innovative Research, Volume 4, Issue 11, pp. 615-618, November 2017, ISSN No. 2349-5162. | Amit Kumar Rana, Kumud, Rajesh Mehra, Shallu |
| "High Gain Amplifier Design for Switched-Capacitor Circuit Applications", IOSR Journal of VLSI and Signal Processing, Volume 7, Issue 5. pp. 62-69, October 2017. | Pragati Sheel, Rajesh Mehra |
| "Design of SRR array embedded PIFA for LTE-Hi Applications", Journal of Engineering and Applied Sciences, 12(22), pp. 6033-6038, 2017, ISSN:1816-949x, Scopus, UGC Journal No:7336 | Garima Saini, Shyam Sunder Pattnaik |
| "Corporate Social Responsibility Reporting by Indian Banks from the Perspective of Employees", International Journal of Research in Business Management, Volume 5, No.11, Nov. 2017 pp 43-64. | Puneet Kaur and Jasmer Singh Saini, |
| Effect of Web Quest based Instruction on student's Achievement and Critical Thinking: A Review. International Journal of Multidisciplinary Educational Research. Vol. 6, No. 7(1), 2017.145-155p. | Richa Bansal and Sunil Dutt |
| Gender and Academic Achievement in Engineering Colleges. International Journal of Engineering, Research & Technology. Vol. 6, Issue 6, 2017, 1027-29p. | K Krishnakumar and Sunil Dutt |
| Predictive Value of Engineering Entrance Test on Academic Performance in Engineering Degree Course. International Journal of Recent Engineering Research and Development. Vol. 2, Issue 6, 2017, 38-43p. K | Krishnakumar and Sunil Dutt |
| Effect and Use of Collaborative Learning: A Review International Educational E-Journal Vol. 6, No. 3, 2017, 102-113p. | Suruchi and Sunil Dutt |
| Attitude of secondary class students towards biology exposed through problem based learning. International Journal of Multidisciplinary Research and Development Vol. 4, Issue 6, 2017, 427-432p. | Preeti Thakur and Sunil Dutt |
| Problem based Learning in Biology: Its effect on achievement motivation of students of 9th standard. International Journal of Multidisciplinary Education & Research. Vol. 2, issue 2, 2017, 99-104p. | Preeti Thakur and Sunil Dutt |
| Analyzing the concept of Big Data Using Hadoop's Mapreduce with HDFcs, Journal of Network Communication and Emerging Technologies, Vol.7, Issue 12, Dec17. | Amandeep Kaur 1, Gurbinder Singh 1 & Tanvi Sharma 2 |
| A review of task scheduling based on Meta heuristics Approach in Cloud Computing, International Journal on Knowledge and Information Systems (SCI Indexed journal) Vol 36, No. 3, 2017, Springer Publication. | Poonam Singh, Maitreyee Dutta, Naveen Aggarwal |
| An extensive review of development of EEG based Computer-Aided diagnosis systems for epilepsy detection published in Networ: Computation in Neural Systems (SCI Indexed journal, Taylor and Francis), Vo. 28, Iss 1, 2017 | Jagriti Saini, Maitreyee Dutta |
| GA based Blind Deconvolution Technique of Image Restoration using Cepstrum Domain of Motion Blur, Indian Journal of Science and Technology (SCOPUS Indexed), vol. 10 (16), April, 2017 | Ramteke Mamta, Maiteyee Dutta |
| Epilepsy Disease Detection Using Artificial Neural Network and MSE Optimization with GA, in International journal of Innovative Research in Science, Engineering and Technology (IJIRSET), Vol. 6, Iss 7, July 2017 | Jagriti Saini, Maitreyee Dutta |
| Contrast Enhancement Techniques: A Brief and concise Review, International Research Journal of Engineering and Technology (IRJET), Vol 4, Iss. 7, pp. | Nikil Verma, Maitreyee Dutta |

| | |
|--|---|
| A study on Control of Myoelectric Prosthetic Hand Based on Surface EMG Pattern Recognition, International journal of Advance Research in Science and Engineering, Vol 06, Iss 07, July 2017 | Suraj, Maitreyee Dutta |
| Literature Review of Feature Extraction Methods for Classification of EEG Signals, International Journal of Advance Research in Sciences and Engineering, Vol 06, Iss 07, July 2017 | Prince Saini, Maitreyee Dutta |
| Implementation of single-packet hybrid IP traceback for IPv4 and IPv6 Networks, IET Information Security (SCIIndexed Journal), 2017 doi: q0.1049/iet-ifs. 20150483 | Kamaldeep, Manisha Malik Maitreyee Dutta |
| PSO Based Blind Deconvolution Technique of Image Restoration Using Cepstrum Domain of Motion Blur, Springer Lec. Notes Computational Vision, vol. 28 Book on Computational vision and Bioinspired Computing, Chapter 84, ISBN: 978-3-31971766-1 | G. Ramteke Mamta, Maitreyee Dutta |
| “Analyzing the Effect of Different Process Parameters on Tool Wear, Chip Formation and Surface Integrity During Milling of Hastelloy C-276”, International Research Journal of Engineering and Technology (IRJET), Vol. 4, Issue 7, July 2017, pp. 2631-2634 | Tarun Batra and P S Rao |
| “Review on Effect of Various Type of Reinforcement Particle on Mechanical Behavior of 6161 and 7045 Al Alloy Matrix Composite”, International Journal of Engineering Technologies in Engineering Research (IJETER), Vol. 5, Issue 8, Aug 2017, pp. 100-109 | Nishant Verma, P S Rao and S C Vettivel |
| A Review of Modelling of Temperature Distribution at Tool-Work piece Interface During Machining Process; International Journal of Innovative Research in Science, Engineering and Technology; Vol 6, Issue 8, August 2017, DOI:10.15680/IJRSET.2016.0608105 | Arun Kumar and S. S. Dhami |
| “Characterization of Any Experimental Investigation on Mechanical Behavior of B4C and RHA Reinforced Al alloy 7075 hybrid composite using stir casting”, International Research Journal of Engineering and Technology (IRJET), Vol/Issue 8(3), September 2017, pp. 179-186 | Nishant Verma, P S Rao and S C Vettivel |
| “Application of RSM to Optimize MIG Welding Process Parameters for Hardness”, International Journal of Engineering Technologies in Engineering Research (IJETER), Vol 5, Issue 9, September 2017, pp. 31-36 | Sahil Angaria, P S Rao and SS Dhami |
| Optimization of Machining Parameters in Turning EN-45 Steel Using Plain Carbide Tool, International Journal of Scientific Research in Science, Engineering and Technology, Volume 3, Issue 6, September 2017 | Santosh Kumar, B S Pabla, Jatinder Madaan |
| Finite Element Analysis and Multibody Dynamics of 6-DOF Industrial Robot; International Journal of Mechanical and Production Engineering Research and Development; Vol. 7, Issue 5, October 2017, pp. 1-12 | Rahul Arora and S. S. Dhami |
| 3D Scanning for Reverse Engineering- Technological Advancement, Process Overview, Accuracy Inspection, Challenges and Remedies; International Journal of Emerging Technologies in Engineering Research; Volume 5, Issue 10, October 2017, pp. 33 – 40 | Mudit Bansal and S. S. Dhami |
| Modelling and Control of Electromagnetic Fuel Injection Solenoid Valve; International Journal of Recent Innovation in Engineering and Research; e-ISSN: 2456 – 2084, October 2017, Pp. 39 – 45 | Anmoldeep Singh Sidhu and S. S. Dhami |
| “Performance Evaluation of 65 HP Transmission System of a Tractor”, International Journal of Emerging Technologies in Engineering Research, Vol. 5, Issue 10, October 2017, pp. 154-162. | Aneesh Longia, S. S. Banwait |
| “Analysis of Axle Tube and Brake Housing of 65 HP Tractor”, International Journal of emerging Technologies in Engineering Research, Vol. 5, Issue 11, November 2017, pp. 11-17. | Vikas, S. S. Banwait |
| “Analysis of Clutch Housing and Gear Box of 65 HP Tractor”, International Journal of emerging Technologies in Engineering Research, Vol. 5, Issue 11, November 2017, pp. 36-40. | Pankaj, S.S. Banwait |

| | |
|--|---|
| “Analysis of Rear Differential Housing of 65 HP Tractor”, International Journal of emerging Technologies in Engineering Research, Vol. 5, Issue 11, November 2017, pp. 41-45. | Gopal Sharma, S. S. Banwait |
| “ A Parametric Analysis of Deformation of Workpiece” in Closed Die Forging ” International Journal of Mechanical and Production Engineering Research and Development; Vol. 7, Issue 6, December 2017, pp. 147-154 | Jasleen Kaur, S. S. Dhami and B. S. Pabla |
| “Robot Position Optimization for a Pick & Place Operation; International Journal of Emerging Technologies in Engineering Research; Volume 5, Issue 12, December 2017, pp. 63 – 70 | Varinder Singh and S. S. Dhami |
| “Optimization of CGI during Milling using Tungsten Carbide Tool” International Journal of Emerging Technologies in Engineering Research; Volume 5, Issue 12, December 2017, Pp. 55 – 62 | Subhash Pokhariyal, K. C. Rai and S. S. Dhami |
| “Experimental Investigation during CNC Milling of Hastelloy C-276 in Dry Conditions” International Journal for Research in Applied Science and Engineering Technology, Vol 5, issue IX,2017. 1753-1759 | Tarun Batra and PS Rao |
| “Comparative Analysis of Cryogenic Treated Carbide Tools: A Review International Journal for scientific research and development, Vol 5, Issue 02, 2017, pp 2195-2197 | Sameem and PS Rao |
| Ultrasonic Machining Of WC–Co Composite Material: Experimental Investigation And Optimization Using Statistical Techniques , Proceedings of the Institution of Mechanical Engineers, Volume 231 Issue 5, April 2017 | R Kataria, J Kumar, B S Pabla |
| Experimental Investigations in Powder Mixed Electric Discharge Machining of Ti–35Nb–7Ta–5Zrβ-titanium alloy, Materials and Manufacturing Processes, 32:3, 274-285, DOI: 10.1080/ 10426914 . 2016.1198018, 2017 | Chander Prakash, H. K. Kansal, B. S. Pabla & Sanjeev Puri |
| Optimization of Sound Sensor Placement for Condition Monitoring of Fixed-Axis Gearbox; Cogent Engineering; June2017, https://doi.org/10.1080/23311916.2017.1345673 | Vanraj, S. S. Dhami and B. S. Pabla |
| Multi Sensor Data Fusion based Gear Fault Diagnosis using Complete Ensemble Empirical Mode Decomposition with Adaptive Noise; Indian Journal of Science & Technology; Volume 10, Issue 24, June 2017 , DOI 10.17485/ijst/2017/v10i24/115296 | Vanraj, S. S. Dhami and B. S. Pabla |
| Non-Contact Incipient Fault Diagnosis Method of Fixed-Axis Gearbox Based on CEEMDAN; Royal Society Open Science; July 2017, http://dx.doi.org/10.1098/rsos.170616 | Vanraj, S. S. Dhami and B. S. Pabla |
| Parametric Analysis and Optimization of Closed Die Forging of Gear Blank ; Indian Journal of Science and Technology; Volume 10, Issue 26, July 2017 , DOI: 10.17485/ijst/2017/v10i26/115760 | J Kaur, S. S. Dhami and B. S. Pabla |
| Condition Monitoring Parameters for Fault Diagnosis of Fixed Axis Gearbox: A Review ; Computational Methods in Engineering; July 2017, Volume 24, Issue 3 , pp 543–556 | D Goyal, S. S. Dhami and B. S. Pabla |
| Hybrid Data Fusion Approach for Fault Diagnosis of Fixed-Axis Gearbox ; Structural Health Monitoring; August 2017; DOI: 10.1177/1475921717727700 | Vanraj, S. S. Dhami and B. S. Pabla |
| Effect of Nanoparticles based Lubricants on Static Thermal Behaviour of Journal Bearings: A Review; Research Journal of Engineering and Technology; Vol. 8(2), August 2017, pp. 149-153 | Rajeev Kumar Dang, Deepam Goyal, S. S. Dhami, Amit Chauhan |
| “ Microwave Joining of Metals: A Review ”, Research Journal of Engineering and Tech. 2017; 8(3): 282-290, September 2017 | S Salot, B S Pabla, S Sehgal, H Kumar |

| | |
|---|---|
| “Effect of TIG Welding Process Parameters Tensile Behavior of 5XXX and 6XXX series Aluminium Alloys: A Review”, Research J. Engineering and Tech. 2018;9(1): 01-08, January 2018 | Abhi Bansal, B.S Pabla, S.C Vettivel |
| “ Characterization, Physical and Mechanical Behavior of Sintered Atomized Iron–Zinc Stearate Composite ”, Transactions of the Indian Institute of Metals, Volume 71, Issue 1, pp. 41–55, January 2018 | R Kumar, B S Pabla, SC Vettivel, J Madan, S Kumar |
| “ Condition Based Maintenance of Bearings and Gears for Fault Detection – A Review ” Materials Today; Volume 5, Issue 2, Part 1 , March 2018, pp. 6128-6137 | Sanjay Kumar, Deepam Goyal, Rajeev K. Dang, Sukhdeep S. Dhami and B. S. Pabla |
| “Quality Education for Empowering Indian Youth” Yojana Journal, June, 2017 Publication | Rakesh Wats/ Meenu Wats |
| “Employee Engagement: A Study of Drivers among Teachers | Rakesh Wats/ Kamaksi Malik |
| “Use of Rubber and Steel Industry Waste for the improvement of Concrete Strength”, E-ISSN 2250–2459, Volume 7, Special Issue 2, December 2017, pp. 318-322. | Dinesh Kumar, Amit Goyal, Sunita Kotwal |
| “Low Cost Passive Energy Dissipation System for Masonry Buildings under Earthquake Loading”, E-ISSN 2250–2459, Volume 7, Special Issue 2, December, 2017, pp. 323-329. | Amit Goyal, Pankaj Agarwal |
| “High Speed Intersatellite Communication System by Incorporating Hybrid Polarization Wavelength Division Multiplexing Scheme”, Journal of Optical Communication, August 2016. | Sushank Chaudhary Neha Chaudhary Saurabh Sharma BC Choudhary |
| “FGP Approach to Multiobjective Quadratic Fractional Programming Problem”, International Journal of Applied and Computational Mathematics (Springer) 2016. | KC Lachhwani |
| “Optimization of Condition-based Maintenance using Soft Computing” International Journal on Neural Computing and Applications (Springer), 2016. | Deepam Goyal BS Pabla SS Dhami KC Lachhwani |
| “Impact of Treated Waste Water on Flexural and Split Strength in Ambuja Technical Journal, Vol-2, October, 2016. | Hemant Sood |
| “Effect of Treated Waste Water on Compressive Strength and Permeability of M-25 Grade Concrete”, International Journal of Advanced Research (IJAR), Vol-4 (2016). | Hemant Sood |
| “Effect of PET Fibres on the Mechanical Properties of Concrete”, International Journal of Civil Engineering December, 2016. | Hemant Sood |
| “Effect of PET Fibres in the Performance of Concrete”, International Journal of Scientific Research and Education – Vol.4, Issue/12/December, 2016. | Hemant Sood |
| “Effect of Using Slag and Treated Waste Water on the Strength of PPC Concrete”, International Journal of Advanced Engineering & Research Development, Vol-4, Issue 1, January, 2017. | Hemant Sood |
| “Effect of Using Slag and Treated Waste Water on the Compressive Strength of Variable Grades of PPC Concrete”, International Journal of Advanced Engineering & Research Development, Vol-4, Issue 1, January, 2017. | Hemant Sood |
| “Level of Service Concept in Urban Roads”, International Journal of Engineering Science Invention Research Development (IJESIRD), VOL III, Issue I, July 2016, e-ISSN: 2349-6185 | Robin Dhiman Ajay K Duggal |

| | | |
|---|-----------------------------------|------|
| “Determination of Level of Service of Jan Marg in Chandigarh”, International National Research Journal of Engineering and Technology (IRJET) Vol. III Issue 07, July 2016, e-ISSN 2395-0056. | Robin Dhiman Ajay K Duggal | |
| “Recycling practices in Flexible pavement with the help of RAP and rejuvenators”, International Journal of Engineering Science, Invention Research Development (IJESIRD) III , issue 1 , July 2016 , www.ijesird.com , e-ISSN2349-6185 | Viranta Sharma Ajay K Duggal | |
| “To study the effect of partial replacement of lime by cement in Mastic Asphalt”, International Journal of Engineering & Technology , Vol 03 , Issue : 11 , Nov 2016. | Swati Chandel Ajay K Duggal | |
| “Feasibility Study of Metro Rail Project in Chandigarh ; International Research Journal of Engineering & Technology”, IJERT Journal , Vol: 3 , Issue 7 , July 2016 e-ISSN 2395-0056. | Prateek Malhotra Ajay K Duggal | |
| “Metro Rail Transit System in various Indian Cities –A Preliminary Study, International Journal of Engineering Science Invention Research Development Vol III , issue 1 , July 2016 , www.ijesird.com , e-ISSN2349-6185 2016. | Prateek Malhotra Ajay K Duggal | |
| “Flexible Pavements with repeated distress history – A case Study”, International research Journal of Engineering and technology IRJET Vol.3 Issue 08, Aug 2016, e-ISSN 2395-0056. | Naiyara Khan Ajay K Duggal | |
| “Review on Improvement of Engg Properties of Soil using Waste Plastic Bottles Strips (Polyethylene Terephthalate)”, International Journal on Emerging Technologies 8 (1) : 01-04 (2017). | VK Sonthwal | |
| “Improvement of Engg Properties of Soil Using Waste Plastic Bottles Strips (Polyethylene Terephthalate)”, International Journal on Theoretical & Applied Sciences 9 (1) : 21-27 (2017). | VK Sonthwal | |
| “Review on Improvement of Engg Properties of Soil”, International Journal on Emerging Technologies 7 (2) : 48-51 (2016). | VK Sonthwal | |
| “Improvement of Engg Properties of Clayey Soil Using Shredded Rustar Tyre”, International Journal of Theoretical and Applied Sciences 9 (1) : 01-06 (2017). | VK Sonthwal | |
| “Stabilization of Soil Reinforced with Quarry Dust”, International Journal of Recent Trends in Engg & Research 318-323, Vol 21, issue 9 September, 2016. | VK Sonthwal | |
| “Stabilization of Soil Reinforced with Quarry Dust and Poly Propylene Fibre Waste” International Journal of Trend in Research and Development, Vol. 315, 325-328 September-October, 2016. | VK Sonthwal | |
| “Soil Stabilization by Using Waste Material : A Review”, International Journal of Science, Invention Research & Development, Vol-III, Issue 1.... | VK Sonthwal | |
| “Analysis of Water Quality Parameters & Discharge Rate through Conventional & Geo Textile Based Filter”, International Research Journal of Engineering & Technology (IRJET), Vol- 03 issue: 08/August, 2016. | SK Sharma Anirudh | |
| “To Determine the Efficiency of Crystalline Water Proofing System in Concrete”, International Research Journal of Engineering & Technology (IRJET) / Vol – 03 issue. 08/ August, 2016. | SK Sharma Navrit Bhandari | |
| “Development of Eco Friendly Geopolymer Brick Using Foundation Sand IRJET / Vol – 03, issue 08/August, 2016. | SK Sharma Preetinder Singh | |
| “An Experimental Investigation on Properties of High Strength Bacterial Concrete (Bacillus Subtilis)”, International Research Journal of Engineering & Technology IRJET - /Vol – 03 issue 05/ May2016. | SK Sharma Singla | Neha |
| “Abilympics – A Way Forward for Harnessing the Potential of Persons with Disabilities”, International Journal of Business Management and Scientific Research, Volume 20, PP20-36, August 2016. | JS Saini | |

| | |
|--|---|
| "Botnet Analysis using Ensemble Classifier", Elsevier Journal on Perspective in Science, Vol. 8, pp. 502–504, September 2016. | A Bijalwan N Chand E Pilli C Ramakrishna |
| "Classification of Heavy Metal Ions Present in Multi-frequency Multi-electrode Potable Water Data using Evolutionary Algorithm", Springer Journal on Applied Water Science, pp. 1-11, doi:10.1007/s13201-016-0514-0, December 2016. | Rashmi Karkra Prashant Kumar Baban K. S. Bansod Sudeshn Bagchi Pooja Sharma C Ramakrishna |
| "Stream Control Transmission Protocol," CSI Communications, Vol. 40, Issue 4, pp. 33-35, July 2016. | Anurag Jagetiya C Ramakrishna |
| "Multi-path TCP: Future of Multi-homing," CSI Communications, Vol. 40, Issue 1, pp.19-20, April 2016. | Anurag Jagetiya C Ramakrishna |
| "Scalable Key Parameter Yield of Resources Model for Performance Enhancement in Mobile Cloud Computing", Springer, Wireless Personal Communications, 2017. {Online First}. | Rakesh Kumar Santosh Kumar Yadav |
| "D-BEENISH: Distance Incorporated Balanced Energy Efficient Network Integrated Super Heterogeneous Protocol for WSN", Inderscience International Journal of Systems, Control and Communications {Accepted}. | Rakesh Kumar Rakesh Mathur |
| "A Fuzzy Logic Based Clustering Algorithm for Network Optimization", Inderscience International Journal of Systems, Control and Communications, Volume-7, Issue-2, pp. 132-150, 2016. | Navdeep Singh Rakesh Kumar |
| "Blind Water Marking of 3-D Images using DWT-SVD Technique", International Journal of Advanced Research in Computer Science and Software Engineering(IJARCSSE), Vol. 6, Issue 12, pp. 173-181, December 2016. | Rikky Rastogi Rakesh Kumar |
| "A Survey on Workflow Scheduling in Cloud Computing Environment", International Journal of Innovative Research in Computer and Communication Engineering, Vol. 4, Issue 5, pp. 8504-8510, May 2016. | Rakesh Kumar Manish Gautam |
| "A Survey on Android Malware Detection", International Journal of New Technology and Research (IJNTR), Volume-2, Issue-12, December 2016, pp. 47-53. | Nirmala Yadav Aditi Sharma Amit Doegar |
| "Design of Pixel Neighborhood Based Offline Handwritten Thinning Framework for Devnagri Numeral Script using Elman Neural Network" Thomson Reuter International Journal of Computer Science and Security, vol14, No.07, June 2016. | Gulshan Goyal Maitreyee Dutta |
| "Experimental Approach for Performance Analysis of Thinning Algorithms for Offline Handwritten Devnagri Numerals" Thomson Reuter Indian Journal of Science and Technology, Vol 9(30), DOI:10.17485/ijst/2016/v9i30/97528, August 2016. | Gulshan Goyal Maitreyee Dutta |
| "Classification of Objects from High Resolution Remote Sensing Images using Recognition", International Journal of Engineering Trends and Technology, Vol 38, no. 1, August 2016 ISSN : 2231-5381. | Nikita Aggarwal Mohit Srivastava Maitreyee Dutta |
| "Comparative Analysis of Pixel Based and Object Based Classification of High Resolution Remote Sensing Images- A Review", International Journal of Engineering Trends and Technology, Vol 38, no. 1, August 2016 ISSN : 2231-5381. | Nikita Aggarwal, Mohit Srivastava, Maitreyee Dutta |
| "Time Dependent Signature Verification using Normalized Weighed Coefficients", SCOPUS indexed International Journal of Electrical and Computer Engineering, Vol 6, No 6, September 2016. | Manas Singal Manish Trikha Maitreyee Dutta |
| "Signature Verification using Normalized Static Features and Neural Network Classification", SCOPUS indexed International Journal of Electrical and Computer Engineering, Vol 6, No 6, September 2016. | Manish Trikha Manas Singal Maitreyee Dutta |

| | |
|---|---|
| “Online Signature Verification: Present State of Technology”, Thomson Reuter indexed International Journal on Recent and Innovation Trends in Computing and Communication.”, Vol 4, Issue 9, pp: 66-68, Sept. 2016 ISSN 2321-8169. | Manas Singal Maitreyee Dutta |
| “Online Signature Verification using Normalized Dynamic Feature with Artificial Neural Network Classification,” Thomson Reuter indexed International Journal of Engineering Sciences and Research Technology”, 5(9), September 2016, ISSN: 2277-9655. | Manish Trikha Maitreyee Dutta |
| “Online Signature Verification with Periodic Template Updating Mechanism”, SCI Xplore Indexed International Journal of Engineering and Technical Research, vol-6, Iss-1, pp 68-71, Oct., 2016 ISSN: 2321-0869. | Manas Singal Maitreyee Dutta |
| “Review on Point Spread Function Estimation Techniques”, IJEEE, Vol 3, Issue 5, October 2016, e ISSN: 1694-2310, p-ISSN: 1694-2426. | Ritesh Pawar Maitreyee Dutta |
| “Face Detection and Recognition using Binary Patterns”, International Journal of advanced research in Electrical, Electronics and Instrumentation Engineering, Vol 5, Issue 10, October 2016. | Amit Kumar Chanchal Dr. Maitreyee Dutta |
| “Recognition of Emotions from Facial Expressions and its Application in CAR Driving System,” International Journal of Advanced Research in Electronics and Communication Engg., Vol 5, issue 10, October. 2016. | Amit Kumar Chanchal Maitreyee Dutta |
| “SURE Based Parametric PSF Estimation for Image Deconvolution”, Thomson Reuter indexed International Journal of Computer Science and Information Security, Vol 14, No. 10, Oct., 2016 , Researcher IdE-1319-2016. | Ritesh Pawa Maitreyee Dutta |
| “ PSF Estimation with PSO and SURELET Deconvolution for Blurred Image” International Journal of Innovative Technology and Exploring Engineering, Vol 6, Issue 6, November 2016, ISSN 2278-3075. | Ritesh Pawar Maitreyee Dutta |
| “Novel Low Power & High Speed 13T SRAM Cell using Fin FETs”, IET Circuits, Devices & Systems, 2016. (SCI Indexed). | Shilpa Saxena Rajesh Mehra |
| “Reconfigurable Low Pass FIR Filter Design Using Canonic Signed Digit For Audio Application, Indian Journal of Science and Technology, Vol. 10, No. 16, pp. 1-6, 2017. (Scopus Indexed in UGC list). | Preethi Nair Rajesh Mehra Chandni |
| “20 Tap Reconfigurable IIR Filter Using Fully Parallel MAC Algorithm”, International Journal of Computer Applications (IJCA), Vol. 156, No.10, pp. 1-6, 2016. (Google Indexed). | Rohini Rajesh Mehra Chandni |
| “FPGA Based Asynchronous FIR Filter Design for ECG Signal Processing”, International Journal of Computer Applications (IJCA), Vol. 156, No.7, pp. 16-20, 2016. (Google Indexed). | Rahul Rajesh Mehra Chandni |
| “IIR Filter Design using Factored-Canonical Signed Digit for SONAR Applications”, International Journal of Computer Science and Information Security, Vol. 14, No. 11, pp. 216-221, 2016. (Google Indexed). | Pushpraj Rajesh Mehra Shallu |
| “FPGA Based Band Pass FIR Filter using Factored Canonic Signed Digit Technique for Satellite Application”, International Journal of Computer Applications (IJCA), Vol. 156, No 3, pp. 45-49, 2016. (Google Indexed). | Roshan Lal Rajesh Mehra Shallu |
| “Selective Mapping and Partial Transmit Sequence Based PAPR Reduction for OFDM Applications”, International Organization of Scientific Research (IOSR), Vol. 15, No. 06, pp.70-76, 2016. (Google Indexed). | Shailly Kumari Rajesh Mehra |
| "PAPR Reduction using Companding Technique for Multicarrier Transmission", International Journal of Engineering Science and Technology (IJEST), Vol. 8, No. 11, pp. 237-243, 2016. (Google Indexed) | Shailly Kumari Rajesh Mehra |
| “Adaptive Noise Cancellation using Modified Normalized Least Mean Square Algorithm”, International Journal of Engineering Trends and Technology (IJETT), Vol. 34. No. 4. pp. 215-219, April 2016. (Google Indexed). | Lalita Sharma and Rajesh Mehra |

| | |
|---|--|
| "Denoising ECG Signal Using Daubechies and Symlet Wavelet Transform Techniques", International Journal of Advanced Research in Computer and Communication Engineering, Vol. 5, No. 9. pp. 438-443, September 2016. (Google Indexed) | Tanuj Yadav Rajesh Mehra |
| "Reconfigurable Distributed Arithmetic Based Adaptive Noise Canceller using Modified NLMS Algorithm", IOSR Journal of VLSI and Signal Processing, Vol. 6 No. 3, pp. 31-37, 2016. (Google Indexed). | Rajesh Mehra Lalita Sharma |
| "High Performance and Low Power SRAM Cell design using Power Gating Technique", International Journal of Electrical and Electronic Engineering & Telecommunication. Vol. 5. No. 3. pp. 35-47, July 2016. (Google Indexed). | Shilpa Saxena Rajesh Mehra |
| "Finfet Based Low Power & High Speed SRAM Cell Design", International Journal of Engineering Science and Technology. Vol. 8, No. 6, pp. 158-170, July 2016. (Google Indexed). | Shilpa Saxena Rajesh Mehra |
| "Unsupervised Learning Based Modified C-ICA for Audio Source Separation in Blind Scenario", International Journal of Information Technology and Computer Science, Vol. 3, pp 10-18, 2016. (Google Indexed). | Naveen Dubey Rajesh Mehra |
| "Design Analysis of Two – Code Keying Approach Based on MD code to Improve the Performance of OCDMA System" International Journal of Engineering Science and Computing (IJESC) Vol. 6, pp. 2062-2066, July, 2016. | Mukesh Kumar Umesh Kumar Tiwari Kanika Sharma Sandeep Singhai |
| "Improvement of Span Length of 160Gb/s Ultra Dense Wavelength Division Multiplexing PON with FBG by reducing Chromatic Dispersion ", International Journal of Engineering Science and Computing, Vol. 6, Issue 7, pp1921-1924, August, 2016. | Chhavi Saini Umesh Tiwari Kanika Sharma |
| "Design and Analysis of Multiplier Accumulation Unit by Using Hybrid Adder", International Journal of Computing Trends & Technology (IJCTT), ISSN 2231-2803, July 2016. | Amiya Prakash Kanika Sharma |
| "Literature Review on Design and Analysis of Multiplier Accumulation Unit by Using Hybrid Adder", International Research Journal of Engineering and Technology (IRJET), Volume 3, Issue, 7 July 2016. | Amiya Prakash Kanika Sharma |
| "Improved Energy Efficient Routing Scheme (IEERS) for Wireless Sensor Network", International Journal of Engineering Science and Computing, Vol. 6 Issue 7, pp 1996-1999, July 2016. | Ravi Kumar Anand Kanika Sharma |
| "Resonantly Peak Detection Algorithm in Structural Health Monitoring", International Research Journal of Engineering and Technology , pp. 100-106 Vol. 3, Issue 8, August 2016. | H Singh Kanika Sharma |
| "Survey on Impedance Measurement Technique Based Structural Health Monitoring", International Research Journal of Engineering and Technology, pp. 106-116, Vol. 3, Issue 8, August 2016. | H Singh Kanika Sharma |
| "Improved Development of Energy Efficient Routing Algorithm for Privacy Preservation of Sink in WSN", International Research Journal of Engineering and Technology, Vol. 3 No. 1 ISSN 2395- 0056, pp 1-7, January 2016. | Pallavi Saxena Kanika Sharma |
| "Review Paper on Data Gathering Techniques Based on Mobile Sink In WSN", International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering (IJIREEICE), ISSN 2321-2004, Vol. 4 , Issue 8, pp. 29-32, Aug 2016. | Shipra Sharma Kanika Sharma |
| "Improved Lifetime by Mobile Sink Based Energy Efficient Adaptive Threshold Clustering Hierarchy Algorithm for WSN", International Advanced Research Journal in Science , Engineering and Technology , Vol . 3 ISSN 2393-8021, Issue 10, pp. 72-75, October 2016. | Shipra Sharma Kanika Sharma |
| "Improved Stability Period by Mobile Sink based Energy Efficient Adaptive Threshold Clustering Hierarchy Algorithm for WSN", International | Shipra Sharma Kanika Sharma |

| | |
|--|---|
| Advanced Research Journal in Science , Engineering and Technology ,Vol. 3, ISSN 2393- 8021, Issue 10, pp 81-84,October 2016. | |
| "Energy Efficient Routing Algorithm for Privacy Preservation of Sink in WSN,"MIT International Journal of Electronics and Communication Engineering, Vol.5, no.2, pp.56-59, 2015. | Pallavi Saxena Kanika Sharma |
| "Spectrum Sensing Schemes in Cognitive Radio Networks: A Review", International Journal of Engineering Trends and Technology, Volume-40, Number-4, pp. 215-219, October 2016, ISSN No: 2349-0918. | Anita Kumari Garima Saini |
| "Optimizing Channel Estimation for SCFDMA", International Journal of Advanced Research, Ideas And Innovation in Technology, Volume-2, Issue-6, pp.1-5, 2016, ISSN No: 2454-132X. | Priyanka Malhotra Garima Saini |
| "Optimization of Horn Antenna using various Technique- A review", International Journal of Advance Research In Electrical, Electronics And Instrument Engineering, Volume-5, Issue-10, pp.7806-7809, October 2016, ISSN No: 2320-3765. | Anku Bala Garima Saini |
| "Gain Enhancement of Pyramidal Horn Antenna for X Band using Improved Geometry", International Journal of Advance Research In Electrical, Electronics and Instrument Engineering, Volume-5, Issue-10, pp.8804-8809, October 2016 ISSN No: 2320-3765. | Anku Bala Garima Saini |
| "Compact Printed Dipole Antenna with Low Return Loss and VSWR", International Journal of Scientific Research Engineering and Technology, Volume-5, Issue-11, November 2016, ISSN No: 2278-0882. | Sarabjeet Kaur Garima Saini |
| "Design and Fabrication of Compact PIFA Portable Device", International Journal of Electronics and Electricals and Computational System, Volume-5, Issue-11, November 2016, ISSN No: 2348-117X. | Anamika Sharma Garima Saini |
| "Performance Analysis for PAPR Reduction using Hybrid Technique in OFDM System", International Journal of Engineering Technology And Research, Volume-3, Issue-11, pp.18-22, November 2016, ISSN No: 2394-3386. | Arushi Garg Garima Saini |
| "A Printed Monopole Antenna for TV White Space Application" International Journal of Electronics and Communication Technology, Volume-7, Issue-4, pp. 32-34, December 2016, ISSN No: 2230-9543. | Ghulam Ahmed Raza Garima Saini |
| "A Review of Antenna For TV White Space Spectrum Communication" International Journal of Electrical and Electronics Engineering, Volume-3, Issue-4, pp. 17-20, August 2016, ISSN No: 1694-2310. | Ghulam Ahmed Raza, Garima Saini, |
| "Gain and Bandwidth Enhancement of Microstrip Patch Antenna for 2.4/5 GHz WLAN Application Using EVG Structure", International Journal of Engineering Research Online , Volume-4, Issue-4, 2016, ISSN No: 2321-7758. | Vijay Kumar Srivastva, Garima Saini, |
| "A Dual Wide-Band Slotted Rectangular Patch Antenna For 2.4/5 GHz WLAN Application", International Journal of Engineering Research and Technology , Volume-5, Issue-7, pp. 60-65, July-2016, ISSN No: 2278-0181. | Vijay Kumar Srivastva, Garima Saini |
| "Design Analysis of Cross-Slot Patch Antenna for Hotspot Applications", International Journal of Electrical and Electronics Engineering, Volume-3, Issue-7, pp. 1-4, July-2016, ISSN No: 2348 – 8379. | Avneet Kaur Garima Saini |
| "A-Review of Various Design of Periodic Structures For Frequency Selective Surface", International Journal of Engineering Trends and Technology, Volume-37, Issue-5, pp. 246-250, July-2016, ISSN No: 2231-5381. | Avneet Kaur Garima Saini |
| "Design of Novel Modified SSRR Antenna for WLAN Applications", International Journal of Electrical & Electronics Engineering, Volume -3, Issue-6, pp. 1-11, December, 2016, ISSN No: 1694-2310. | Sushil Kumar Verma Garima Saini |
| "Energy Efficient Algorithm using Sensing Time and Secondary User in Cognitive Radio Network", International Journal of Engineering Trends and | Anita Kumari Garima Saini |

| | |
|--|---|
| Technology, Volume 41, Issue 1, pp. 11-14, November, 2016 , ISSN No: 2231-5381. | |
| "Split Ring Resonator Based Wide Bandwidth Planar Inverted-F Antenna For Wi-Fi/WLAN Applications", International Journal of Control Theory and Application, Volume 41, Issue 1, pp. 9027-9034, Sep, 2016 , ISSN No.- 2229-6093. | Neha Yadav Garima Saini |
| "Log-Periodic Terahertz Antenna with CSRR Metamaterial Superstrate", International Journal of Engineering Research & Technology, Volume-5, Issue-9, pp. 583-586, September, 2016 , ISSN No.- 2278-0181. | Pankaj Kumar Singh Garima Saini |
| "Log-Periodic Terahertz Antenna with Square SRR Metamaterial Superstrate", International Journal of Engineering Research & Technology, Volume-5, Issue-7, pp. 527-530, September, 2016 , ISSN No.- 2278-0181. | Pankaj Kumar Singh Garima Saini |
| "A Review of Patch Antennas Loaded With Different Metamaterials", International Journal of Electrical and Electronics Engineering (IJEEE), Volume 2, Issue 08, pp. 38-40, October, 2015 , ISSN No.- 1694-2310. | Sushil Kumar Garima Saini |
| "Miniaturization of Microstrip Patch Antenna using Slots for S band", International Engineering Science and Computing", Volume 6, Issue No. 7, pp. 2000-2003, July, 2016. | Vaishali Kamboj Garima Saini Ashish Saini |
| "The Association Between Students' Learning Engagement and Their Achievement in Psychology", International Journal of Multidisciplinary Education and Research, Volume 1, Issue 7, 33-35 p. | A Dogra Sunil Dutt |
| "Effect of Online Learning in Psychology Course on Undergraduate Students' Engagement in Learning", Issues and Ideas in Education, Volume 4, Issue 1, 17-24 p. | A Dogra Sunil Dutt |
| "Online Learning in Undergraduate Psychology Course - Its Effect on Students' Achievement", Innovative Research in Applied Science & Technology, Volume 2, No. 2, 1-5p; 2016. | A Dogra Sunil Dutt |
| "Efficient Hydro Energy Production and Operation Management in Residential Building Feasibility Analysis", Accepted for Publication in International Journal of Sustainable Building Technology & Urban Development, Vol.8, No.1, 1-12. | Anil Kumar Misra Amandeep Kaur Neelabh Jain Bhavish Mahipal Manpreet Singh |
| "Cost Analysis of Trips in Chemical Industry due to Line Faults with Flexible Controller", International Journal of Engineering Research and General Science, Vol.4, Issue 3, pp.644-651, May-June, 2016. | Meraj Akhtar Lini Mathew |
| "Cost Comparison of FACTS Devices for Industrial Applications – A study", International Journal of Technical Research and Science, Vol.1, Issue 4, pp.39-46, July, 2016. | Meraj Akhtar Lini Mathew |
| "A Comparative Study for Different Methods used for ECG Demonising", International Journal of Science, Technology and Engineering, Vol.3, Issue 1, pp.166-169, July, 2016. | Anupma Kumari Lini Mathew |
| "Adaptive Second Order Volterra Series Filter for Removing Noise from Nonlinear System", International Journal of Current Research, Vol.8, Issue 5, pp.30944-30948, May, 2016. | Dhanesh Lini Mathew |
| "Maximum Power Point Tracking Control Method for a Hybrid PV/WT/FC Renewable Energy System", International Journal of Control Theory and Applications, Vol.10, No. 6, pp.411-424, 13, 2017. [Scopus Indexed] ISSN 0974-5572. | Md.Junaid Khan Lini Mathew |
| "Different Kinds of Maximum Power Point Tracking control method for Photovoltaic Systems: A Review Achieves of Computational Methods in Engineering", Springer Netherlands, pp. 1-13, September 2016. (DOI: 10.1007/s11831-016-9192-1). [SCI Indexed, IF=4.214]. | Md. Junaid Khan Lini Mathew |
| "Elbow Movement Classification of a Robotic Arm using Wavelet Packet and Cubic SVM, Communication and Computing Systems", Taylor and | Y Narayan P Kumari Garima |

| | | |
|--|---|------------------|
| Francis Group, London, pp. 605-610, November 2016. ISBN 978-1-138-02952-1, DOI: 10.1201/9781315364094. | Lini Mathew Shallu | |
| "Advance Approach towards Elbow Movement Classification using Discrete Wavelet Transform and Quadratic Support Vector Machine., Communication and Computing Systems", Taylor and Francis Group, London, pp. 839-844, November 2016. ISBN 978-1-138-02952-1, DOI: 10.1201/9781315364094 | P Kumari Narayan Ahlawat Lini Mathew Alokdeep | Y V |
| "EMG Signal Classification Using Discrete Wavelet Transform and Decision Tree classifier", International Journal of Control Theory and Applications, Vol.10, No. 6, pp. 411-424, 13, 2017. [Scopus Indexed] ISSN 0974-5572. | Yogendra Narayan Lini Mathew S Chatterji | |
| "Detection of Bearing Faults in Rotary Machine using Vibration Signatures", International Journal of Control Theory and Applications, Vol. 9, Issue No. 19, pp. 9107-9115, 2016. [Scopus Indexed] ISSN 0974-5572. | Pankaj Verma Sharma Mathew | Amandeep Lini |
| "Measurement of Soil Attributes Using NIR Spectroscopy: A Review", International Journal of Advance Research in Science and Engineering, Vol.5, No. 8, August 2016 | Babankumar S Bansod Ritula Thakur Vikash Yadav Neha Kamboj | |
| "Agricultural Robot: Intelligent Robot for Farming", International Advanced Research Journal in Science, Engineering and Technology, Vol.3, No.8, August 2016. | Nidhi Aggarwal Ritula Thakur | |
| "Design of an Agricultural Robot to Move between Rows", International Journal on Innovative Research in Science, Engineering and Technology, Vol.5, No. 8, August 2016. | Nidhi Aggarwal Ritula Thakur | |
| "Zigbee Based Smart Street Light Control System using LabVIEW", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 5, No. 4, April 2016. | Manish Kumar Ritula Thakur | |
| "Detection of Fluoride Ion in Water: An Optical Approach and Review", International Journal of Advanced Technology in Engineering and Science, (ISSN 2348-7550), Vol. 04, Issue 06, June 2016. | Neha Sahu Thakur Baban K Bansod | Ritula |
| "Density Independent and Temperature Compensated Moisture Prediction Model for Agricultural Products using Impedance Analyzer: A Review", International Journal of Advanced Engineering, Management and Science, Vol. 02, Issue 07, July 2016, Page no.-1129-1135. | Arti Sharma, Baban K Bansod Ritula Thakur | |
| "Power Quality Improvement using Passive & Active Filters", International Journal of Engineering Trends and Technology (IJETT), Vol. 36, No. 3, pp.130-136 June 2016 | Anuj Chauhan Ritula Thakur | |
| "Design of Shunt Passive Filter for Harmonic Mitigation", International Journal of Current Research, Vol. 8, Issue 06, pp.33307-33312, June, 2016. | Gagandeep Kaur Thakur | Ritula |
| "Harmonic Analysis of CFL and Incandescent Lamp", International Journal of Current Research, Vol. 8, Issue, 06, pp.33299-33303, June, 2016. | Gagandeep Kaur Ritula Thakur | |
| "Online Monitoring of Moisture Content in Transformer Oil", Global Journal of Engineering, Science and Research Management, Vol.3, No.4, April 2016. | Sandeep Kumar Ritula Thakur | |
| "Online Monitoring of Petroleum Fuel Parameters in Storage Tank Using Microcontroller", Global Journal of Engineering, Science and Research Management, Vol.3, No.4, April 2016. | Pankaj Joshi Ritula Thakur | |
| "Mitigation of Power Quality Problems using Unified Series Shunt Compensator in MATLAB/SIMULINK", International Journal of Management, IT & Engineering, Vol. 6, No. 11, November, 2016. | Pradeep Kumar Ritula Thakur | |
| "Pedestrian Aware Automatic Street Light using Motion Sensor", International Research of Advanced Engineering and Science, Vol. 1, No. 4, pp.1-4, 2016. | Manish Kumar Ritula Thakur | |

| | |
|--|--|
| “Sugar Analysis in Apple Juice by FTIR Spectroscopy with PLS Regression”, International Journal of Science, Technology and Engineering, Vol.2, No. 12, June 2016. | Sarvesh Singh Ritula Thakur |
| “PV Integration at IEEE 14 Bus System using 3-Phase 4-Leg Interfacing Inverter”, International Journal of Computer Technology & Applications, Vol 7(4),617-623, July-August 2016. | Prashant Kumar Shimi SL Arindam Chowdhury |
| “Automated Checking of PCB Circuits using Labview Vision Toolkit”, International Journal of Advance Research, Ideas and Innovations in Technology, ISSN: 2454-132X (Volume2, Issue4),July 2016. | Manoj Kumar Shimi SL |
| “Automated Supervision of PCB Circuits using MVI”, International Journal of Advance Research, Ideas and Innovations in Technology, Vol2, Issue 4, July 2016. | Manoj Kumar Shimi SL |
| “DSP-Based SVPWM Signal Generation Algorithm for Three Phase Inverter”, International Journal of Modern Electronics and Communication Engineering (IJMECE) ISSN: 2321-2152 Volume No 4, Issue No 6, November, 2016. | Karthar Singh Shimi SL |
| “Sensorless Control of Induction Motor: A Review”, International Journal of Engineering Research and Applied of Science Allied Science. ISSN : 24551 - 9660 , Vol 01 , issue 08, October 2016. | Karthar Singh Shimi SL |
| “Real Time Implementation of Hybrid Maximum Power Point Training (MPPT) for Solar PV System”, International Journal of Modern Electronics and Communication Engineering (IJMECE) ISSN: 2321-2152 Volume No 4, Issue No 6, November, 2016. | Ashish Thakur Shimi SL Ashutosh Dixit |
| “Low Cost Solar Powered Smart Management System for Indian Farming”, International Journal of Advance Research, Ideas and Innovations in Technology, ISSN: 2454-132X Impact factor: 4.295 (Volume3, Issue1), January 2017. | Nirdosh Kumar Shimi SL |
| “Smart Farming System for Indian Farmers using Arduino Based Technology”, International Journal of Advance Research, Ideas and Innovations in Technology, ISSN: 2454-132X Impact factor: 4.295 (Volume3, Issue1), January 2017. | Nirdosh Kumar Shimi SL |
| “Extensive Labview Based Power Quality Monitoring and Protection System”, International Journal of Advance Research, Ideas and Innovations in Technology Volume-2, Issue-4, July 2016. | Anurag Verma Shimi SL |
| “Arduino Based Low Cost Power Protection System”, International Journal of Advance Research, Ideas and Innovations in Technology Volume-2, Issue-4, July 2016. | Anurag Verma Shimi SL |
| “Elimination of Harmonics using Modified Space Vector Pulse Width Modulation Algorithm in an Eleven-level Cascaded H-bridge Inverter”, International Journal of Modern Electronics and Communication Engineering (IJMECE) ISSN: 2321-2152 Volume No.4, Issue No.6, November, 2016. | Jhalak Gupta Vimal Kumar Verma Shimi SL |
| “PMU-The Next Generation Tools for Smart Grid”, International Journal of Computer Technology & Applications, Vol 7(5),731-737, ISSN:2229-6093, September-October, 2016 | Arindam Chowdhury Shimi SL Prashant Kumar Ashutosh Dixit |
| “Design and Implementation of MPPT Technique Applied to Solar Wind Hybrid System”, International Journal of Advanced Research in Computer and Communication Engineering ISO 3297:2007 Certified Vol. 5, Issue 7, July 2016. | Praveen Shukla Shimi SL Lini Mathew |
| “A Review of Remote Patient Monitoring System: Potentials, Challenges and Current Issues”, International Journal of Trend in Research and Development, Volume 3(3), ISSN: 2394-9333, May-June 2016. | Amritjot Kaur Shimi SL |

| | |
|--|--|
| “Real Time Implementation of PV Fed IEEE Bus System Interfaced by 3-Phase 4-Leg Inverter Using OPAL-RT” , International Journal of Emerging Technology and Advanced Engineering, ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 7, Issue 3, March 2017. | Prashant Kumar Shimi SL Arindam Chowdhury |
| “Harmonic Elimination of a Photo-voltaic Based Cascaded H-bridge Multilevel Inverter using PSO (particle swarm optimization) for Induction Motor Drive, Energy” ,107, July, 2016, pp. 335- 346. | Shimi SL Thakur Kumar Tilak Jagdish |
| “Smart Vital Sign Monitoring System Based on LabVIEW Using Zigbee” , International Journal of Computer Technology & Applications (IJCTA), 9(16), pp. 8083-8094, 2016. | Amritjot Kaur Shimi SL |
| “Goods and Service Tax in India and its Impact on Indian Economy” , Vanijya Manthan, Journal of Commerce and Management, (ISSN No. 2350-0719, Vol 3, No.2, July – December., 2016). | SK Dhameja Deepak Kumar Manika |
| “Motivation behind Corporate Social Responsibility – A Case study of BHEL, India” , Vanijya Manthan, Journal of Commerce and Management, (ISSN No. 2350-0719, Vol 3, No.1, January – June, 2016). | SK Dhameja Madhulika Manika |
| Green Information Technology for A Sustainable Future” , Vanijya Manthan, SDCC’s Journal of Commerce & Management (ISSN No. 2350-0719; Vol. 03; No. 2; July – December, 2016). | Amardev Singh |
| “Development of Non-contact Structural Health Monitoring system for Machine Tools” , Journal of Applied Research and Technology, Elsevier, Vol. 14(4), 2016, pp. 245-258. | Goyal D BS Pabla |
| “Study of Variation of Groove Angle on Performance Characteristics of Two-Axial Groove Journal Bearing” , American Journal of Mechanical Engineering, 2016, Vol. 4, No. 3, pp. 82-91. | KR Kadam SS Banwait |
| “Experimental Investigation of Different Additives used for Surface Modification of EN31 Steel by EDM Process” , American Journal of Mechanical Engineering, 2016, Vol. 4, No. 6, pp. 226-235. | Rajeev Kumar SS Banwait |
| “Intelligent Tool Wear Monitoring in Machining Ti6Al4V Alloy using Support Vector Machines; (2016), Communication and Computing Systems” , CRC Press, Print ISBN: 978-1-138-02952-1, eBook ISBN: 978-1-315-31944-5, DOI: 10.1201/9781315364094-90, pp. 499-505. | Saini A Vanraj Goyal D Pabla BS Dhami SS |
| “Sound Emission based Sensor Location Optimization in Fixed Axis Gearbox using Support Vector Machines; (2016), Communication and Computing Systems” , CRC Press, Print ISBN: 978-1-138-02952-1, eBook ISBN: 978-1-315-31944-5, DOI: 10.1201/9781315364094-156, pp. 867-872. | Vanraj Saini A Goyal D Dhami SS Pabla BS |
| “Study on Formation of Wrinkles in Panel Drawing Operation using FEM; (2016), Communication and Computing Systems” , CRC Press, Print ISBN: 978-1-138-02952-1, eBook ISBN: 978-1-315-31944-5, DOI: 10.1201/9781315364094-6, pp. 23-29. | Jasleen Kaur SS Dhami Pabla BS |
| “Optimization of Condition Based Maintenance using Soft Computing: A Review; (2016), Neural Computing & Applications” , Springer, DOI: 10.1007/s00521-016-2377-6. | Goyal D Pabla BS Dhami SS Lachhwani K |
| “Condition Monitoring Indicators for Fault Diagnosis of Fixed-Axis Gearbox: A Review; (2016), Archives of Computational Methods in Engineering” , Springer, DOI: 10.1007/s11831-016-9176-1, pp. 1-14. | Goyal D Vanraj Pabla B S Dhami SS |
| “Design and Fabrication of a Strain Gauge Type 3-axis Milling Tool Dynamometer: Fabrication and Testing” , International Journal of Materials Forming and Machining Processes, Volume 3, Issue 2, July-December 2016, DOI: 10.4018 / IJMFMP. 2016070101. | SS Dhami et.al. |

| | |
|---|------------------------------|
| Chapter on A Treatise on Management and its Relevance in Contemporary Business Environment in book entitled “Reflection on Indian Management”, VSRD Academic Publishing Kanpur, India. | RK Wats Kamakshi Malik |
| “Impact of Residential Building Towers on the Ambient Air in Peri-Urban Areas of Chandigarh, UT, India”, Published in International Journal of Management and Applied Science. Vol:2, Issue 12, December 16, 2016. | Rakesh K Wats Meenu Wats |
| “Earthquake Resistant Interlinked Block Masonry System with Energy Dissipater Visco-elastic Links”, Journal of Practice Periodical on Structural Design and Construction, ASCE, pp-04017001-1-13. | Amit Goyal Pankaj Agarwal |
| "Use of Co-Polymer of Styrene Butadiene Rubber-A Seismically Innovative Approach towards Energy Dissipation", Elsevier Journal of Procedia Engineering, 173, pp-1800-1807. | Amit Goyal Pankaj Agarwal |
| “Fuzzy Goal Programming Applied to Multi-objective programming Problem with FREa as Constraints”, Decision Science Letters, 4(4) (2015), 465-476. | KC Lachhwani |
| “Corrigendum/Addendum to “Multi-objective Stochastic Linear Programming Problems when bi’s follow Weibull distribution” [OPSEARCH 50(2) (2013): 250-259], International Journal of Pure and Applied Mathematical Sciences, 8(2)(2015), 151-153. | KC Lachhwani |
| “Uncertain Multi-objective Programming Models: A Genetic Algorithm Approach”, International Journal of Mathematics in Operational Research (Inderscience). | KC Lachhwani |
| “Modified Fuzzy Goal Programming Procedure for Multi-objective Linear Plus Linear Fractional Programming Problem”, International Journal of Pure and Applied Mathematical Sciences, 8(2) (2015), 163-176. | KC Lachhwani |
| “Improving Structural Performance using Fibre in Concrete”, International Research Journal of Engineering & Technology (IRJET) – Vol-02, Issue-03/June 2015”. | Hemant Sood |
| “A Comparative Study of Varying Dosage of Different Air Entraining Agents for M35 & M40 Concrete Grades”, Indian Journal of Research. P-ISSN-2250-1991-Vol4. Issue 8, August, 2015. | Hemant Sood |
| “Analysis of M35 & M40 Grades of Concrete by DOE and BIS Methods of Mix Design on Replacing Fine Aggregates with Stone Dust”, Journal of Engineering Education by NITTTR, Publication, Chandigarh, (Aug-Dec, 2015). | Hemant Sood |
| “Evaluation of Different Grades of Concrete Designed as per BIS and USBR Methods using Rounded Aggregates”, International Research Journal of Engineering & Technology (IRJET) – Vol-02, Issue-01/Jan 2015, e-ISSN-2395-0056, P-ISSN : 2395-0072. | Hemant Sood |
| “Evaluation of M35 & M40 Grades of Concrete Designed as per ACI and DOE Methods using Rounded and Crushed Aggregates”, Journal of Engineering Education by NITTTR, Publication, Chandigarh, (Aug-Dec, 2015). | Hemant Sood |
| “Comparative Study of M35 & M40 Grades of Concrete by USBR and BIS Methods of Mix Design – Journal of Engineering Education by NITTTR, Publication, Chandigarh, (Aug-Dec, 2015). | Hemant Sood |
| “Evaluating M35 & M40 Grades of Concrete by ACI, DOE, USBR and BIS methods of Mix Design” in IRJET-Vol. 02, August, 2015. | Hemant Sood |
| “Analysis of M35 & M40 Grades of Concrete by ACI and USBR Methods of Mix Design on Replacing Fine Aggregates with Stone Dust”- International Research Journal of Engineering and Technology (IRJET) – Vol-02 : Issue 05/Aug, 2015. | Hemant Sood |

| | | |
|---|-----------------------|-------|
| “Comparative Study of Varying Dosage of Different Plasticizers for Standard Concrete of Grades M35 & M40” – Journal of Engineering & Technology Education – Vol.9, No.2 (July-Dec, 2015). | Hemant Sood | |
| “Geopolymer Concrete – Eco Friendly” – International Journal of Innovation in Engineering and Technology (Vol. 6, Issue 2 , Dec, 2015). | Hemant Sood | |
| “Development of Timbercrete by Replacing Coarse Aggregate with Sand Dust” – International Journal of Civil Engineering (IJCE) – Vol. 2, Issue – 2 (Sep 2015). | Hemant Sood | |
| “Effect of Hydrochloric Acid in Mixing and Curing Water on Strength of Concrete” – International Journal of Civil Engineering (IJCE) – Vol. 2, Issue – 2 (Sept. 2015). | Hemant Sood | |
| “Effect of Concentration of Alkaline Water on Strength of Concrete” – International Journal of Civil Engineering (IJCE) – Vol. 2, Issue – 2 (Sept. 2015). | Hemant Sood | |
| “An Experimental Study on Correlation Between California Bearing Ratio (CBR) and Dynamic Cone Penetration Test (DCPT)”, IJMTER PP 15-19 ISSN (Online) 2349-9745 ISSN (PRINT) 2393-8161. | AK Duggal Kumar | Vinod |
| “Soil Stabilization Using Shredded Rubber Tyre : A Review”, International Journal of Civil and Structural Engineering Research ISSN 2348-7607 Vol. 3 issue1, PP 57-60, April 2015-Sept., 2015. | Vinod Kumar Duggal | AK |
| “Review on Stabilization of Soil Using Polypropylene as Waste Fibre Materials”, IJIRSET Vol.4, Issue11, Nov, 2015. | Vinod Kumar | |
| “Effect of Partial Replacement of Sand with Municipal Solid Waste Ash on the Strength of Concrete”, The Indian Concrete Journal, October 2014, Vol. 88, Issue 10, pp. 65-73. | SK Sharma | |
| “Abrasion Resistance Strength Properties of Concrete Containing Municipal Solid Waste Ash”, The Indian Concrete Journal, 2015, vol. 89, Issue 3, pp. 22-29. | SK Sharma | |
| “Utilization of Waste Foundry Sand in Geopolymer Concrete”, International Research Journal of Engineering and Technology, in IRJET Journal Vol. 2, Issue 2, May 2015. | SK Sharma | |
| “Site Safety and Planning for Building Construction”, International Research Journal of Engineering and Technology, in IRJET Journal Vol. 2 Issue 2, May 2015. | SK Sharma | |
| “Evaluation of Stipulated Conditions Imposed at the Time of Grant of Environment Clearance from the Perspective of implementation of Compliance–A Case Study for Construction Projects in India”, Chinese Journal of Urban and Environmental Studies Vol.3, No.1(2015) 1550006. | SK Sharma | |
| “Structural Characteristics of HPDSP Concrete on Beam Colum Joints”, Journal International Science Index 17, 2015, eISSN : 1307-6892, September 28-29, 2015, Los Angeles, USA. | SK Sharma | |
| “Structural Characteristics of HPDSP Concrete : An overview, Proceeding of ICRTET 2015, 4th” International Conference of Recent Trends in Engineering & Technology, July, 2015 McGraw Hill Publication, at Nashik Maharashtra. | SK Sharma | |
| “Effect of Partial Replacement of Sand with Foundry Slag on Strength of Concrete”, The Indian Concrete Journal, July, 2015, Vol. 89, Issue 7, pp 64-73. | SK Sharma | |
| “Performance Characteristics of HPDSP Concrete : An overview HPRCC-7”, 7th RILEM Workshop on High Performance Fibre Reinforced, Cement Composites, Stuttgart, Germany June 1-3, 2015. | SK Sharma | |

| | | |
|---|-------------------------------------|---------------|
| “Subgrade Soil Stabilization using Fines Obtained from Demolished Concrete Structures”, International Research Journal of Engineering and Technology, Vol.2, Issue 1, 2015. | Vinod Kumar | |
| “An Experimental Study on Correlation between California Bearing Ratio (CBR) and Dynamic Cone Penetration Test (DCPT)”, International Journal of Modern Trends in Engineering and Research (IJMTER), Vol. 02, Issue 08, August-2015. | AK Duggal Kumar | Vinod |
| “Soil Stabilisation using Shredded Rubber Tyre: A Review”, Vol. 3, Issue 1, pp : (57-60), April, 2015 to Sept., 2015. | AK Duggal Kumar | Vinod |
| “Improvement of Subgrade by RBI Grade 81 and Pond ASH”, International Research Journal of Engineering and Technology (IRJET), Vol. 02, Issue: 02, Aug, 2015. | AK Duggal | |
| “Condition Assessment of RCC Bridges”, Journal of Engineering & Technology Education; Vol.9, No.1, January-June, 2015, ISSN, 2229-631 x, P 34-38. | Himmi Gupta | |
| “An Efficient Cluster-based Multi-Keyword Search on Encrypted Cloud Data”, International Journal of CSI Communications, Vol.39 Issue 3, pp. 20-27, June 2015. | Rohit Handa Ramakrishna | C |
| “Compressing the Data Densely by New Geflochtener to Accelerate Web”, International Journal of Computer Applications, Vol. 94, Issue10, pp. 12-17, May 2015. | HK Saini Kushwaha Ramakrishna | SS C |
| “Data Relationship Degree Based Clustering Data Aggregation for VANET”, International Journal of Electronics, Taylor & Francis, Vol. 103, Issue 3, 2016, pp. 485-503. | Rakesh Kumar Dave | Mayank |
| A Novel Framework for Secure File Transmission using Modified AES and MD5 Algorithms”, International Journal of Information and Computer Security, Vol-7, Issue-2/3/4, 2015, pp. 91-112. | Rakesh Kumar Mahajan | |
| “DDDR: Decentralized Data Dissemination in VANET Using Raptor Codes”, International Journal of Electronics, Taylor & Francis, Volume-102, Issue-6, Jun 2015, pp. 946-966. | Rakesh Kumar Dave | Mayank |
| “Green Telecommunication: Life Cycle Assessment of Energy Efficient Wireless BTS”, International Journal of Advanced Research in Computer Science and Software Engineering, Vol. 5, Issue 10, 2015, pp. 186-189. | Rakesh Mathur Rakesh Kumar | |
| “Secured Image Transmission Using A Novel Neural Network Approach And Secret Image Sharing Technique”, International Journal of Signal Processing, Image Processing and Pattern Recognition (IJSIP), Vol. 8, Issue 1, 2015, pp. 161-192. | Rakesh Kumar Dhiman | |
| “A Survey of Mobile Cloudlets Based Computing System”, Journal of Algorithms, Computer Network, and Security, Austria, Vol-1, Issue-2, pp. 1-7, Mar 2016. | Rakesh Kumar Yadav | SK |
| “Event-Triggered Localization Algorithm Based On RF with IR Fingerprint and RSSI with PSO Techniques”, American International Journal of Research in Science, Technology, Engineering & Mathematics, Issue-13, Vol-1, pp. 66-72, Feb, 2016. | A A Saihood Kumar Hamad | Rakesh A M |
| “Recommender System using Collaborative Filtering and Demographic Characteristics of Users”, International Journal of Recent and Innovative Trends in Computing and Communication (IJRITCC), Vol. 3, Issue 7, July 2015, pp. 4735-4741. | Shano Solanki Shalini Batra | |
| “Effective Review of Multiprocessor Scheduling in Cloud Infrastructure”, International Journal of Enterprise computing and Business Systems (IJECS), Vol. 5, Issue 2, July 2015. | Marish Kumar | Amit Doegar |
| “Automatic Detection of Sickle Cell in Red Blood Cell using Watershed Segmentation”, International Journal of Advanced Research in Computer and Communication Engineering, Volume 4, Issue 6, June 2015. | Shashi Bala Doegar | Amit |

| | | |
|--|--------------------------------------|-------------------|
| "An effective Approach for Face Recognition using PCA and LDA on visible and IR Images", International Journal of Computer Trends and Technology (IJCTT) Vol. 32, 01 February, 2016. | Rupish Arora Doegar | Amit |
| "A Review of Metaheuristic Scheduling Techniques in Cloud Computing", Egyptian Informatics Journal, Vol. 16, Issue 3, pp. 275-295, November 2015. | Mala Kalra Singh | Sarbjee |
| "Workflow Scheduling Using Hybrid Discrete Particle Swarm Optimization (HDPSO) in Cloud Computing Environment", International Journal of Innovative Research in Computer and Communication Engineering, 3(12):12301-12307, 2015. DOI: 10.15680/ IJIRCC. 2015.0312059 | Purnima Devi Mala Kalra | |
| "Lossless Image Compression of Medical Images Using Golomb Rice Coding Technique", International Journal of Advances in Computer Science and Information Technology, Vol.2 No.120, pp 30-34, April 2015. | Girish Gangwar Dutta Gaurav Gupta | Maitreyee |
| "Image Encryption and Compression using Prediction Error K-Mean Clustering and Cyclic Permutation", International journal of Advance Research in Computer Science and Management Studies, Vol 3, Issue 4, May 2015. | Parveen Kumar Dutta | Maitreyee |
| "An Improved Single Packet IP Traceback for D/DOS Attack", International Journal of Applied Engineering Research, ISSN 0973-4562, vol. 10, No 44, May, 2015,pp 30723-30728 (SCOPUS Indexed) | Kamaldeep Malik Maitreyee Dutta | Manisha |
| "Comparative Analysis of Blind and nonBlind Deconvolution techniques of various blurs", International Journal of Applied Engineering Research, ISSN 0973-4562, vol. 10, No 44, May, 2015, pp-30843-30850 (SCOPUS Indexed) | Ashish Kalia Dutta | Maitreyee |
| "Security Analysis of Web Log Files against IP Spoofing and Brute Force Attack using Genetic algorithm and Neural Network", International Journal of Advanced Information Science and Technology, vol. 39, no.39, July 2015, pp 116-111 IF: 3.564 (SCOPUS Indexed) | Neha Dutta | Maitreyee |
| "An Integrated Approach for Digital Image Inpainting", International Journal of Advanced Information Science and Technology, vol. 39, no.39, July 2015, pp 71-79 IF: 3.564, (SCOPUS Indexed) | Lavina Kalra Dutta | Maitreyee |
| "A Proposed Work on Segmentation Based Enhancement of Medical Images for Rapid Diagnosis in Telemedicine", International Journal of Engineering and Technology, vol. 7 No 4, ISSN: 0975-4024, September, 2015 | Sanyam Anand Dutta | Maitreyee |
| "Optimal Priority Based Service Broker Policy in Cloud Computing", International Journal of Advanced Information Science and Technology, vol. 40, No.40, August, 2015 (SCOPUS INDEXED) | Pawan Kumar Dutta | Maitreyee |
| "Performance Analysis of Hadoop Mapreduce on Amazon EC2 vs. Microsoft Azure Cloud Services, International Journal of Advance Information Science and Technology (IJAIST) (SCOPUS Indexed) | Aditya Bhardwaj Dutta | Maitreyee |
| "Sentiment Analysis for Indian Stock Market Prediction Using Sensex and Nifty" EISEVIER (SCI indexed), Proceedia Computer Science, 70 (2015) 85-91 | Aditya Bhardwaj Dutta | Maitreyee |
| "Time and Accuracy Analysis of Skew Detection Methods for Document Images" International Journal of Information Technology and Computer Science, 2015, 11, 43-54 | Sunita Mehta Walia Dutta | Ekta Maitreyee |
| "MetaHeuristics Based Approach for Workflow Scheduling in Cloud Computing: A Survey, Proceedings of Artificial Intelligence and Evolutionary Computations in Engineering Systems, Springer AISC (Advances in Intelligent Systems and Computing) Series Vol 394, pp 1331-1345 | Poonam Dutta Naveen Aggarwal | Maitreyee |

| | | |
|--|--------------------------------|--------------|
| "Area and Power Efficient Hybrid Reversible Shift Register", International Journal of Advanced Information Science & Technology (IJAIST), Volume 39, No. 39, pp. 13-19, July 2015, I.F: 5.032. | Anju Devi Mehra | Rajesh |
| "Pulse Triggered Flip Flop Design Using Signal Feed Through Scheme for Area and Power Reduction", International Journal of Advanced Information Science & Technology (IJAIST), Volume 39, No. 39, pp. 7-12, July 2015, I.F: 5.032. | Neha Thapa Mehra | Rajesh |
| "Layout Design of CMOS Buffer to Reduce Area and Power", International Journal for Innovative Research in Science & Technology (IJIRST), Volume 2, No. 1, pp. 22-25, June 2015, I.F: 3.55. | M S Mahoob Mehra | Rajesh |
| "FPGA Based Design of Speed Efficient Vedic Multiplier", International Journal of Electronics, Electrical & Computational Systems, Volume 4, No. 1, pp. 94-98, March 2015. ISSN: 2348-117x, I.F: 2.52. | Arushi Garg Mehra | Rajesh |
| "Image Restoration and Comparative Analysis", International Journal of Engineering Trends & Technology (IJETT), Volume 27, No. 4, pp. 195-200, September 2015, I.F: 1.795 | Parul Gupta Mehra | Rajesh |
| "Efficient Layout Design of 4-Bit Full Adder Using Transmission Gate", International Journal of Computer Trends & Technology (IJCTT), Volume 23, No. 3, pp. 116-119, May 2015, I.F: 1.51 | Anurag Yadav Rajesh Mehra | |
| "Power and Area Analysis of Flip Flop Using Different Techniques", International Journal of Computer Trends & Technology (IJCTT), Volume 24, No. 2, pp. 57-62, June 2015, I.F: 1.51. | Neha Thapa Mehra | Rajesh |
| "Enhancement of SR Flip Flop Layout Design in 45nm Technology", International Journal of Computer Trends & Technology (IJCTT), Volume 25, No. 3, pp. 118-121, July 2015, I.F: 1.51. | Avneet Kaur Mehra | Rajesh |
| "Design of Low Power High Performance JK Flip Flop", International Journal of Scientific Research Engineering & Technology (IJSRET), pp.1-4, March 2015. ISSN: 2278-0882, I.F: 1.24. | Pinki | Rajesh Mehra |
| "Design and Implementation of S R Flip Flop for Efficient Power Using CMOS 90 nm Technology", International Journal of Scientific Research Engineering & Technology (IJSRET), Volume 4, No. 5, pp. 480-483, May 2015, I.F: 1.24. | Anjana S Mehra | Rajesh |
| "Area Efficient Layout Design Analysis, "International Journal of Scientific Research Engineering & Technology (IJSRET), pp. 57-60, March 2015. ISSN: 2278-0882, I.F: 1.24. | Renuka Verma Mehra | Rajesh |
| "Area Efficient Layout Design & Analysis of Full Subtractor", International Journal of Scientific Research Engineering & Technology (IJSRET), pp.173-177, March 2015. ISSN: 2278-0882, I.F: 1.24. | Anamika Sharma Mehra | Rajesh |
| "Design and Performance Analysis of Area Efficient CMOS Decoder", International Journal of Scientific Research Engineering & Technology (IJSRET), pp.43-48, March 2015. ISSN: 2278-0882, I.F: 1.24. | Vanshika Singh Rajesh Mehra | |
| "Reduced Rate of Energy Consumption in WSN With Dual Cluster Heads", International Research Journal of Engineering and Technology (IRJET), Vol.2 Issue 4, pp. 1126- 1129, July 2015 , e-ISSN: 2395-0056 ,p-ISSN: 2395-0072. | Neelam Ojha Sharma | Kanika |
| "An Energy Efficient Unequal Clustered Based Multi-Hop Routing Protocol for WSN", International Research Journal of Engineering and Technology (IRJET), Vol.2 Issue 4, pp. 1130-1133, July 2015, e-ISSN: 2395-0056, p-ISSN: 2395-0072. | Neelam Ojha Sharma | Kanika |
| "Review Paper on Routing Protocol in WSN", International Journal of Exploring Emerging Trends in Engineering (IJEETE), Vol.2 Issue 3, pp. 94-99, May- June 2015, ISSN – 2394-0573 | Neelam Ojha Sharma | Kanika |

| | | |
|--|--|--------|
| "Design Low Noise Digital decimation Filter for Sigma- Delta ADC", International Journal of Scientific Research and Management (IJSRM), Vol. 3, Issue 6, pp.519- 524, June 2015, Online ISSN : 2321-3418. | P K Singh Sharma | Kanika |
| "A Survey: Design Low Noise Digital Decimation Filter for Sigma-Delta-ADC", International Journal of Engineering and Technology Research (IJETR), Vol. 3, Issue 4, pp. 154-156, April 2015, ISSN: 2321-0869. | P K Singh Sharma | Kanika |
| "Design and Implementation of High Speed Area Efficient Double Precision Floating Point Arithmetic Unit", IOSR Journal of Electronics and Communication Engineering (IOSR-JECE), Vol. 10, Issue 1, pp 49-54, Jan.-Feb. 2015, e-ISSN: 2278-2834, p-ISSN: 2278-8735. | Onkar Singh Sharma | Kanika |
| "A Hardware Efficient Robust Digital Image Watermarking Algorithm using Integer DCT", International Journal of Engineering Trends and Technology, Vol. 25, Issue 2, pp 89-95, July 2015. | Gaurav Gupta Kanika Sharma | |
| "Image Watermarking and its Hardware Realization: A survey", International Journal of Electrical and Electronics Engineering, Vol. 2, Issue 4, pp 20-21, August 2015, e-ISSN: 1694-2310, p-ISSN: 1694-2426. | Gaurav Gupta Kanika Sharma | |
| "Influence of Oxide Layer Thickness on Magnetic Tunnel Junction Based Logic Computation", IJEEE, Volume 2, Issue 4, pp. 13-19, August, 2015, e-ISSN: 1694-2310 p-ISSN: 1694-2426. | Pawan Choudhary Sharma Sagar Balecha A Singh Boparai | Kanika |
| "A Review on Magnetic Tunnel Junction Technology," International Research Journal of Engineering and Technology (IRJET), Volume 02, Issue 04, PP. 1635- 1639, July-2015, e-ISSN: 2395 -0056, p-ISSN: 2395-0072. | Pawan Choudhary Sharma Sagar Balecha Bhaskar Mishra | Kanika |
| "Op-amp Selection for Transimpedance Amplifier Design", IJEEE, Volume 2, Issue 4, pp. 8-12, August, 2015, e-ISSN: 1694-2310 , p-ISSN: 1694-2426. | Bhaskar Mishra Sharma Pawan Choudhary | Kanika |
| "Design of Planar Inverted F Antenna for Multiband Applications," International Journal of Electrical and Electronics Engineering, Vol. 2, Spl. Issue 1, pp. 181-183, May, 2015. | Praveen Kumar Garima Saini | |
| "Comparative Analysis of PIFA and PIFA with Metamaterial Lenses," International Journal of Electrical and Electronics Engineering, Vol. 2, No .2, pp.4-7, June, 2015. | Praveen Kumar Garima Saini | |
| "Nonlinear Interference Suppressor for LTE in Multimode Environment: A Survey", IOSR Journal of Electronics and Communication Engineering, e-ISSN:2278-2834, pp. 19-22, 2015. | Divya Garima Saini | |
| "A Hybrid Approach to Improve PAPR Analysis of MIMO-OFDM Systems," International Journal of Electrical and Electronics Engineering, Volume 2, Special Issue 1, pp.123-127, 2015. | R L Shukla Saini | Garima |
| "A Review Paper on: The PAPR in MIMO-OFDM Systems," International Journal of Advance Information Science and Technology, Vol. 39, No. 39, pp.151-155, May, 2015. | R L Shukla Saini | Garima |
| "A Review on Beamforming Techniques in Wireless Communication," International Research Journal of Engineering and Technology (IRJET) Volume: 02 Issue: 05, pp. 715-720, e-ISSN: 2395-0056, p-ISSN: 2395-0072, August, 2015. | Hemant Garima Saini | |
| "Co Channel Interference Rejection of OFDM Signals using Frost Beamforming Technique," International Journal of Research in Advent Technology, Vol.3, No.8, pp. 61-67, ISSSN No. -2321-9637. August, 2015. | Hemant Saini | Garima |
| "Strain Sensor for Strain Measurement: A Review," International Journal of Electrical and Electronics Engineering, Volume 1, Spl. Issue pp. 144-146, May 2015. | Shivendra Saini | Garima |
| "A Survey of Bio Inspired Algorithm Based Image Enhancement," International Journal of Innovation and Advancement in Computer Science, Vol. 4, No. 8, pp. 1-4, August, 2015. | Lalit Maurya Garima Saini | |

| | |
|---|--|
| “Techniques Based on Resource Allocation in Chunk Based OFDMA: A survey”, International Journal of Advanced Engineering Research and science, Vol. 2, No.12, pp. 37-40, December, 2015. | M K Yadav Garima Saini |
| “Different Propagation Modelling Tools used for Various Indoor and Outdoor Scenarios”, International journal of Electrical, and Electronic Engineering & Telecommunications, Vol. 1, Spl. Issue No.2, pp. 40-55, July, 2015. | Ranjeeta Verma Garima Saini |
| “Common Path Optical Coherence Tomography Using Optical Conventional Tiny Probe in Frequency Domain”, International Journal of Engineering Research, Vol. 3, Issue. 5, September-October, 2015. | Shekhar Srivastava Garima Saini |
| “ICI Reduction Technique for OFDM Systems Using Combining Weight Technique”, International Journal of Emerging Technology and Advance Engineering, Vol. 6, Issue. 1, pp. 136-140, January, 2016. | Md. Jafir Alam Garima Saini |
| “A Review on Future Planar Transmission Line”, Cogent Engineering, Vol.3, Issue 1, pp. 1-12, January, 2016. | Ashok Kumar Garima Saini Shailendra Singh |
| “Experimental Analysis of Cellular Outdoor Propagation at 1800MHz over Dense urban regions of Ghaziabad”, International journal of Engineering & Technology, Vol. 8, No. 1, pp. 396-404, February-March, 2016. | Ranjeeta Verma Garima Saini Chhaya Dalela |
| “Training of Teachers Through Face to Face Contact Mode and Online”, Journal of Engineering Education Transformation (29:1), p.67-72. (2015). | PK Tulsi MP Poonia Anku Bala |
| “Learning Style of Students Pursuing Masters in Engineering”, Journal of Engineering Education Transformation , Special Issue, January, 2016. | PK Tulsi MP Poonia Anu Priya |
| “An Empirical Study of Leadership and Motivational factors for Successful Implementation of QM Practices in Small and Medium scale & Large scale Electronic Industry in Northern India” (Scopus Indexed Journal) International Journal of Advanced Information Science and Technology; Vol. 40, No. 40, August, 2015, 26-44p; ISSN 2319-2682. | S Dey Sunil Dutt S Sharma |
| “A Comparative Study of Application of Quality Management Practices and their Benefits between Small and Medium Scale Versus Large Scale Electronic Industries in Northern”, International Journal of Applied Engineering Research; Vol. 10, No. 44, 2015, 31856-31864p; ISSN 0973-4562. | S Dey Sunil Dutt S Sharma |
| “Effect of Online Learning in Psychology Course on Undergraduate Students’ Engagement in Learning”, Published in Issues and Ideas in Education, Vol. 4; Number 1; March, 2016; Print ISSN No. 2320-7655; Online ISSN No. 2320-8805. | Ambalika Dogra Sunil Dutt |
| Watershed Management Structures and Decision Making Framework”, Water Resource Management Volume 29 No.12 (ISSN 0920-4741) published for the European Water Resource Association (EWRA) by Springer, 19 August, 2015. | A K Mishra Pachouri Kaur Ankit Amandeep |
| “Assessment of Fault Diagnosis Techniques of Induction Motors”, International Journal of Advances in Electrical and Electronics Engineering (IJAEIE), Vol.5, No. 1, pp.21-27, 2015, EISSN No. 2319-1112. | Amandeep Sharma S Chatterji Niranjan Gupta Lini Mathew |
| “Controlling of Temperature & Humidity for an Infant Incubator using Microcontroller”, International Journal of Advanced Research in Electrical, Electronics & Instrumentation Engineering IJAREEIE, Vol. 4, Issue-6, June 2015. | Hitu Bansal Gupta Ashish Lini Mathew |
| “A review of Fault Diagnostic & Monitoring Schemes of Induction Motors”, International Journal for Research in Applied Science & Engineering Technology (IJRASET), Vol.3, Issue-4, April 2015. | Amandeep Sharma Mohd. Junaid Khan S Chatterji Lini Mathew |

| | | |
|---|---|----------------------|
| “Design and Implementation of Multi Agent System in IDAPS Micro Grid for Optimal Load Scheduling Network “, International Journal of Advance Technology in Engineering and Science, Vol 3, Issue 4, April 2015. | MK Bhardwaj S Chatterji | Shimi SL |
| “Harmonic Elimination in Cascade Multilevel Inverter with Non Equal Dc Sources Using Genetic and Differential Evolution Algorithm”, IJSET - International Journal of Innovative Science, Engineering & Technology, Vol. 2 Issue 5, May 2015. | Sudhakar V Pawar | Shimi SL |
| “Harmonic Elimination in Cascade Multilevel Inverter with Non Equal DC Sources using Genetic Algorithm”, International Journal of Advanced Research in Computer and Communication Engineering Vol. 4, Issue 6, June 2015. | Sudhakar V. Pawar | Shimi SL |
| “Management of Micro Grid with Multi Agent System”, International Journal of Engineering Research Online, Vol 3, Issue 3, ISSN 2321-7758, 2015. | MK Bhardwaj | Shimi SL |
| “Robust Crone Control for Quadrotor type UAV’s”, International Journal of Innovative Research in Science , Engineering and Technology – ISSN (online 2319-8753), ISSN (Print 2347 - 6710) , Vol 4, Issue 8, August 2015. | Geetanjali Pal | Shimi SL |
| “Fractional Order Control for Quad Rotor Type UAV’s”, International Journal of Engineering and Innovative Technology , Vol 4, Issue 11, May 2015. | Geetanjali Pal | Shimi SL |
| “A Microcontroller Based Hygrometer for Moisture Level Measurement”, International Journal of Advanced Research in Computer Science and Software Engineering, Volume 5, Issue 7, July 2015 | Meraj Ahmad | Shimi SL |
| “Capacitive Humidity Sensor -Design and Its Application in Measurement Science”, International Journal on Recent Technologies in Mechanical and Electrical Engineering (IJRMEE), ISSN: 2349-7947, Volume: 2, Issue: 10 pp. 039-041, October 2015. | Meraj Ahmad | Shimi SL |
| “Voice Recognition Based Home Automation System for Paralyzed People –A Review”, International Journal of Engineering Research and General Science, Volume 3, Issue 5, September-ISSN 2091-2730, October 2015. | Mukesh Kumar | Shimi SL |
| “Voice Recognition Based Home Automation System for Paralyzed People”, International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE) Volume 4, Issue10, October 2015. | Mukesh Kumar | Shimi SL |
| “Development of Multi-grain Capacitive Sensor for Determination of Moisture Content in Grains”, Quality Assurance and Safety of Crops and Food, Vol. 7(2), pp 201-206, 2015. | Ritula Thakur Chatterji BS Bansod | S Amod Kumar |
| “Analysis of Milk Adulteration Using MID-IR Spectroscopy”, International Journal of Engineering Technology, Management and Applied Science, Volume-3 Issue-5 pp-696-698, September –October 2015. | Kunal Kishore Thakur | Ritula |
| “Microcontroller Based Automatic Sprinkler Irrigation System”, International Journal of Modern Engineering Trends(IJMER), Volume 5, Issue 4, April 2015. | Jagdeep Daljit Singh | Ritula Thakur |
| “High Temperature Superconducting Techniques and its Applications”, International Journal of Engineering Technology, Management and Applied Sciences, Volume 3, Issue 5 pp-286-294, May-2015. | Ritula Thakur Chawla | Puneet |
| “Soil pH Sensing Techniques and Technologies”, International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Volume- 4, Issue 5, May-2015. | Sachin Kumar Bansod Manish Kumar | B S Ritula Thakur |
| “Calculative Analysis of 11KV Urban Distribution Feeder”, International Journal on Recent Techniques in Mechanical and Electrical Engineering, Volume-2 Issue-8 pp-74-84, August 2015. | Ritula Thakur Chawla | Puneet |
| “Determination of Grain Moisture Content Using FTIR Spectroscopy”, International Journal of Scientific Research, Volume 4, Issue 10, October 2015. | Supriya | Ritula Thakur |

| | | |
|---|--|---------------------------|
| “Analysis and Review of Possible e-pill with Wireless Communication, Finding Applications in Biomedical”, Journal of Engineering & Technology Education, Volume 9, No.1, January-June 2015. | Ajay Sharma Thakur | Ritula Abhishek Mishra |
| “Analysis of Milk Adulteration Using MID-IR Spectroscopy”, International Journal on Recent and Innovation Trends in Computing and Communication (IJRITCC), Volume 3 Issue 10, pp. 5890 – 5895, October 2015. | Kunal Kishore Thakur | Ritula |
| “Determination of Grain Moisture Content Using FTIR Spectroscopy Paripex”, - Indian Journal of Research, Vol. 4, Issue. 10, October 2015. | Supriya | Ritula Thakur |
| “A Review of PROFINET Fieldbus System”, International Research Journal of Engineering and Technology, Vol. 2, Issue 8, November, 2015. | Varun | Ritula Thakur |
| “The Role of Modular Programming in Industrial Control System”, International Research Journal of Engineering and Technology, Vol. 2, Issue 9, December, 2015. | Varun | Ritula Thakur |
| “Analysis of Peanut Seed Oil by NIR”, American Journal of Analytical Chemistry, Vol. 6, pp. 917-922, 2015. | BS Bansod Thakur | Ritula Ron Holser |
| “Determination of Sugar Content in Apple Juice using FTIR Spectroscopy: A Review”, International Journal of Sciences & Applied Research. | Sarvesh Singh Thakur | Ritula |
| “A Low Cost Non-Destructive Grain Moisture Embedded System for Food Safety and Quality”, World Academy of Science, Engineering and Technology, International Science Index, Nutrition and Food Sciences (2015), 2(2), 264. | Ritula Thakur Bansod S Chatterji | BS P Mehta |
| “Reduction on GHGs Effects and Emission Possible by Energy Efficient HTSrs”, International Journal of Engineering Technology, Management and Applied Sciences, Volume 3, Issue 12, pp.1-11, December 2015. | Ritula Thakur Chawla | Puneet |
| “Voltage drop calculations & design of urban distribution feeders”, IJRET: International Journal of Research in Engineering and Technology, Volume: 04 Special Issue: 12, Oct-2015. | Ritula Thakur Chawla | Puneet |
| “Safety and Security System for House Boats”, International Journal of Innovations in Engineering and Technology , Vol 6, No.1, pp 65-73, October 2015 | B Indulal | Shimi SL |
| “Implementation of Safety and Security System for House Boats using PIC Microcontrollers”, International Journal of Engineering Research and Technology , Dec 2015, http://dx.doi.org/10.17577/IJERTV41S110235 . | B Indulal | Shimi SL |
| “Design and Fluid Structure Interaction Analysis of a Micro-Channel as Fluid Sensor”, Advanced Engineering Forum Vol. 14 pp.46-56, 2016, ISBN-13: 978-3-03835-887-9. | Vandana Sharma Saleem Khan | Shimi SL Sandeep Arya |
| “Home Automation and Energy Management Using Smart Phone”, International Journal for Research in Applied Science and engineering Technology , Vol 3, Issue X , Oct 2015, ISSN No. 2321-9653. | Amit Dwivedi | Shimi SL |
| “Home Automation and Energy Management using Android App”, International Journal of Engineering Research & Technology, Volume. 4 - Issue. 12 , December – 2015. | Amit Dwivedi | Shimi SL |
| “ANN Based Age Estimation of In Service Transformer Oil Samples”, International Journal on Recent Technologies in Mechanical and Electrical Engineering Vol 2 ,issue 11, November 2015. | Mohd. Aslam Ansari | Shimi SL |
| “Development of ANN and ANFIS Models for Age Prediction of in Service Transformer Oil Samples”, International Journal for Innovative Research in Science and Technology , Vol 2, Issue 7, December 2015. | Mohd. Aslam Ansari | Shimi SL |
| “Online Condition Assessment of Transformer Oil for Incipient Fault Detection”, International journal of science research engineering and technology. Vol. 4 Issue 10,pp.991-997, October 2015. | Kamini Devi | Shimi SL |

| | | |
|--|--|------------|
| “Design of Online Condition Assessment of Transformer Oil for Incipient Fault Detection”, International journal of engineering trends and technology, Vol 31 no.2 pp.59-68, January 2016. | Kamini Devi | Shimi SL |
| “Condition Based Maintenance of Machine Tools-A Review”, CIRP Journal of Manufacturing Science and Technology, Elsevier , Vol.10, pp. 24-35 (2015) | D Goyal Pabla | BS |
| “Experimental Investigation and Optimization of Machining Characteristics in Ultrasonic Machining of WC-Co Composite Using GRA Method”, Journal of Materials and Manufacturing Processes, April, 2015, pp. 921-933 | BS Pabla | R Kataria |
| “Precision Finishing of External Cylindrical Surfaces of En8 Steel by Electro Chemical Honing (ECH) Process using OFAT Technique”, Journal of Materials Today Proceedings, 2 (2015), pp. 3220-3229. | PS Rao | DK Dwivedi |
| “Seismic Performance Evaluation of Innovative Inter-Linked Block Masonry System with Viscoelastic Link Elements”, The Masterbuilder, August 2015, Vol.17, NO. 8, 112-115 | Amit Goyal Agarwal | Pankaj |
| “Seismic Performance Evaluation of Inter-Linked Block Masonry System with Vicoelastic Link Elements”, Surface Reporter Magazine , August 2015, 99. | Amit Goyal Agarwal | Pankaj |
| “Shake Table Testing of Seismic Resistant Inter-Linked Block Masonry System with Vicoelastic Energy Elements Links”, Published Proceedings of the International Seminar on Emerging Building Material and Construction Technology, March 2016, New Delhi, 251-258. | Amit Goyal Agarwal | Pankaj |
| “Smartphone Based Context-Aware iver Behavior Classification using Dynamic Bayesian Network”, Journal of Intelligent and Fuzzy Systems, IOS Press, (Preprint), 1-14. | Rishu Chhabra, C. Rama Krishna and Seema Verma | |
| “Keyword Binning-Based Efficient Search on Encrypted Cloud Data,” Arabian Journal for Science & Engineering, Springer, DOI: 10.1007/s13369-018-3580-9, 2018. | Rohit Handa, C. Rama Krishna and Naveen Aggarwal | |
| “Searchable Encryption: A Survey on Privacy-Preserving Search Schemes on Encrypted Outsourced Data,” Concurrency Computation Practice and Experience, Wiley, DOI: 10.1002/cpe.5201, 2019. | Rohit Handa, C. Rama Krishna and Naveen Aggarwal | |
| “An Efficient Approach for Secure Information Retrieval on Cloud,” Journal of Intelligent and Fuzzy Systems, IOS Press, vol. 34, no. 3, pp. 1345-1353, 2018 | Rohit Handa, C. Rama Krishna and Naveen Aggarwal | |
| “A Container-based Technique to Improve Virtual Machine Migration in Cloud Computing”, IETE Journal of Research, pp. 1-17, 2019. | A. Bhardwaj and C. Rama Krishna | |
| “Document clustering for efficient and secure information retrieval from cloud,” Concurrency Computation Practice and Experience, Wiley, DOI: 10.1002/cpe.5127, 2018. | Rohit Handa, C. Rama Krishna and Naveen Aggarwal | |
| “Efficient Privacy-Preserving Scheme Supporting Disjunctive Multi-Keyword Search with Ranking,” Concurrency Computation Practice and Experience, Wiley, DOI: 10.1002/cpe.5127, 2018. | Rohit Handa, C. Rama Krishna and Naveen Aggarwal, | |
| “Multi-criteria workflow scheduling on clouds under deadline and budget constraints”, Concurrency and Computation: Practice and Experience, Wiley, e5193, February 2019, https://doi.org/10.1002/cpe.5193 | Mala Kalra, Sarbjeet Singh | |
| “Load balancing Techniques in Cloud Computing Environment: Issues and Challenges,” ACM Computing Surveys, ISSN:0360-0300 EISSN:1557-7341, Volume-51, Issue-6, Article No. 120, Feb. 2019, SCI, Scopus Indexed, IF=5.5 | Pawan Kumar and Rakesh Kumar | |
| “Ubiquitous Health Monitoring Using WBANs: A Comprehensive Review,” Wireless Networks, Springer, Print ISSN: 1022-0038, Online ISSN: 1572-8196, Volume-25, Issue-3, pp. 1125-1157, Apr 2019, SCI, Scopus Indexed, IF=1.9 | Roopali and Rakesh Kumar | |

| | |
|--|--|
| “SEMG signal classification with novel feature extraction using different machine learning approaches”, Journal of Intelligent & Fuzzy Systems Vol.35 pages 5099-5109, 2018 DOI 10.3233/JIFS-169794. (Thomson Renters SCI E indexed with impact factor 1.426). | Yogena Narayan, Lini Mathew S. Chatterji |
| “Comparative Study of Maximum Power Point tracking techniques for hybrid renewable energy system”, International Journal of Electronics, Taylor & Francis Online, published online 7 March 2019. DOI: 10.1080/00207217. 2019.1584917 | Mohammad Junaid Khan, Lini Mathew |
| “Estimation of Leaf Chlorophyll Concentration in Turmeric (<i>Curcuma longa</i>) Using High-Resolution Unmanned Aerial Vehicle Imagery Based on Kernel Ridge Regression”, Journal of the Indian Society of Remote Sensing (Springer) Published online 25 March 2019, DOI 10.1007/s12524-019-00969-9. | Gaurav Singhal, Baban kumar Bansor, Lini Mathew, Jonali Goswami, B.U. Choudhury, P.L.N. Raju |
| “Fuzzy Logic Controller Based MPPT for Hybrid Photo-Voltaic/Wind/ Fuel Cell Power System”, Neural Computing and Applications, Springer, Vol. 29, No. 10, pp.1-14, 2018. https://doi.org/10.1007/s00521-018-3456-7 [SCI, IF=4.213] | Mohammad Junaid Khan and Lini Mathew |
| “Comparative analysis of maximum power point tracking controller for wind energy system”, International Journal of Electronics, Vol. 105, No. 9, pp.1535-1550, 2018. DOI: 10.1080/00207217. 2018.1461251 [SCI, IF=0.939] | Mohammad Junaid Khan and Lini Mathew |
| “Effectiveness of Robo-Assisted Lower Limb Rehabilitation for Spastic Patients: A systematic review”, Biosensors and Bio-electronics, Vol.117, pp.403-415, 2018. Elsevier [SCI, IF = 8.173] | D. Shakti, Lini Mathew, N. Kumar and C. Kataria |
| “Increasing trend of wearables and multimodal interface for human activity monitoring: A Review”, Biosensors and Bioelectronics, Vol. 90, pp. 298-307, 2018. Elsevier [SCI, IF = 8.173] | Preeti Kumari, Lini Mathew, and Poonam Syal |
| “Comparative study of Optimisation Techniques for Renewable Energy System”, Archives of Computational Methods in Engineering. (Online December 2018), pp 1-10, (Springer) (SCI Indexed) | Mohammd Junaid Khan, Lini Mathew |
| “Emerging Energy Sources for Electric Vehicle Charging Station”, Environment, Development and Sustainability, (SCI Impact Factor : 1.37), pp.1-40 April 2018. | Arshdeep Singh, Shimi SL |
| “Comparative Analysis of Electron Transport Materials in Mixed Halide Perovskite Solar Cells for Enhanced Efficiency”, Journal of Nanoelectronics and Optoelectronics, Vol. 13, pp. 1–10, 2018. | Neha Thakur, Rajesh Mehra |
| “Efficient Design of Perovskite Solar Cell Using Parametric Grading of Mixed Halide Perovskite and Copper Iodide”, Journal of Electronic Materials https://doi.org/10.1007/s11664-018-6620-z . | Neha Thakur, Rajesh Mehra, Chandni Devi |
| “Efficient Tandem Organic Light Emitting Diode Using Organic Photovoltaic Charge Generation Layer”, International Journal of Optics, Volume 86, 2018, https://doi.org/10.1155/2018/9458530 . | Akansha Jetly, Rajesh Mehra |
| “Design of Tandem Organic Light Emitting Diode using efficient charge generation layer”, International Journal of Optics, Volume 88, pp. 304-312, 2019. | Akansha Jetly, Rajesh Mehra |
| “Device simulation of lead-free MASnI ₃ solar cell with CuSbS ₂ (copper antimony sulfide)”, Journal of Material Science (Electronic Materials), Volume 54, Number 7, pp. 5615-5624, 2019. DOI 10.1007/s10853-018-03265-y. | Chandni Devi, Rajesh Mehra |
| “Breast Cancer Histology Images Classification: Training from Scratch of Transfer Learning”, Journal of ICT Express, Vol. 4(4), 247-254, 2018. | Shallu, Rajesh Mehra |

RESEARCH PUBLICATIONS

[CONTRIBUTIONS OF NEWLY JOINED FACULTY TO OTHER ORGANIZATIONS AFTER JOINING NITTTR CHANDIGARH]

| | |
|--|---|
| “Alloyed Ag ₂ Se _x S _{1-x} quantum dots with red to NIR shift: the band gap tuning with dopant content for energy harvesting applications” Infrared Physics and Technology Vol 105 (March 2020) 103162 (SCI, Scopus Indexed). | Subhash Chand, A. Dahshan, Nagesh Thakur, Vineet Sharma, Pankaj Sharma |
| “Optical properties of (Se ₈₀ Te ₂₀) _{100-x} Zn _x (2≤x≤ 6) amorphous thin films” Journal of Non-Crystalline Solids Vol 531 (1 March, 2020) 119848 (SCI, Scopus Indexed). | Arun Kumar, Vipenpal Singh, Pankaj Sharma, Navdeep Goyal, |
| “Investigation of dispersion parameters, dielectric properties and opto–electrical parameters Of ZnO thin film grown by ALD” Optik International Journal for Light and Electron Optics Vol 203 (February 2020) 163933 (SCI, Scopus Indexed). | Hanaa Zaka, B. Parditka, Z. Erdélyi, H. E. Atyia, Pankaj Sharma, S. S. Fouad, |
| “Dual-tree complex wavelet transform technique-based optimal threshold tuning system to deliver denoised ECG signal” Transactions of the Institute of Measurement and Control First Published January 22, 2020 Volume: 42 issue: 4, page(s): 854-869, SCI | Navdeep Prashar, Meenakshi Sood and Shruti Jain |
| “On mechanical and morphological investigations of tungsten inert gas welded SS 304 thin pipe joints”, Measurement and Control, Vol. 53, No.1-2, 2020, PP 61-72, DOI: 10.1177/0020294019885152 | Hitesh Arora, Rupinder Singh, G.S.Brar, |
| “Volumetric medical image compression using inter-slice correlation switched prediction approach”, International Journal of Imaging Systems and Technology, 2020, SCI | U. Sharma, M. Sood, and E. Puthooran, |
| A Block Adaptive Near-Lossless Compression Algorithm for Medical Image Sequences and Diagnostic Quality Assessment. Journal of Digital Imaging, vol 33, pp. 546-530, April 2020, SCI | Sharma, U., Sood, M., & Puthooran, E., |
| Hydrothermal synthesis and electrochemical performance of nanostructured cobalt free La ₂ CuMnO ₆ , Solid State Sciences (SCI I.F. 2.155) 95, 105927 (2019) | Jashandeep Singh, Uttam Kumar Goutam and Ashok Kumar, |
| Effect of novel ZnO/Zn ₂ SnO ₄ photoanode on the performance of dye sensitized solar cell, Optik (SCI I.F. 1.914),194, 163117 (2019) | Sonia Siwath, Virender Singh Kundu, Ashok Kumar, Suresh Kumar, Nikhil Chauhan and Monika Kumari |
| Electrochemical behavior of oxygen-deficient double perovskite, Ba ₂ FeCoO _{6-δ} , synthesized by facile wet chemical process, Ceram. Int. (SCI I.F. 3.450), 45, 14105- 14110, (2019) | Amit Kumar and Ashok Kumar |
| Facile synthesis of novel ZnO/Cd _{0.5} Zn _{0.5} S photoanode for dye-sensitized solar cell, Mater. Res. Express (SCI I.F. 1.449)6, 085029 (2019) | Sonia Siwath, Virender Singh Kundu, Ashok Kumar, Suresh Kumar and Monika Kumari |
| Lanthanum containing barium stannate nanoparticles synthesized by cetyltrimmonium bromide assisted wet chemistry route for application in perovskite solar cell, Mater. Today Proc. 17(4) 1487-1493 (2019) | Astakala Anil Kumar, Ashok Kumar and Jitender Kumar Quamara |
| On 3D printed scaffolds for orthopedic tissue engineering applications”, SN Applied Sciences, 2(2), 2020, doi.org/10.1007/s42452-020-1936-8, (Springer publications), pp: 192 | Nishant Ranjan, Rupinder Singh, Ranvijay Kumar, IPS Ahuja, JP Singh, Anita K Verma, Ankita Leekha |
| “Metal matrix composite: a methodological review”, Advances in Materials and Processing Technologies, Vol. 6, No. 1, 2020, | Sudhir Kumar, Rupinder Singh, M.S.J Hashmi |

| | |
|--|---|
| doi.org/10.1080/2374068X.2019.1682296, (Taylor and Francis publications), pp: 13-24 | |
| "On technological solutions for repair and rehabilitation of heritage sites: A review", Advances in Materials and Processing Technologies, Vol. 6, No. 1, 2020, (Taylor and Francis publications), doi.org/10.1080/2374068X.2019.1709310, 146-166 | Vinay Kumar, Rupinder Singh, I.P.S. Ahuja, M.S.J. Hashmi |
| "On flexural and pull out properties of 3D printed PLA based hybrid composite matrix", Materials research express, Vol. 7, 2020, doi.org/10.1088/2053-1591/ab66f4, pp 1-14 | Sudhir Kumar, Rupinder Singh, T.P.Singh, Ajay Batish |
| Development of PLA-HAp-CS based biocompatible functional prototype: A case study", Journal of Thermoplastic Composite Materials, Vol. 33, No. 3, 2020, DOI: 10.1177/0892705718805531, (Sage Publications), 305-323 | Nishant Ranjan, Rupinder Singh, IPS Ahuja |
| "Mechanical characterization and comparison of additive manufactured ABS, Polyflex™ and ABS/ Polyflex™ blended functional prototypes", Rapid prototyping Journal, Vol. 26, No. 2, 2020, DOI: 10.1108/RPJ-11-2017-0234, (Emerald Publications) pp: 225-237 | Sunpreet Singh, Rupinder Singh |
| "Multifactor optimization of FDM process parameters for development of rapid tooling by using SiC/Al ₂ O ₃ reinforced LDPE filament", Journal of Thermoplastic Composite Materials, Vol. 33(5), 2020, DOI: 10.1177/0892705718808572, (Sage Publications), pp: 581-598 | Piyush Bedi, Rupinder Singh, IPS Ahuja |
| "Flexural, pullout and fractured surface characterization for multi material 3D printed functionally graded prototype", Journal of composite materials, Vol. 54(16), 2020, DOI: 10.1177/0021998319892067, (Sage publications), pp: 2087- 2099 | Sudhir Kumar, Rupinder Singh, T.P.Singh, Ajay Batish |
| "Hybrid Fractal Boundary MIMO Antenna for Multiband Applications," Journal of Innovation in Electronics and Communication Engineering, Vol. 9, No. 2, 2019, pp. 29 – 32. Print ISSN: 2249-9946. Online ISSN: 2455-3514. | Mansi Girdhar, and Balwinder S. Dhaliwal |
| Design of Wearable Antennas for Body Area Networks. In: Pant M., Sharma T., Verma O., Singla R., Sikander A. (eds) Soft Computing: Theories and Applications. Advances in Intelligent Systems and Computing, vol 1053. Springer, Singapore, 11 February 2020, https://doi.org/10.1007/978-981-15-0751-9_84(Scopus) | V. Jain, and Balwinder S. Dhaliwal |
| On investigations of thermal conductivity, circumferential compressive strength and surface characterization of 3D printed hybrid blended magnetostrictive PLA composite", Journal of Thermoplastic Composite Materials, 2020, DOI: 10.1177/0892705720907651, (Sage Publications), 1-20 | Sudhir Kumar, Rupinder Singh, T.P.Singh, Ajay Batish |
| On mechanical characterization of 3D printed PLA-PVC-wood dust-Fe ₃ O ₄ composite", Journal of Thermoplastic Composite Materials, 2019, DOI: 10.1177/0892705719879195, (Sage Publications), pp: 1-18 | Sudhir Kumar, Rupinder Singh, T.P.Singh, Ajay Batish |
| On mechanical and surface properties of electro-active polymer matrix based 3D printed functionally graded prototypes", Journal of Thermoplastic Composite Materials, 2020, DOI: 10.1177/0892705720907677, (Sage Publications) | R. Sharma, Rupinder Singh, Ajay Batish |
| "Additive manufacturing of smart materials exhibiting 4D properties: A state of art review", Journal of Thermoplastic Composite Materials, 2019, doi.org/10.1177/0892705719895052, (Sage Publications),pp: 1-24 | Sudhir Kumar, Rupinder Singh, Ajay Batish, T.P.Singh |
| "Investigations for tensile, compressive and morphological properties of 3D printed functional prototypes of PLA-PEKK-HAp- CS", Journal of Thermoplastic Composite Materials, 2019, DOI: 10.1177/0892705719870595, (Sage Publications), pp:1-20 | Rupinder Singh, Gurchetan Singh, Jaskaran Singh, Ranvijay Kumar |
| On effect of chemical assisted mechanical blending of barium titanate and graphene in PVDF for 3D printing applications", Journal of Thermoplastic | Ravinder Sharma, Rupinder Singh, Ajay Batish |

| | |
|---|--|
| Composite Materials, 2020, DOI: 10.1177/0892705720945377, (Sage Publications),pp: 1-20 | |
| “On mechanical, thermal and morphological investigations of almond skin powder reinforced polylactic acid feedstock filament”, Journal of Thermoplastic Composite Materials, 2019, DOI: 10.1177/0892705719886010, (Sage Publications),pp:1-19 | Rupinder Singh, R. Kumar, Pawanpreet, M. Singh, JP Singh |
| “A study of ac conductivity of nano TiO ₂ –polyaniline based film” Materials Today: Proceedings Volume 26, Part 2, (2020), Pages 341-343 (Scopus Indexed). | Rajeev Arora, A. Dahshan, Pankaj Sharma, |
| “Study of Tauc gap, optical density and penetration depth of vacuum evaporated Pb ₁₅ Se _{85-x} Gex (x = 0, 3, 6 at. %) thin films supported by chemical bond approach and physical parameters” Materials Today: Proceedings Volume 28, Part 2, (2020) 402-407 (Scopus Indexed). | I. Sharma, S.R. Madara, Pankaj Sharma |
| Predictor Based Block Adaptive Near-Lossless Coding Technique for Magnetic Resonance Image Sequence. January 2020, Procedia Computer Science 167:696-705 (Scopus Indexed) | Sharma, U., Sood, M., & Puthooran, E. |
| Two-Tier Grading System for NPDR Severities of Diabetic Retinopathy in Retinal Fundus Images” Recent Patents on Engineering January 2020, Vol 14. No 1, 2020, (Scopus Indexed) | Charu Bhardwaj, Shruti Jain, Meenakshi Sood |
| Diabetic Retinopathy Lesion Discriminative Diagnostic System for Retinal Fundus Images”, Advanced Biomedical Engineering, vol. 9, pp. 71-82, march 2020, ESCI | Charu Bhardwaj, Shruti Jain, Meenakshi Sood |
| Novel Seed Selection Techniques For MR Brain Image Segmentation Using Graph Cut” Computer Methods in Biomechanics and Biomedical Engineering: Imaging & Visualization, Dec 2019 pp. 389-399 , (ESCI/Scopus) | Jyotsna Dogra, Shruti Jain, Meenakshi Sood |
| “Thermo-mechanical investigations for friction stir spot welding of dissimilar thermoplastic”, Composite Structures, 253, 2020, PP: 1-17 | Ranjivay Kumar, Rupinder Singh, IPS Ahuja, Antoio Fortunato |
| “Repair of automotive bumpers and bars with modified friction stir welding”, Jol. of central south university, 27, 2020, DOI: 10.1007/s11771-020-4445-4, (Springer publications), PP:2239-2248 | R.Kumar, Rupinder Singh and IPS Ahuja |
| “Investigations for partial denture casting by fused deposition modelling assisted chemical vapour smoothing”, Assembly Automation, Vol. 40, No. 5, 2020, DOI: 10.1108/AA-03-2020-0048, (Emerald publications), PP:745 – 754 | Gurpartap Singh, Rupinder Singh, Sarbjit Singh |
| “Evaluation of optical properties of thermally deposited (Sn,Se)-(Bi,Te) thin film” AIP Conf Proc 2265 (2020) 030263 (CPCI, Scopus Indexed). | R Sharma, E Sharma, S Kumar, V Sharma, P Sharma |
| “On secondary recycling of ZrO ₂ reinforced HDPE filament prepared from domestic waste for possible 3D printing of bearings”, Journal of Thermoplastic Composite Materials, 2019, DOI: 10.1177/0892705719864628, (Sage Publications), PP:1-19 | Rupinder Singh, R Kumar, S.Tiwari, S. Vishwakarma, S. Kakkar, V. Rajora, S. Bhattoa |
| Study on barium titanate and graphene reinforced PVDF matrix for 4-D applications”, Journal of Thermoplastic Composite Materials, 2019, (Sage Publications), DOI: 10.1177/0892705719865004, PP: 1-20 | R.Sharma, Rupinder Singh, Ajay Batish |
| “Novel Graph Cut Based GBKS Technique for Tumor Detection and Extraction from Medical Images”, IET Image Processing, vol. 14, no. 1, pp. 84-93, 2019, SCI | Dogra, J., Jain, S. and Sood, M., |
| Facile wet chemical synthesis and electrochemical behavior of La ₂ FeCoO ₆ nano-crystallites, Materials Science in Semiconductor Processing (SCI I.F. 2.722), 99, 8-13 (2019) | Jashandeep Singh and Ashok Kumar |
| Morphology correlated efficiency of ZnO photoanode in dye sensitized solar cell, Materials Research Express (SCI I.F. 1.449), 6, 1050d3 (2019) | Sonia Siwatch, Virender Singh Kundu, Ashok Kumar, Suresh Kumar, Nikhil Chauhan and Monika Kumari |

**CONFERENCE (NATIONAL/INTERNATIONAL) PUBLICATIONS BY INSTITUTE
FACULTY IN THE LAST 5 YEARS**

| Details of the Paper Published | Author (s) Name |
|--|--|
| “IoT based Data Storage for Cloud Computing Applications” Proceedings of International Conference on Artificial Intelligence and Data Engineering (AIDE 2019), Advances in Artificial Intelligence and Data Engineering. Advances in Intelligent Systems and Computing, pp. 1455-1464, vol. 1133. Springer, Singapore, May 2019 (Book Chapter). | Ankita Shukla, Priyatam Reddy Somagattu, Vishal Krishna Singh and Mala Kalra |
| “Prediction of Bug Severity by classification of Bug Reports” , Proceedings of the international conference on Communication and Electronics System (ICES 2019) organized PPG Institute of Technology during 17-19 July, Coimbatore, India | Sarbjit Kaur, Dr. Maitreyee Dutta |
| “Analysis of various student Performance Prediction Techniques” Proceedings of International Conference on Intelligent Computing and Control Systems from 15-17 May 2019, Madurai, India | Abhinav Jain, Shano Solanki |
| “Energy-Aware VM Migration in Cloud Computing”, International Conference on IoT inclusive Life, Proceedings of International Conference on IoT Inclusive Life (ICIIL 2019), NITTTR Chandigarh, Lecture Notes in Networks and Systems, pp. 353-364, vol. 116. Springer, Singapore, December 2019 (Book Chapter). | Shashi Bhushan Singh Yadav, Mala Kalra |
| “Deadline Constrained Energy-Efficient Workflow Scheduling Heuristic for Cloud”, Proceedings of International Conference on IoT Inclusive Life (ICIIL 2019), NITTTR Chandigarh, Lecture Notes in Networks and Systems, pp. 365-382, vol. 116. Springer, Singapore, December 2019 (Book Chapter). | Shalu Saharawat, Mala Kalra |
| “Improved Symbiotic Organism Search based Approach for Scheduling Jobs in Cloud”, Proceedings of International Conference on IoT Inclusive Life (ICIIL 2019), NITTTR Chandigarh, Lecture Notes in Networks and Systems, pp. 453-461, vol. 116. Springer, Singapore, December 2019 (Book Chapter). | Deepika Srivastava, Mala Kalra |
| “An Efficient Approach for Multiclass Student Performance Prediction based upon Machine Learning” in Proceedings of International Conference on Communication and Electronics Systems (ICES) 2019/7/17 IEEE: https://ieeexplore.ieee.org/document/9002038 DOI: 10.1109/ICES45898.2019.9002038 | Abhinav Jain, Shano Solanki |
| “A Hybrid Approach for Intrusion Detection Based on Machine Learning”, Proceedings of International Conference on Intelligent Sustainable Systems (ICISS 2019) at SCAD Instt. of Technology, Palladam, Tamil Nadu, India IEEE: https://ieeexplore.ieee.org/document/8908116?denied=2019/11/21 | Abhinav Jain, Shano Solanki |
| “Web Service Ranking and Selection Based on QoS Emerging Research in Electronics, Computer Science and Technology”, Lecture Notes in Electrical Engineering, vol 545. Springer, Singapore. https://doi.org/10.1007/978-981-13-5802-9_28 https://doi.org/10.1007/978-981-13-5802-9_281 | Vaishali, Kumar R., Solanki S. |
| “Advances in Solar Cells as Renewable Energy”, International Conference on Advancements in Computing & Management (ICACM), pp.201-208, April 2019. | Srishtee Chaudhary, Rajesh Mehra |
| “35.3% Efficient Non-Toxic Perovskite Solar Cell using Copper-Iodide and Tin-Oxide”, IEEE International Conference on Computation, Automation and Knowledge Management (ICCAKM), pp.258-262, Dubai, Jan 9-11,2020. | Srishtee Chaudhary, Rajesh Mehra |
| “FPGA Based Multiplier Less Decimator for Wireless Communication Systems”, IEEE International Conference on Computation, Automation and Knowledge Management (ICCAKM), pp. 58-61, Dubai, Jan 9-11,2020. | Geetanjali, Rajesh Mehra, Lajwanti Singh |

| | |
|---|---|
| “Review on Full Protection Covers for Parked Car at Remote Stations” IEEE International Conference on Signal Processing, Computing and Control, pp. 24-29, October 2019. | Kirti Masown, Rajesh Mehra |
| “Performance Enhancement of Data centers by using low power and high speed CNTFET based SRAM Cell” IEEE International Conference Image Information Processing, pp. 459-462, November 2019. | Chauhan R, Mehra R |
| “Performance Investigation of CH ₃ NH ₃ SnI ₃ Solar Cell with HTM of CuSbS ₂ ” Symposium on NanoGe Fall Meeting, Berlin, Germany, November 2019. | Chandni Devi, Rajesh Mehra |
| “Design of Waste Heat Recovery System for Green Environment”, 2nd International Conference on Recent Innovations in Computing (ICRIC-2020), March 20-21, 2020, Central University of Jammu, J & K. | Meenakshi Sood, Pramod Kumar, Shruti Jain |
| “Anomaly Detection and Qualitative Analysis of Diseases in Tomato Plant Using Texture Features”, 2nd International Conference on Recent Innovations in Computing (ICRIC-2020), March 20-21, 2020, Central University of Jammu, J & K. | Anjna Meenakshi Sood Pradeep Kumar Singh |
| ‘Experience of Offering MOOC on Research in Technical Education for Teachers and Lessons Learnt’ in the Conference: Learning with MOOCs 2019: Enhancing Workforce Diversity and Inclusion, 23-25 October, 2019, Milwaukee, WI, USA | Presented and authored by Dr. PK Tulsi |
| ‘Student Readiness for Online Learning in relation to Gender and Stream of Study’ in the Conference: Learning with MOOCs 2019: Enhancing Workforce Diversity and Inclusion, 23-25 October, 2019, Milwaukee, WI, USA | Presented by Dr. PK Tulsi and authored by Mr. Parminder Walia, Dr. PK Tulsi & Er. Amandeep Kaur |
| Methods of Short Term Load Forecasting: A Systematic Review, IEEE 2nd International Conference on Power Energy, Environment and Intelligent Control, G.L. Bajaj Institute of Technology & Management, Greater Noida, 18-19 October, 2019 | Dhruv Upadhaya, Navneet K Singh, Ritula Thakur |
| Innovative Technologies for Clean & Sustainable Development | Dr. Sanjay Kumar Sharma |
| Application of Wavelet Analysis in Condition Monitoring of Induction Motors, International Conference (Springer), on Emerging Trends in Electro-Mechanical Technologies and Management, HMRITM, New Delhi, India, (TEMT-2019) 26-27 July, 2019 | Amandeep Sharma, Pankaj Verma, Anurag Choudhary, Lini Mathew, S.Chatterji |
| A Comparative Study of Different Converter Topologies for Photovoltaic System under Variable Environmental Conditions. International Conference (Springer), on Emerging Trends in Electro-Mechanical Technologies and Management, HMRITM, New Delhi, India, (TEMT-2019) 26-27 July, 2019 | Preeti Gupta, Shimi S.L |
| Spasticity and its Treatment : A Review, International Conference on Advanced Technologies in Science and Engineering (ICATSE 2019), PRS College of Engineering and Technology and ARMAGNA at Trivandrum 8th May 2019 | Divya Shakti, Lini Mathew |
| Fault Diagnosing and Condition Monitoring Techniques for Induction Motors – A Review, IEEE Sponsored International Conference on Intelligent Computing and Control Systems (ICICCS 2019), VAIGAI College of Engineering, Madurai, India, May15-17, 2019, pp.1628-1634 | Shaina Grover, Amandeep Sharma, Lini Mathew, Shantanu Chatterji |
| sEMG signal based hand and finger movement using different classifiers and techniques: A Review, Proceedings of IEEE sponsored International Conference on Intelligent Computing and Control Systems (ICICCS 2019), VAIGAI College of Engineering, Madurai, India, May15-17, 2019, pp.1586-1591 | Shivi Varshney, Ritula Thakur, Rajvardhan Jigyasu, Yogendra Narayana |
| A review on different Cluster head selection methods for improving the lifetime of wireless sensor network in International conference on Electrical, Electronics, Computer Science and Information Technology on 2ndJan. 2020 at Ernakulam, India | Vinod, Kanika Sharma |
| “Optimization of Hybrid Fractal Antenna Using Curve Fitting and GA Approach for RF Energy Harvesting Application,” IEEE Indian Conference on Antennas and | Balwinder S. Dhaliwal, Amritpal Kaur, Suman |

| | |
|--|--|
| Propagation (InCAP), 19-22 Dec. 2019, Ahmedabad, India, DOI: 10.1109/InCAP47789.2019.9134573 | Pattnaik, and Shyam S. Pattnaik, |
| Impact of High-k Gate Dielectric and Workfunction Variation on Electrical Characteristics of VeSFET, AMLTA2020, Manipal University, Jaipur, February 13-15, 2020 | Gurpurneet Kaur, Sandeep Singh Gill, Munish Rattan |
| "Advances in Solar Cells as Renewable Energy", International Conference on Advancements in Computing & Management (ICACM), pp.201-208, Bangkok, Thailand, April 2019. | Srishtee Chaudhary, Rajesh Mehra |
| "35.3% Efficient Non-Toxic Perovskite Solar Cell using Copper-Iodide and Tin-Oxide", IEEE International Conference on Computation, Automation and Knowledge Management (ICCAKM), pp.258-262, Dubai, Jan 9-11,2020. | Srishtee Chaudhary, Rajesh Mehra |
| "FPGA Based Multiplier Less Decimator for Wireless Communication Systems", IEEE International Conference on Computation, Automation and Knowledge Management (ICCAKM), pp. 58-61, Dubai, Jan 9-11,2020. | Geetanjali, Rajesh Mehra, Lajwanti Singh |
| "Review on Full Protection Covers for Parked Car at Remote Stations" IEEE International Conference on Signal Processing, Computing and Control, pp. 24-29, October 2019. | Kirti Masown, Rajesh Mehra |
| " Performance Enhancement of Data centers by using low power and high speed CNTFET based SRAM Cell" IEEE International Conference Image Information Processing, pp. 459-462, November 2019. | Chauhan R, Mehra R |
| "Current Perspectives and Advancements of Perovskite Photovoltaic Cells" Springer International Conference on Advanced Computing and Intelligent Engineering, pp. 83 92, March 2020 | Chandni Devi, Rajesh Mehra |
| "Performance Investigation of CH ₃ NH ₃ SnI ₃ Solar Cell with HTM of CuSbS ₂ " Symposium on NanoGe Fall Meeting, Berlin, Germany, November 2019. | Chandni Devi, Rajesh Mehra |
| " An Extensive Review on Organic Light-Emitting Diode for Energy-Saving and Eco-friendly Technology" Springer International Conference on Applications of Computing, Automation and Wireless Systems in Electrical Engineering, pp 891-912, June 2019. | Rita Rana, Akansha Jetly, Rajesh Mehra |
| Design and analysis on omega structure metamaterial in lower C Band for Shared Aperture Applications," National Conference on Biomedical Engineering (NCBE-2020), Chandigarh, January 22-24, 2020. | Chahat Jain and Balwinder Singh Dhaliwal |
| "Smart healthcare using Wireless Sensor Networks," National Conference on Biomedical Engineering (NCBE-2020), Chandigarh, January 22-24, 2020 | Amandeep Kumar, Balwinder Singh Dhaliwal, and Damanpreet Singh |
| "Recent Wearable Microstrip Patch Antennas for Body Area Networks," National Conference on Biomedical Engineering (NCBE-2020), Chandigarh, January 22-24, 2020 | Vikas Jain, Balwinder S. Dhaliwal and Suman Pattnaik |
| "Technopreneurship Promotion in TVET sector for Growth Acceleration" as a Key-Note presentation in an International conference on "Skills Readiness for Achieving SDGs and adopting IR 4.0" jointly organized by IDEB Bangladesh and CPSC Philippines at Dhaka from 2-4 February 2020. | Dr. SK Dhameja |
| Heat and Mass Transfer Modelling in Lyophilization using Comsol Multiphysics, Proceedings of the 2019 COMSOL Conference, November 28-29, 2019, Bangalore | Vikas Garg, Sukhdeep S. Dhama, Harry Garg, P. Sudhakar Rao |
| Employee Engagement and its relationship with organizational Effectiveness. | Dr. Rakesh Wats |
| Paper presented in International Conference on "Agro-ecology Transforming Agriculture & Food System" in Africa at Nairobi from 18-21 June 2019 | UN Roy |
| "Study on design and development of NZEB", International Conference on Innovative Technologies for Clean and Sustainable Development 19 - 21 February 2020 at NITTTR, Chandigarh | Balkar Singh, Sanjay Sharma, Poonam Syal |

| | |
|--|--|
| “Increasing Income of the Farmers By Creating Chandigarh Organic Farmers Market” on 11th August, 2019 in National Workshop on "TechSeva4" from 10-12 August, 2019 at IIT Delhi in Technical Session on Small Farmers- High Income. | UN Roy |
| Theme Paper Presentation on Unnat Bharat Abhiyan: NITTTR Chandigarh Experiment in a national seminar on “Unnat Bharat Abhiyan: Prospects and Challenges” was organized by NITTTR Chandigarh on 28 – 29 November 2019 by NITTTR Chandigarh | U N Roy |
| “Innovative Projects of Rural Development” paper presented in a national Conclave on “Innovative Rural Development Conclave (ERDC) – 2019 organized on 18th December 2019 by NITTTR Chandigarh | U N Roy |
| “Technological Interventions for Sustainable Rural Development: Climate Smart and SDG Approach” presented in a Capacity Building and Training under RD&PR – Visioning Workshop on 3rd Jan 2020 at Panagal Building, Chennai Chaired by ACS, RD&PR and ACS/DG (Trg), Organized by SIRD and PR, Tamil Nadu | U N Roy |
| “Application of IoT in Rural Development”, in National Seminar on 'Unnat Bharat Abhiyan: Prospects and Challenges' organised at NITTTR, Chandigarh from 28 - 29 November, 2019 | Poonam Syal & Pushkar Raj |
| “A Study of 2D Nanostructures for Sensing of Toxic Gases”, 7th International Conference on Advancements in Engineering and Technology”, ICAET – 2019 from 15-16 March, 2019 at BGIET, Sangrur, Punjab (India) ISBN No. 978-81-924893-4-6 | Tarun, Paramjot Singh, Deep Kamal Kaur Randhawa Gurleen Kaur Walia and B.C. Choudhary |
| “A Study of Advancements in FSO-WDM System”, 7th International Conference on Advancements in Engineering and Technology”, ICAET – 2019 from 15-16 March, 2019 at BGIET, Sangrur, Punjab (India) ISBN No. 978-81-924893-4.6 | Shivam Sharma and B.C. Choudhary |
| “Development of a model for Accident Predictions”, International Conference on Urban Sustainability : Emerging Trends, Themes, Concepts and Practices” 16-18th March, 2018 (Social Science Research Network Database: Elsevier) (HS/Navdeep) | Hemant Sood//Navdeep |
| “Geotechnical and Geo-environmental Properties of Discrete Polyester Fibre-Reinforced and RBI-Grade 81 – Stabilized Clay and Sand”, presented at International Conference on Environmental, Industrial and Energy Engineering (EIEE 2018) at Bangkok, Thailand from October 19 to 21, 2018.(HS/Gaurav Gupta/Pradeep Gupta) | Hemant Sood/ Gaurav Gupta/ Pradeep Gupta |
| “A review on Strengthening of Beam-Column Joints by Using FRP materials”, in International Conference On Clean Technologies And sustainable Development, pp 337-341,February 23-24,2018 | Sanjay Kumar Sharma |
| “Strengthening Beams With Carbon Fibre Reinforced Polymer Laminate”, in International Conference On Clean Technologies and Sustainable Development. February 23-24,2018 | Sanjay Kumar Sharma, Aman Kumar |
| “Utilisation of Iron Slag As Partial Replacement Of Fine Aggregates In High Strength Self Compacting Concrete in International Conference On Clean Technologies And Sustainable Development February 23-24,2018 | Sanjay Kumar Sharma, Jaskaran |
| “Behaviour of HPDSP concrete on Beam Column Joints”, in International Conference On Clean Technologies And Sustainable Development, pp 112 – 121,February 23-24,2018. | Dr. Sanjay Kumar Sharma, Mr. Sushil Kumar Swar, , Dr. Hari Kishan Sharma |
| “Issues Related to Various Construction Techniques Practiced in Rural Himachal”, in International Conference On Clean Technologies And Sustainable Development,pp 122 - 125,February 23-24,2018. | Sanjay K sharma Robin Mahajan, |

| | |
|--|--|
| “Structural Strength Assessment of Timber members from a sustainable Heritage Building”, in International Conference On Clean Technologies And Sustainable Development, pp 157-163, February 23-24,2018. | Sanjay Kumar Sharma |
| “Sustainable Water Supply Infrastructure Rainwater Harvesting- A Review”, in International Conference On Clean Technologies And Sustainable Development, pp 389-393, February 23-24,2018. | Sanjay Kumar Sharma |
| “Sustainable Rural Houses Conforming to Traditional and Modern Construction Practices in Southern-Western Part of Rajasthan”, in International Conference On Clean Technologies And Sustainable Development, pp 126 - 133,Februaryary 23-24,2018. | Sanjay K. Sharma, Mansingh Rathore, Vimal Preet |
| “Sustainable Rural Houses Conforming to Traditional and Modern Construction Practices in Northern-Eastern Part of Rajasthan”, in International Conference On Clean Technologies And Sustainable Development,pp 134 - 141,Februaryary 23-24,2018. | Sanjay K. Sharma Prateek Sharma, , Vimal Preet |
| “Pathology of the Amber Fort: Reconnaissance Survey, Monitoring & Find Root Cause of Cracks”, in International Conference On Clean Technologies And Sustainable Development,pp 150 - 156,Februaryary 23-24,2018. | Sanjay Kumar Sharma Kaushal Choudhary, |
| “Development of Wastewater Reutilization Framework through Study of Wastewater Reutilization Potential in PEC, NITTR & CCET”, in International Conference On Clean Technologies And Sustainable Development, Chandigarh,pp 190-198,Februaryary 23-24,2018. | Sanjay Kumar Sharma Charul Sharma, |
| “Analysis and design of developing net zero energy buildings”, in International Conference On Clean Technologies And Sustainable Development, pp 323-331,Februaryary 23-24,2018. | Sanjay Kumar Sharma Shah Iffat Hussain, Ayoona Yaqoob, Jai Prakash |
| “Condition assessment using non destructive tests and repair of RCC building”, in International Conference On Clean Technologies And Sustainable Development,pp 342-350,Februaryary 23-24,2018. | Sanjay Kumar Sharma Ashish Kapoor, Aman Kumar, |
| “Evaluation of Green House gases Emissions from Industrial Waste Water Treatment plants in Una (H.P)”, in International Conference On Clean Technologies And Sustainable Development, pp 503-509,Februaryary 23-24,2018. | Sanjay Kumar Sharma Anil Kumar, Dr.Sarawan Kumar |
| “A New Approach for Book Recommendation Using Opinion Leader Mining” published in International Conference on Emerging Research in Electronics, Computer Science and Technology (ICERECT-2018) from 23-24 Aug, 2018 at P.E.S College of Engineering, Mandya. | Honey Pasricha, Shano Solanki |
| “Web service ranking and selection based on QoS” published in International Conference on Emerging Research in Electronics, Computer Science and Technology (ICERECT-2018) from 23-24 Aug, 2018 at P.E.S College of Engineering, Mandya. | Vaishali, Rakesh Kumar, Shano Solanki |
| “A Movie Recommender System using Modified Cuckoo Search” published in International Conference on Emerging Research in Electronics, Computer Science and Technology (ICERECT-2018) from 23-24 Aug, 2018 at P.E.S College of Engg., Mandya. | Suraj Pal Singh, Shano Solanki |
| “A Hybrid Approach for Intrusion Detection Based on Machine Learning” published in International Conference on Intelligent Sustainable Systems (ICISS 2019) from 21-22 Feb, 2019, at SCAD Instt. of Technology, Palladam, Tamil Nadu, India. | Rohit Singh, Mala Kalra, Shano Solanki |
| “A Review of Passive Image Cloning Detection Approaches” in: Proceedings of 2nd International Conference on Communication, Computing and Networking. Lecture Notes in Networks and Systems, vol 46. Springer, Singapore, DOI https://doi.org/10.1007/978-981-13-1217-5_46 | Doegar A., Dutta M., Kumar G. |

| | |
|--|--|
| | |
| "A Hybrid of Fireworks and Harmony Search Algorithm for Multilevel Image Thresholding" in Advanced Computing and Communication Technologies. Advances in Intelligent Systems and Computing, vol 562. Springer, Singapore | Shivali, Maurya L., Sharma E., Mahapatra P., Doegar A. |
| "Fault Identification in Electrical Equipment using Thermal Image Processing at 2018 International Conference on Computing, Power and Communication Technologies (GUCON), Galgotias University, Greater Noida, UP, India. Sep 28-29, 2018, DOI: 10.1109/GUCON.2018.8675108 | Mohammad Haider, Amit Doegar, Ram Kumar Verma |
| "Acoustic Scene Classification for Personal Commuting Mode: Detecting Polluting vs. Non Polluting Vehicles," 2018 8th International Conference on Cloud Computing, Data Science & Engineering, (Confluence), Noida, 2018, pp. 274-279. 23 August 2018, doi: 10.1109/ CONFLUENCE .2018.8442576 | S. Soni, N. Aggarwal, D. Vij and A. Doegar |
| "A Hybrid Approach for Intrusion Detection Based on Machine Learning", IEEE International conference on Intelligent Sustainable Systems (ICISS 2019), Scad Institute of Technology, Coimbatore, February 2019. | Rohit Singh, Mala Kalra, Shano Solanki |
| "Outlier Detection in Wireless Sensor Network", 3rd International Conference on Inventive Computation Technologies (ICICT-2018), 15-16 Nov 2018, Tamil Nadu, India | Rana Jafri and Rakesh Kumar |
| "Artificial Intelligence Based Energy Efficient Grid PEGASIS Routing Protocol in WSN", IEEE 7th International Conference on reliability, Infocom Technologies and Optimization (ICRITO), 29-31 August 2018, UP, India | Shokat Ali and Rakesh Kumar |
| "A hybrid Approach for Financial Sentiment Analysis using Artificial Intelligence and Cuckoo Search", International Conference on Advanced Computing & Communication Systems (ICACCS-2019), 15-16 Mar 2019, Tamil Nadu, India. | Vani Kansal and Rakesh Kumar |
| IEEE – Industry Application Society 54th Annual Industrial & Commercial Power Systems (I&CPS) Technical Conference, at Marriot on the Falls, Niagara Falls, and presented a paper titled "Optimal Placement of United Power Flow Controller and Hybrid Power Flow Controller Using Optimization Technique | Lini Mathew |
| 27th IEEE International Symposium on Industrial Electronics held in Cairns, Queensland from 12-15 June 2018 and presented a paper on Hardware Implementation of Power Quality Improvement in Photo-voltaic Fed Cascaded H-bridge Multilevel Inverter | Shimi Sudha Letha co-authored by Tilak Thakur, Jagdish Kumar |
| "A Review on Real Time Simulation of UPFC" IEEE International Conference on Computational and Characterization Techniques in Engineering & Sciences (CCTES-18) Lucknow, Uttar Pradesh, 14th-15th Sep.(2017). (Any Other) | Amritpreet Singh and Lini Mathew |
| Data Acquisition System for the Development of Non-Invasive Hemoglobin Measurement, International Conference on New Trends in Engineering & Technology, held at Chennai on 7&8 September, 2018 | Akansha Deep, Yogesh Kumar, Poonam Syal, Sanjeev Kumar |
| Adaptive filter design for suppression of tremor in robotic surgery , International Conference on New Trends in Engineering & Technology, held at Chennai on 7&8 September, 2018 | Amrita Singh, Poonam Syal, Sanjeev Kumar |
| Advanced Skills for emerging trends and enhancing self-employment, International Conference on Skilling for Self-employment at NITTTR, Chandigarh organized by CPSC, Manila, Philippines and NITTTR, Chandigarh on 21-22 February, 2019 | Shivaji G.Thube, Poonam Syal |
| "Methods of Short Term Load Forecasting: A Systematic review", 2018 1st IEEE International Conference on Power Energy, Environment & Intelligent Control , (PEEIC2018), Greater Noida, 13th and 14th April, 2018 | Dhruv Upadhaya, Ritula Thakur, Navneet Kumar Singh |
| "Genetic Algorithm Optimized Artificial Neural Network for Short Term Load Forecasting: An Indian Scenario" - International Conference on Manufacturing, Advance Computing, Renewable Energy and Communication (MARC-2018), Lecture Notes in Electrical Engineering, Springer, Scopus Indexed book Series, New Delhi, 19th and 20th July, 2018 | Dhruv Upadhaya, Ritula Thakur, Navneet Kumar Singh |

| | |
|--|--|
| “PSO Optimized ANN for Short Term Load Forecasting: An Indian Scenario”- International Conference on Manufacturing, Advance Computing, Renewable Energy and Communication (MARC-2018), Lecture Notes in Electrical Engineering, Springer, Scopus Indexed book Series, New Delhi, 19th and 20th July, 2018. | Dhruv Upadhaya, Ritula Thakur, Navneet Kumar Singh |
| Real Time Simulation IEEE 9 bus system for Fault Analysis using Transient Response, Second International Conference on Advance Informatics for Computing Research, ICAICR-2018, Shimla, 14-15 July 2018 | Ankit Singh, Ritula Thakur |
| Fractional order PID Controller Design for DFIG Based Wind Energy Conversion System, Second International Conference on Advance Informatics for Computing Research, ICAICR-2018, Shimla, 14-15 July 2018 | Renuka Thakur, Ritula Thakur |
| Modeling and validation of shunt active power filter by using Opal-RT Second International Conference on Advance Informatics for Computing Research, ICAICR-2018, Shimla, 14-15 July 2018 | Sanjeev Kumar, Ritula Thakur |
| An Intelligent Machine Learning Model for Soil Image Classification, IEEE sponsored International Conference on Signal Processing, VLSI and Communication Engineering (ICSPVCE 2019), Delhi Technical University, Delhi, 28-30 March, 2019 | Chandan, Ritula Thakur |
| Comparative Study Analysis of GA Based PID and Fractional Order PID Controller for DFIG Based Wind System, IEEE International Conference on Intelligent Computing and Sustainable System(ICICSS 2018), Akshaya College of Engineering and Technology (ACET) Coimbatore, Tamil Nadu, 20-21 September, 2018 | Renuka Thakur, Ritula Thakur |
| Comparative Analysis of Fractional order PID Controller for pitch Angle Control of Wind Turbine System, 4th International Conference on Computing in Engineering & Technology (Springer), Aurangabad, January 9-11, 2019. | Shivaji Karad, Ritula Thakur |
| “ A Novel Topology of Fifteen Level Multilevel Inverter with Harmonic Elimination Using GA-SHE” , IEEE International Conference on Power Energy, Environment & Intelligent Control (PEEIC2018), Greater Noida, India, 14th April, 2018. | Rohit Kumar, Shimi S.L., Shivena Kaur |
| "An overview of various DC-DC converter Topologies used for Fuel Cell based Applications". IEEE International Conference on Power Energy, Environment & Intelligent Control (PEEIC2018), Greater Noida, India, 14th April, 2018 | R. Deepak, S.L. Shimi, S. Paulson, and R. Bandi Mallikarjuna |
| Design and control of solar based three phase Brushless motors ive using D-STATCOM Batch R2015, 18th January, 2019. | Suneet Singh, Shimi S.L |
| Design and Hardware Chip Implementation of Network Security Protocol for Smart Grid M 2013, 18th January, 2019. | PriyanshiVishnoi, Shimi S.L |
| NN based Hybrid Model for the detection of Maximum Power Point Tracking in PV System. M2012, 18th January, 2019 | Md. Naqui Akhtar, Shimi S.L |
| Bearing Fault Diagnosis of Induction Motor using Thermal Imaging, IEEE International Conference on Computing, Power and Communication Technologies, Greater Noida, Utter Pradesh, 28th – 29th Sept, 2018 | Anurag Choudhary, Sudha Letha Shimi, Aparna Akula |
| “Comparative Evaluation of Cluster Head Selection Algorithm for Wireless Sensor Networks”, International Conference on Manufacturing Advance Computing, Renewable Energy and Communication (MARC-2018) from 19-20th July 2018 at HMRITM, New Delhi. | Tanvi Sood, Kanika Sharma |
| “A Comparative Analysis on the Scheduling Algorithms for Wireless Sensor Networks”, IEEE 13th International Conference on industrial and Information Systems from 01-02 December, 2018 at IIT Ropar. | Tanvi Sood, Kanika Sharma |
| “A Survey on Routing Algorithms for Wireless Sensor Network”, IEEE International Conference on Recent Innovations in Electrical, Electronics & Communication Engineering (ICRIEECE), Manuscript ID – 355 with catalog “CFP18P98-PRT:978-1-5386-5994-6” July 2018. | Harsh Sharma, Kanika Sharma |

| | |
|--|--|
| Design of MOOC on Research in Technical Education, IEEE International Conference: Learning with MOOCs 2018 at Maid, Spain 26 – 28 September, 2018 Presented / Published in Proceedings | PK Tulsi |
| “Efficient Approaches to Mitigate the Effect of Sybil Attack in MANET for High Network Lifetime – A Review”, in 5th International Conference on Parallel, Distributed and Grid Computing”, Scopus indexed. | Ritu Kumar and Maitreyee Dutta |
| “Intrusion Detection of Wormhole Attack in IoT – A Review”, in 2018 International Conference on Circuits and Systems in Digital Enterprise Technology, Scopus indexed. | Mrinalini Goyal and Maitreyee Dutta |
| “Condition based maintenance management system for improvement in key performance indicators of mining haul trucks-a case study”, 2018 IEEE International Conference on Innovative Research and Development (ICIRD), 2018 | BS Pabla, M. Kalra, Tilak Thakur |
| “Gear fault classification using Vibration and Acoustic Sensor Fusion: A Case Study”, Condition Monitoring and Diagnosis (CMD), Curtin University, Perth, Australia, 23-26 September 2018 | Vanraj, S. S Dhami, BS Pabla |
| “A Review of Electrodeposited HAP Coatings on CP-Ti and Ti-6Al-4V”, Proceedings of International Conference on Advances and Soft Computing Applications in Design and Manufacturing (ASCADM-2018) held on 4th-6th June, 2018, Page No. 415-422. | Vinod Kumar, P. S. Rao and S.S. Bhogal |
| Status of Surface Water Quality in River Markanda and its Correlation with Ground Water Quality and Health of the residents of Shahabad, Kurukshetra, Haryana, India- A Case Study”, at International Conference on Civil, Architectural and Environmental Sciences (ICCAES-2018), Portmore, Jamaica from December 20-21, 2018 | Rakesh K Wats |
| “TVET Accreditation System in India. An Approach to Train the Youth with Quality as per International Standard ”Paper Presented in International Conference on “Innovation in TVET for Socio-economic Development” 4th and 5th October, 2019, held at Kathmandu Nepal, Organized by CPSC Manila and DEAN, CTVET, Nepal | UN Roy/ Hussain Jeevakhan |
| “Green TVET and Green Technologies for Sustainable Development” in an International Workshop on “Networking of Technology and Education for Sustainable Development” on 12th October, 2018 organized by Dept. of Civil Engineering, Delhi Technical University, Delhi. | UN Roy |
| “Interlinked Block Masonary System with Energy Dissipator Links” in International Conference on “Next Frontiers in Civil Engineering- Sustainable & Resistant Infrastructure” held at IIT, Bombay from 30.11.2018 to 01.12.2018. | Amit Goyal |
| “Recent Development and Future Demands for Civil Engineers” by UN Roy, Keynote Speaker during the National Conference on “Advances in Electrical and Information Communication Technology” held at RV Institute of Technology, Bijnor (UP) from 13-14 April, 2018. | UN Roy |
| “Role of ICT in Interlinked Block Masonry in Rural Construction” by Amit Goyal, Keynote Speaker during the National Conference on “Advances in Electrical and Information Communication Technology” held at RV Institute of Technology, Bijnor (UP) from 13-14 April, 2018. | Amit Goyal |
| Key Note Address in a Regional Seminar on “Rural Development Community Programmes and Role of Media” Organized by Hans Raj Mahila Mahavidyalaya, Jalandhar on 8th September, 2018. | UN Roy |
| Key Note Speaker “Opportunities of Employment and Entrepreneurship in Agriculture and Allied Actives in India: A Case Study” Paper presented in National Conference on Emerging Research Trends in Chemical, Physical and Life Sciences for Entrepreneurial Skill Development” organized by Department of Bio-technology, HP University, Shimla on 26th and 27th December, 2018. | UN Roy |

| | |
|--|---|
| Experimental and Theoretical Investigation of Phase Shifted Fiber Bragg Grating for Temperature Measurement, Presented in IEEE-International Conference on Power, Control, Signals and Instrumentation Engineering (IEEE-ICPCISI), Chennai, Sept. 2017. | Deepa Srivastava, Bhargab Das, Umesh Tiwari and B.C. Choudhary, |
| Partial Replacement of Lime by Cement and Fly ash in Mastic Asphalt - International Journal of Arts & Sciences (IJAS) Academic Conference at University of Freiburg, Germany from 28 November to 01 December, 2017. | Ajay Kr. Duggal |
| Partial Replacement of Lime by Cement and Fly ash in Mastic Asphalt - International Journal of Arts & Sciences (IJAS) Academic Conference at University of Freiburg, Germany from 28 November to 01 December, 2017 | Hemant Sood |
| Life Cycle Analysis of Pond Ash Stabilized Pavements for Lowering Carbon Emissions in India - 2nd Indian International Conference on Air Quality Mgt. Organized by IIT, Madras. Book Chapter Publication with Springer Process - IIT Delhi, 01-02 June,2017 | Hemant Sood/ Pardeep Gupta & Gaurav Gupta |
| Critical Pavements Response Analysis of Pond Ash Stabilized Sub-Grade Using Non-Linear Approach - ASCE International Conference on Highway Pavements & Airfield Technology. Proceeding published by ASCE: Airfield and Highway Pavements 2017: Testing and Characterization of Bound and Unbound Pavements Materials. pp382395 Doi:10.1061/9780784480939.033, Philadeiphia, USA 27-30 Aug., 2017 | Hemant Sood/ Pardeep Gupta & Gaurav Gupta |
| Performance Evaluation of Pond Ash-Brick Kiln Dust Stabilized Silty Clay Mixture - Conference of International Journal of Arts and Sciences, Freiburg Germany 28 Nov. -01 Dec.,2017 | Hemant Sood/ Pardeep Gupta & Gaurav Gupta |
| Artificial Neural Network : A Tool for Sustainable Infrastructure Development 23-24 Feb, 2018 - International Conference on Clean Technology & Sustainable Development, 23-24 Feb, 2018 at NITTTR, CHD | Himmi Gupta |
| Pathway To Net Zero Energy Buildings (72–78), International Conference on Clean Technologies and sustainable Development February 23-24, 2018 at NITTTR Chandigarh. | Sanjay Sharma/Priyanka, Balkar Singh, |
| Behaviour of Hpdsp Concrete On Beam Column Joints (112–121), International Conference on Clean Technologies and sustainable Development February 23-24, 2018 at NITTTR Chandigarh. | Sanjay Sharma, Mr. Sushil Kumar Swar, Dr Harikishan Sharma |
| Issues Related To Various Construction Techniques Practiced In Rural Himachal (122–125), International Conference on Clean Technologies and sustainable Development February 23-24, 2018 | Sanjay Sharma, Robin Mahajan |
| Sustainable Rural Houses Confirming To Traditional And Modern Construction Practices In South Western Part of Rajasthan (126-133), International Conference on Clean Technologies and sustainable Development February 23-24, 2018 at NITTTR Chandigarh. | Sanjay. K .Sharma, Mansingh Rathore, Vimalpreet, |
| Sustainable Rural Houses Confirming To Traditional And Modern Construction Practices In Northern-Eastern Part of Rajasthan(134-141), International Conference on Clean Technologies and sustainable Development February 23-24, 2018 at NITTTR Chandigarh. | Sanjay.K .Sharma, Prateek Sharma, Vimalpreet, |
| PATHOLOGY OF THE AMBER FORT : Reconnaissance Survey, Monitoring & Find Root Cause of Cracks (150–156), International Conference on Clean Technologies and sustainable Development February 23-24, 2018 | Sanjay Kumar Sharma, Kaushal Choudhary, |
| Structural strength Assessment of Timber members from a sustainable Heritage Building (157-163), International Conference on Clean Technologies and sustainable Development February 23-24, 2018 | Sanjay Sharma, Swapna Sarita Pradhan and Ranjana Yadav |
| Development of Wastewater Reutilization Framework through study of wastewater Reutilization potential in PEC, NITTTR and CCET Chandigarh (190-198), International Conference on Clean Technologies and sustainable Development February 23-24, 2018 | Charul Sharma, S.K Sharma |

| | |
|---|---|
| Analysis and Design Developing Net Zero Energy Buildings (323-331), International Conference on Clean Technologies and sustainable Development February 23-24, 2018 | Shah Iffat Hussain, Ayoona Yaqoob , Jai Prakash, Sanjay Sharma, |
| A Review on Strengthening of Beam Column Joints by using FRP Materials (190-198) International Conference on Clean Technologies and sustainable Development February 23-24, 2018 | Sanjay Sharma Akanksha Singh, Bikram Thakur, |
| Condition Assessment using Non-destructive Test and Repair of RCC building (524 - 527), International Conference on Clean Technologies and sustainable Development February 23-24, 2018 | Sanjay Sharma, Ashish Kapoor, Aman Kumar , |
| Sustainable Water Supply Infrastructure Rainwater Harvesting- A review (389 - 393) International Conference on Clean Technologies and sustainable Development February 23-24, 2018 | Sanjay Sharma Abhishek Singh Rana, Uma Malik, |
| Various Effects of Iron Slag on Concrete Properties- A Review (524 - 527) International Conference on Clean Technologies and sustainable Development February 23-24, 2018 | Sanjay Sharma Jaskarn Singh, Jasvir Singh Rattan, |
| Review on Non-destructive and Semi-destructive Test Methods available For Structural Condition Assessment of Timber Structures, International Conference on Advances in Construction Materials and Structures (ACMS-2018) | Sanjay Sharma Swapana Sarita Pradhan, and Rajanana Yadav, |
| Experimental Investigation on Effect of Industrial Waste Slag and alccofine on Durability Properties of High Strength Concrete, 12th International Conference on Civil, agricultural, Biological and Environmental Sciences (CABES-2017) | Sanjay Sharma, |
| Life Cycle Cost Analysis of Brick Kiln Dust Stabilized Perpetual Pavements for Lowering Greenhouse Gas Emissions in India, Scopus Indexed Conference: ASCE India Conference on Urbanization Challenges in Emerging Economies. (publication of proceedings under process), IIT Delhi, 12-14 Dec., 2017 | Hemant Sood/ Pardeep Gupta & Gaurav Gupta |
| Influence of Alccofine on Strength Characteristics of Concrete of Different Grades - National Conference on “ New Generation Concrete” 19.04.2017 | Hemant Sood/ Malvika Gautam |
| Hydrological and hydraulic – Simulation, Science and Technology for Sustainable Livelihood in Indian Himalayan Region November 20-21, 2017 | Sanjay Sharma, Aisha Sharma, |
| Need and Scope of Storm water Management in Chandigarh City, International Academy of Arts , Science & Technology Nov. 7, 2017 | Sanjay Sharma, Aisha Sharma, |
| Enhancing Mechanical and Durability Properties of Geopolymer Concrete with Mineral Admixtures, Computer and Concrete , Vol. 21 , No. 3 (2018) 000-000, DOI: https:// doi.org /10.12989/ cac.2018.21.3.000 | Sanjay Sharma Bharat Bhushan Jindal, Dharendra Singhal, and Parveen |
| Recommender System Survey: Clustering to Nature Inspired Algorithms” published in 2nd International Conference on Communication, Computing and Networking from 29-30 March, 2018 at NITTTR, Chandigarh | Suraj Pal Singh, Shano Solanki |
| “Impact of Factors Affecting Pre-copy Virtual Machine Migration Technique for Cloud Computing,” International Conference on Nanotechnology: Ideas, Innovations & Initiatives, IIT Roorkee, 6-8 December 2017. | A. Bhardwaj and C. Rama Krishna |
| “Improving the Performance of Pre-copy Virtual Machine Migration Technique,” Springer LNNS series- 2nd International Conference on Communication, Computing and Networking (ICCCN), NITTTR Chandigarh, 29-30 March 2018. | A. Bhardwaj and C. Rama Krishna |
| “Privacy Preserving Multi Keyword Ranked Search with Context Sensitive Synonyms over the Encrypted Cloud Data”, Springer Sponsored-International Conference on Communication, Networks and Computing (CNC-2018), ITM University, Gwalior, India 22-24 March 2018. [UGC Approved Journal No.16246] | Anu Khurana, Rama Krishna Challa and Navdeep Kaur |

| | |
|---|---|
| <p>“Improved Ranking for Search over Encrypted Cloud Data using Parallel Index,” Springer AISC Series- International Conference on Advanced Computing Networking and Informatics (ICANI-2018), 22-24 February 2018, MEDI-CAPS University, Indore. [UGC Approved Journal No. 49365]</p> | <p>Anu Khurana, Rama Krishna Challa and Navdeep Kaur</p> |
| <p>“Privacy Preserving Ranked Multi Keyword Context Sensitive Fuzzy Search over Encrypted Cloud Data,” Springer CCIS Series- International Conference on Futuristic Trends in Network and Communication Technologies (FTNCT-2018), Jaypee University, Solan, 9-10 February 2018. [UGC Approved Journal No.16246]</p> | <p>Anu Khurana, Rama Krishna Challa and Navdeep Kaur</p> |
| <p>“Critical Path-based Ant Colony Optimization for Scientific Workflow Scheduling in Cloud Computing under Deadline Constraint,” Springer AISC Series- International Conference on Recent Advancements in Computer, Communication and Computational Sciences (RACCCS- 2017), Aryabhata College of Engineering & Research Center, Ajmer, India, Sep. 2-3, 2017.</p> | <p>A. Lal, C. Rama Krishna</p> |
| <p>“A Technique to Resolve Data Integrity and Confidentiality Issues in Wireless Sensor Network,” IEEE Sponsored-8th International Conference on Cloud Computing, Data Science & Engineering (Confluence-2018), pp. 184-189, 11-12 Jan., 2018.</p> | <p>Sunil Kumar, C. Rama Krishna, and A. K. Solanki</p> |
| <p>“A Technique to Analyze Cyclomatic Complexity and Risk in a Wireless Sensor Network,” IEEE Sponsored-5th International Conference on Signal Processing and Integrated Networks (SPIN-2018), February 2018.</p> | <p>Sunil Kumar, C. Rama Krishna, and A. K. Solanki</p> |
| <p>“Energy Analysis of Two-tiered Clustered Architectures for Smart World Applications,” 5th IEEE Region 10 (Asia Pacific) Humanitarian Technology Conference (R10HTC-2017), Dec. 21-23, 2017, Dhaka Bangladesh.</p> | <p>Singh R., Krishna C.R., Sharma R., Vig R.</p> |
| <p>“Detection of Advanced Malware by Machine Learning Techniques,” Springer Sponsored- 2nd International Conference on Soft Computing: Theories and Applications, Bundelkhand University, Jhansi, 22-24 December 2017.</p> | <p>S. Sharma, C. Rama Krishna and S. K. Sahay</p> |
| <p>“A Review on Methodologies of Scientific Workflow Scheduling Algorithm under Dead Line Constraint,” IEEE Sponsored- International Conference on Energy, Communication, Data Analytics and Soft Computing (ICECDS-2017), SKR Engineering College, Chennai, India, August 1-2, 2017.</p> | <p>A. Lal, C. Rama Krishna</p> |
| <p>“Detecting Aggressive Driving Behavior using Mobile Smartphone,” Springer LNNS Series- 2nd International Conference on Communication, Computing and Networking, March 29-30, 2018, National Institute of Technical Teachers Training and Research, Chandigarh, India.</p> | <p>R. Chhabra, S. Varma, C. Rama Krishna</p> |
| <p>“Real-Time Implementation of Scheduling Policies for Education using Raspberry Pi: A Review,” Springer LNNS Series- 2nd International Conference on Communication, Computing and Networking, March 29-30, 2018, National Institute of Technical Teachers Training and Research, Chandigarh, India.</p> | <p>Payal Kamboj, C Rama Krishna, SRN Reddy</p> |
| <p>“Real-Time Implementation of Scheduling Policies using Raspberry- Pi,” IEEE Sponsored- 8th International Conference on Cloud Computing, Data Science & Engineering (Confluence-2018), 11-12 Jan., 2018, Amity University Uttar Pradesh, Noida.</p> | <p>Payal Kamboj, C Rama Krishna, SRN Reddy</p> |
| <p>“Efficient Key Distribution and Mutual Authentication mechanism Using Modified Needham Schroeder and Otway Rees Protocol for Cloud Environment,” Springer LNNS Series- 2nd International Conference on Communication, Computing and Networking, March 29-30, 2018, National Institute of Technical Teachers Training and Research, Chandigarh, India.</p> | <p>A. K. Vashishtha, C. Rama Krishna, Rajiv Chechi</p> |
| <p>“Energy-efficient Delay-aware Preemptive Variable-length Time Slot Allocation Scheme for WBASN (eDPVT),” Springer LNNS Series- 2nd International Conference on Communication, Computing and Networking, March 29-30, 2018, National Institute of Technical Teachers Training and Research, Chandigarh, India.</p> | <p>Tamanna Puri, Rama Krishna Challa, Navneet Kaur Sehgal</p> |

| | |
|--|--|
| “A Hybrid Approach to Address IP Traceback Problem using Nature Inspired Algorithm,” International Conference on Cognitive Informatics & Soft Computing (CISC-2017), VBIT, Hyderabad, India, 21-22 December 2017. | Amrita Saini, C. Rama Krishna, Sachin Kumar |
| “An Energy Efficient Hybrid Optimized Routing Protocol for WSN,” 2nd International Conference on Telecommunication and Networks (TEL-NET 2017), ISBN: 978-1-5090-6711-4, EISBN: 978-1-5090-6710-7, pp. 1-6, 10-11 August, 2017 at Amity University, Noida, UP, India | Renu Kumari and Rakesh Kumar |
| “An Approach to Improve BEST-MAC: Bit map Assisted Efficient Scalable TDMA-Based MAC protocol Using Optimal Cluster Head Selection,” 2nd International Conference on Telecommunication and Networks (TEL-NET 2017), ISBN: 978-1-5090-6711-4, EISBN: 978-1-5090-6710-7, pp. 1-5, 10-11 August, 2017 at Amity University, Noida, UP, India | Manju Gangwar and Rakesh Kumar |
| “Detection of Object in Motion Using Improvised Background Subtraction Algorithm,” IEEE International Conference on Trends in Electronics and Informatics (ICEI 2017) on 11-12 May 2017, Tamil Nadu, India, pp. 651-656 | Prerna Dewan, and Rakesh Kumar |
| “An Improved Linux Firewall Using a Hybrid Frame of Netfilter,” IEEE International Conference on Trends in Electronics and Informatics (ICEI 2017) on 11- 12 May 2017, Tamil Nadu, India, pp. 657-662 | Nivedita and Rakesh Kumar |
| “Application of Intelligent Water Drops Algorithm to Workflow Scheduling in Cloud Environment”, IEEE International Conference on Computing Communication and Networking Technologies (ICCCNT), IIT Delhi, ISBN: 978-1-5090-3038-5, 3-5 July 2017. | Mala Kalra and Sarbjeet Singh |
| “An Improved Harmony Search Algorithm with Group Technology Model for Scheduling Workflows in Cloud Environment”, 4th IEEE International Conference on Electrical, Computer and Electronics (UPCON), GLA University, Mathura, 26-28 Oct 2017. E-ISBN: 978-1-5386-3004-4. | Nidhi Chaudhary and Mala Kalra |
| “Robust Scheduling of Deadline-Constrained Workflows Using Hybrid Instances” International Conference on Computational Strategies for Next Generation Technologies (NEXTCOM – 2017), CT Institute of Engineering Management & Technology, Jalandhar, Springer, CCIS Series (ISSN No. 1865-0929), November 25-26, 2017. | Urvashi Nag and Mala Kalra |
| “Bio-Inspired Threshold Based VM Migration for Green Cloud”, International Conference on Data and Information Sciences (ICDIS), Springer, IGNTU, Karnataka, pp. 203-211, November 17-18, 2017. | Raksha Kiran, Mala Kalra |
| “Using Artificial Neural Network for VM Consolidation Approach to Enhance Energy Efficiency in Green Cloud”, International Conference on Data and Information Sciences (ICDIS), Springer, IGNTU, Karnataka, pp. 276-285, Nov. 17-18, 2017. | Anjum Mohd Aslam, Mala Kalra |
| “A Hybrid Approach for Energy Efficient Job Scheduling in Cloud”, 2nd International Conference on Communication, Computing and Networking, NITTTR, Chandigarh, 29-30 March, 2018. | Sunil Kumar and Mala Kalra |
| Managing Issues and Concerns of Adolescence presented in 22nd International Conference on Advancements and Challenges in Social Sciences and Business Management-Interdisciplinary Research and Practices 24-25 February, 2018 at Bangalore organized by Research and Development Association, Rajasthan Chamber of Commerce and Industry, Jaipur. | PK Singla |
| Implementation of TQM in Building Construction Industry for Sustainable Building presented in International Conference on Clean Technology and Sustainable Development from 23-24 February, 2018 at NITTTR, Chandigarh | SK Gupta |
| Identification of Obstacles in Implementation of TQM in Building Construction Industry in India, accepted in International Conference on 26th World Congress on Engineering, 04-06 July, 2018 at London. | SK Gupta |
| Implementation of Smart Metering based on Internet of Things, 3rd International Conference on Communication Systems (ICCS-2017), IOP | Milanpreet Kaur, |

| | |
|---|---|
| Conference Series: Materials Science and Engineering, 331(2018)012015, DOI:10. 1088/1757-899X/331/1/012015 | Lini Mathew, Alokdeep, Ajay Kumar |
| Analysis of Broken Rotor Bar Fault Diagnosis for Induction Motor, IEEE International Conference on Innovations in Control, Communication and Information Systems (ICICCI-2017), Delhi-NCR, Greater Noida, India, August 2017, (Scopus Indexed) | Amandeep Sharma, Lini Mathew, S Chatterji |
| A Novel Park's Vector Approach for Investigation of Incipient Stator Fault Using MCSA in Three-Phase Induction Motors, IEEE International Conference on Innovations in Control, Communication and Information Systems (ICICCI-2017), Delhi-NCR, Greater Noida, India, August 2017 (Scopus Indexed) | Amandeep Sharma, Lini Mathew, S.Chatterji |
| Various Indices for Diagnosis of Air-gap Eccentricity Fault in Induction Motor-A Review, 3rd International Conference on Communication Systems (ICCS-2017), Pilani, India, October, 2017. Conference Proceedings also published in IOP Conference Series: Materials Science and Engineering Vol.331, No.1, IOP Publishing (UK), 2018 (Scopus Indexed) | Nikhil, Lini Mathew, Amandeep Sharma |
| Real-Time-Simulation of IEEE-5-Bus Network on OPAL-RT-OP4510 Simulator, Proceedings of 3rd International Conference (ICCS-2017) held at BKBIET Pilani, India, October, 2017. Conference Proceedings also published in IOP Conference Series: Materials Science and Engineering Vol.331. No.1, IOP Publishing (UK), 2018 (Scopus Indexed) | Anjali Atul Bhandakkar, Lini Mathew |
| sEMG Signal Classification using Ensemble Learning Classification Approach and DWT, 2018 IEEE International Conference on Current Trends Towards Converging Technologies, Coimbatore, India March, 2018 | Nityanand Thakur, Lini Mathew, Yogendra Narayan |
| sEMG Signal Classification with Novel Feature Extraction using Different machine Learning Approaches, 1st International Conference on Signals, Machines, and Automation (SIGMA 2018), Delhi, India, February, 2018 | Lini Mathew, Yogendra Narayan |
| Load Flow Analysis and Real-Time Simulation of Multi-Machine-9-Bus system on OPAL-RT-OP4510, IEEE International Conference on Electrical, Electronics, Computers, Communication, Mechanical and Computing (EECCMC), January, 2018 at Tamil Nadu, India. | Anjali Atul Bhandakkar, Lini Mathew |
| An Electrooculogram Signal Based Control System in Offline environment International Conference on Medical Information and Bio Engineering, Indexed by SCOPUS and Eicompendex, 9 to 11 October, 2017 at Barcelona, Spain | Babita, Poonam Syal, Preeti Kumari |
| Comparative Analysis of KNN, SVM, DT for EOG based Human Computer Interface, IEEE International Conference on Current Trends in Computer, Electrical, Electronics and Communication, 8-9 September, 2017 at Mysore, Karnataka. | Babita, Poonam Syal, Preeti Kumari |
| Home Automation Control System Implementation using SSVEP based Brain Computer Interface, IEEE International Conference on Inventing, Computing and Informatics, 23-24 November 2017 at Coimbatore, Tamil Nadu. | Prateek Viridi, Poonam Syal, Preeti Kumari |
| Implementation of Fuzzy Sliding Mode Controller for a Grid Connected Solar Photovoltaic System to Control Voltage, IEEE International Conference on Computational Intelligence and Computing Research, at Coimbatore, Tamil Nadu, 14-16 December, 2017. | Mohd.Amin, Poonam Syal, Shoeb Hussain |
| Comparative Study of Control Schemes for a Utility Grid Connected Solar Photovoltaic System to Control Voltage. International Conference on Recent Innovation and Trends in Engineering Technology & Research, 23-24 December, 2017 at Jaipur, India. | Mohd.Amin, Shoeb Hussain, Poonam Syal |
| Simulation of Intelligent Room Lighting Illuminance Control, IEEE International Conference on Computational Intelligence and Computing Research, 14 to 16 December, 2017 at Coimbatore, Tamil Nadu, | Deepak Makkar, Poonam Syal |
| ZigBee And GSM Based Fault Detection System For Low Tension Pillar, International Conference on Intelligent Communication, Control and Devices | Ram Nath, Ritula Thakur |

| | |
|--|--|
| (ICICCD 2017), 15-16 April, 2017 at University of Petroleum and Energy Studies, Dehradun, | |
| Design and Development of Nano pH Sensor and Interfacing with Arduino, International Conference on Advanced Trend in Engineering (ICATE-2017), Datta Meghe College of Engineering, Navi Mumbai, 7-8 April, 2017 | Shivam Vajpayee, Ritula Thakur, Babankumar |
| Wind Energy Scenario, Policies and Energy Conversion Topologies: An Overview, International Conference on Research Trends in Engineering, Applied Science and Management (ICRTE SM – 2017), Pune, 28th May, 2017 | Ved Prakash, Ritula Thakur, Umesh Rathore |
| Modeling, Simulation and Analysis of Doubly-Fed Induction Generator in Wind Energy Conversion System, International Conference on Research Trends in Engineering, Applied Science and Management (ICRTE SM–2017), Pune, 28th May, 2017 | Ved Prakash, Ritula Thakur, Umesh Rathore |
| Support Vector Machine based classification Improvement for EMG Signals using Principal Component Analysis, 7th International Conference on Computing, Engineering and Information Technology (ICCEIT 2017), August 19, 2017 at Chennai, India. | Vivek Ahlawat, Ritula Thakur, Yogendra Narayan |
| Smooth Starter for DC Shunt Motor using Buck-Boost Power Converter, IEEE conference on International Conference on Innovations in Control, Communication and Information Systems (ICICCI-2017), 12-13 August 2017 Greater Noida, India, | Rohit Kumar, Anurag Choudhary, Shimi S.L. |
| Implementation of Room Automation with Cloud Based Monitoring System, IEEE 2nd International Conference on Inventive Systems and Control (ICISC-2018), Coimbatore, India 19-20 January 2018 (SCOPUS Indexed) | Manjeet Singh, Shimi S.L. |
| Implementation of Smart Classroom Using WAGO PLC, IEEE 2nd International Conference on Inventive Systems and Control (ICISC-2018), Coimbatore, India 19-20 January 2018 (SCOPUS Indexed) | Vibhuti, Shimi S.L. |
| Modeling and Analysis of Novel Topology for Multilevel Inverter with Reduce Number of Switches, International Conference on Recent Trends in Engineering and Science, Andhra Pradesh, 20th and 21st Feb, 2018. (SCOPUS Indexed) | Rohit Kumar, Shimi S.L., Shivendra Kaur |
| Performance Analysis of Various Parameters of Transformers under Short Circuit condition using Finite Element Method-An overview International Conference on Recent Trends in Engineering and Science, Andhra Pradesh, 20th and 21st Feb, 2018 (SCOPUS Indexed) | Divi Saxena, Shimi S.L., Sarpreet Kaur |
| A Review on Islanding Detection Technique Based on Intelligence Methods, International Conference on Recent Trends in Engineering and Science, Andhra Pradesh, 20th and 21st Feb, 2018 (SCOPUS Indexed) | Anu Radha, Shimi S.L. |
| MATLAB/SIMULINK Simulation of PV system based on MPPT in Variable Irradiance with EV Battery as Load, 2017 IEEE International Conference on Computational Intelligence and Computing Research, Tamil Nadu College of Engineering, Coimbatore 641659, Tamil Nadu 14-16 December 2017 (SCOPUS Indexed) | Arshdeep Singh, Shimi S.L. |
| Bidirectional DC to DC Converter: An Overview of Various Topologies Switching Schemes and Control Techniques International Conference on Recent Trends in Engineering and Sciences, Visakhapatnam, India, 21st Feb.2018. | R.Deepak and S.L.Shimi |
| Building and Generation Strategy for Hybrid System in Electricity Market, International Conference on Research Trends in Engineering, Applied Science and Management, Chandigarh 2018 (IJETSR), 11th March 2018, ISSN-2394-3386 (Accepted) | Arun Kumar Sharma, Shimi S.L., Y.P.Verma |
| "Analysis of Darlington pair amplifier at 90nm technology", IEEE International conference on electrical electronics and optimization techniques (ICEEOT), pp. 3637-3641, 2016. | Rashmi Singh, Rajesh Mehra, |

| | |
|--|--|
| "Energy Efficient FinFET Based SRAM Design in 22 Nanometer Technology", International Conference on Electrical, Electronics & Communication Engineering (ICEECE), pp. 20-26.July 2017. | Ayushi Gagneja and Rajesh Mehra |
| "A Novel CNTFET based Power and Delay Optimized Hybrid Full Adder", International Conference on Electrical, Electronics and Communication Engineering(ICEECE), Chandigarh, pp. 13-19, July 2017. | Priya Kaushal , Rajesh Mehra |
| "Routing and Clustering Optimization Techniques in WSN: A Review", IEEE 8th International Conference on Computing and Networking Technologies, July 2017, ISBN-978-1-5090-3037-8 | Neha Sharma, Kanika Sharma |
| "Recent Advancements in Clustering Protocols for Wireless Sensor Networks, "IEEE 8th International Conference on Computing and Networking Technologies, July 2017, ISBN- 978-1-5090-3037-8. | Priya Rana, Kanika Sharma |
| "Maximum Likelihood Estimation based Clustering Algorithm on Wireless Sensor Network – A Review", International Conference on Energy, Communication , Data Analysis& Soft Computing, by IEEE Madras Session, SRK Engineering College, No. 2, pp. 452-457, August 2017. | Uday K.R and KanikaShrama |
| "Energy Efficient Clustering Algorithm Based on Maximum Likelihood Estimation on Wireless Sensor Network", IETE International Conference on Science, Technology & Management, International Journal of Electronics, Electrical and Computational System vol. 6, No.9 pp 679-685, September 2017. | Uday K.R and Kanika Sharma |
| "Review paper on Various Clustering Schemes", IEEE International Conference on Smart Technologies and Management for Computing, Communication, Controls, Energy, and Materials (ICSTM), pp 44-48, October 2017 | Pratiksha Gupta, Kanika Sharma |
| "Optical Reconfigurable Microstrip Patch Antenna for Wide Band Applications: A Review" 4th International Conference on Emerging Trends In Engineering Technology, Science and Management, IETE, pp. 442-449, July 2017, ISBN:978-93-86171-54-2 | Naman Thakur, Garima Saini |
| "Low Complexity MMSE Channel Estimator For Downlink MC-CDMA System" IEEE 2nd International Conference on Inventive Systems and Control, pp. 706-709, 2018 | Nitin Kumar Suyan, Garima Saini |
| "Blue Ocean Strategy in Technical and Vocational Education and Training Sector" International Conference on Education 26-29 June 2017 at University of Toronto, Canada. | SK Dhameja |
| "Green Information Technology: Mapping the Swaying Factors and Strategies" 3rd International Conference on Cyber Security (ICCS-2017) 12–13 August, 2017. organized by the Rajasthan Technical University Kota (Rajasthan) | Amardev Singh |
| "Promotion of Skills and Technologies for Sustainable Rural Development in India", Golden Jubilee National Seminar on Technologies and Skill Promotion for Sustainable Rural Development in India, 31 August to 01 September, 2017 at NITTTR, Chandigarh. | UN Roy JS Saini YK Anand (Presenter) |
| "Contiki based mitigation of UDP flooding attacks in the Internat of things", IEEE International Conference on Computing, Communication and Automation (ICCCA20127), Noida, 5-6th May 2017 | Manisha Malik, Kamaldeep, Maitreyee Dutta |
| "Contrast Enhancement of night time imagery for traffic activity understanding", Proceedings of the IEEE 2017 International Conference on Computing Methodologies and Communication (ICCMC), held at Noida, 18-19 July, 2017, pp 809-813 | Nikil Verma, Maitreyee Dutta |
| "Epilepsy Disease Detection Using Artificial Neural Network and Performance improvement using PSO and GA", in International Conference on Emerging Trends in Electrical, Electronic, Computer Science and Information Technology", held at Mumbai, India on 23rd July, 2017 | Jagruti Saini, Maitreyee Dutta |
| National Conferences: | |

| | |
|---|---|
| “Defending DDoS in the Insecure Internet of things: A Survey”, Springer Advances in Intelligent Systems and Computing (AISC Series) through Power, Circuit and Information Technologies (ICPCIT 2017) held at Madanapalle, Andhra Pradesh, 27-19 April, 2017 | Manisha Malik, Kamaldeep, Maitreyee Dutta |
| “Development of Low Cost Programmable Indexing Head for Horizontal Milling Machine”, IEEE International Conference on Mechatronics and Automation, August 6-9, 2017, Takamatsu, Japan, pp. 2028 – 2033. | Sanjiv Kumar, Deepam Goyal, S. S. Banwait |
| “Diamond Tool Wear Measurement by Profilometry Method for Ultra-Precision Machining of Silicon”, International Conference on Nanotechnology: Ideas, Innovations and Initiatives, December 6 - 08, 2017 at IIT Roorkee, India, pp. 131 – 141. | G. Singh, V. Mishra, V. Karar and S. S. Banwait |
| “Effect of different Cutting Conditions during CNC Machining of Hastelloy-X--A review” NCRAME 2017 June 02-03 2017 at NIT Kurukshetra Haryana, Vol.1, 40-43 | Tarun Batra and P S Rao |
| Performance Improvement Using VSM as a Lean Tool in Ceramic Industry: A Case Study, Joint Indo-German Conference on Sustainable Engineering, BITS Pilani, September 15-16, 2017 | B S Pabla, Suthar, S.S.. and Bhamu |
| “Study of Cutting Performance of Different Materials by Abrasive Jet Machining Process – A review” in National Conference on Unconventional Manufacturing Technology (UMT-2017) held on 22-23 Sep 2017 at AK Garg Engg. College, Ghaziabad, UP | Tarun Batra and P S Rao |
| “A Review on Process Parameters of Ultra Sonic Machining –USM” in National Conference on Unconventional Manufacturing Technology (UMT-2017) held on 22-23 Sep 2017 at AK Garg Engg. College, Ghaziabad, UP | Nishant Verma and P S Rao |
| “Optimization of process parameters on Electrical Discharge Machining- A review” in National conference on Unconventional Manufacturing Technology (UMT-2017) held on 22-23 Sep 2017 at AK Garg Engg. College, Ghaziabad, UP | Sameem Ahmed and P S Rao |
| “Electro Deposition of Titanium Alloys with Hydroxyapatite for Biomedical Implants-A Review” ICCMEMS 2018 at Lovely Professional University, Jalandhar, Punjab, 15-17 March, 2018. | Vinod Kumar, P S Rao, Chander Prakash |
| Impact of Unplanned Vertical Urbanization on Indoor Air Quality and Health of its Occupants, 27th International Conference on Research in Science & Technology (ICRST) held at Asian Institute of Technology (AIT) Bangkok, Thailand December 29-30, 2017 | Rakesh Wats/ Meenu Wats |
| Increasing Trends of Self Medication among Young Girls in Chandigarh with Relation to Their Stress Levels, 27th International Conference on Research in Science & Technology (ICRST) held at Asian Institute of Technology (AIT) Bangkok, Thailand December 29-30, 2017 | Rakesh Wats/ Aanchal |
| “Attaining Employee Engagement through Green Human Resource Management: The Millennials Perception” International Conference on Clean Technologies and Sustainable Development, NITTTR, Chandigarh, Feb., 23-24, 2018.Pp 448-465 | Rakesh Wats/ Kamakshi Malik |
| Paper presented on "Low Cost Passive Energy Dissipation System for Masonry Buildings under Earthquake Loading" in International Conference on Innovation in Structural Engineering, 29-31 December, 2017, University College of Engineering, Osmania University, Hyderabad. | Amit Goyal & Pankaj Agarwal |
| Paper presented "Use of Rubber and Steel Industry Waste for the Improvement of Concrete Strength" in International Conference on Innovation in Structural Engineering, 29-31 December, 2017, University College of Engineering, Osmania University, Hyderabad. | Dinesh Kumar, Amit Goyal & Sunita Kotwal |
| Paper presented in National Seminar on “Development Village: Developed National” 29-30 October 2017 organized by AICTE, New Delhi | UN Roy |
| Key Note Address in a National Seminar on “Recent Innovations and Technological Development in Civil Engg.”(NCRITD 2018) from 12-13 March, | UN Roy |

| | | |
|---|---|--------|
| 2018 held at The Gandhigram Rural Institute (GGRI, Gandhigram Dindigal Disttl, Tamil Nadu on 12th March, 2018 | | |
| Paper presented on "Role of ICT in the Development of Earthquake Resistant Interlinked Block Masonry System with Visco-Elastic Energy Dissipator Links" Conference on Advances in Electrugal & Information Communication Technology, at R.V Institute of Technology, Bijnor in association with IETE & IJCA, India. | Amit Goyal & Pankaj Agarwal | |
| "Subgrade Strength Improvement using Pond Ash and Polyester Fibre for Sustainable Road Construction", National Conference : Civil Engineering Conference – Innovation for sustainability, 9-10 September, 2016. | Hemant Sood | |
| "Influence on Strength Characteristics of Concrete of Variable Grades Using Treated Waste Water", National Conference: Civil Engineering Conference – Innovation for sustainability, 9-10 September, 2016. | Hemant Sood | |
| "Effect of Treated Waste Water on Compressive Strength of Concrete of Variable Grades", National Conference: Civil Engineering Conference – Innovation for sustainability, 9-10 September, 2016. | Hemant Sood | |
| "Effect of Fiber & Silica Fume on High Performance Concrete", R.N Raikar Memorial International Conference & Banathia – Basheu Symposium on Advance in Science & Technology of Concrete , Mumbai December 18th -19th 2016. | SK Sharma Paaras Gupta | |
| "Effect of HPRCC on Beam Coloum Joints", National Conference on Sustainable Civil Engineering Practices, Chitkara University Himachal Pradesh , PEC , Chandigarh & NITTTR, Chandigarh , March 18th-19th 2016. | SK Sharma | |
| "Behavior of High Performance Fiber Reinforced Concrete", International Conference on Sustainable Civil Engineering Practice, NITTTR, Chandigarh, 02-03 March, 2017. | SK Sharma | |
| "Passive Noise Control & its Mechanism", International Conference on Sustainable Civil Engineering Practice, NITTTR, Chandigarh, 02-03 March, 2017. | SK Sharma | |
| "To Study the Effect of Partial Replacement of Lime by Cement in Mastic Asphalt – An overview" in National Conference on Technical Advancement in Civil Engineering (NCTACE- 2016), LPU, Jalandhar, November, 2016 | Swati Chandel Ajay K Duggal | |
| "Flexible Pavements with Repeated Distress History – An Overview in Civil Engineering", National Conference on Technical Advancement in Civil Engineering (NCTACE- 2016) LPU, Jalandhar, November, 2016. | Naiyara Khan Ajay K Duggal | |
| "Inclusive Education System in Chandigarh", International Conference on Education, Psychology and Society, Hong Kong, 14-16 December, 2016. | JS Saini | |
| "Inclusive Development from the Disability Perspective", in National Seminar on Trends and Issues in Social Development Panjab University, Chandigarh on 2-3 March, 2017. | JS Saini | |
| "Quality Management in Building Construction Industry by Implementation of Total Quality Management", International Conference on Sustainable Civil Engineering Practices, NITTTR, Chandigarh, 02-03 March, 2017. | S K Gupta | |
| "Recommendation Generation using Typicality Based Collaborative Filtering Proceedings", 7th IEEE International Conference on Cloud Computing, Data Science & Engineering, Amity University, Noida, India, 12-13 January, 2017. [Scopus indexed]. | Sharandeep Kaur C Ramakrishna S Solanki N Chawla S Sharma K Kaur | |
| "User Interactive Recommender System for Electronic Products using Fuzzy Numbers Proceedings", 10th Springer International Conference on Advanced Computing and Communication Technologies, Panipat, India, 18-20 November 2016. [SCOPUS indexed]. | Shalini Sharma C Ramakrishna S Solanki Kaur Kaur | S K |

| | |
|---|---|
| <p>"A Comparative Analysis of SVM and its Stacking with other Classification Algorithm for Intrusion Detection", International Conference on Advances in Computing, Communication & Automation, 2016, Tulas Institute Dehradun, India, pp. 1-6, 8-9 April 2016.</p> | <p>N Chand P Mishra C Ramakrishna E Pilli M Govil</p> |
| <p>"Performance Analysis of Supervised Learning Based Intrusion Detection System", 2nd International Conference on Sustainable Computing Techniques in Engineering, Management and Science, at Jain Engineering College, Belgaum (Near Goa), India, 27- 28, January 2017.</p> | <p>Shalini Chaurasia C Ramakrishna</p> |
| <p>"Performance Evaluation of Multipath TCP under Diversified Networks", 1st International Conference on Communication, Computing and Networking (ICCCN 2017), NITTTR Chandigarh, pp. 443-448, 23-24 March 2017.</p> | <p>Anurag Jagetiya C Ramakrishna</p> |
| <p>Performance Analysis of IDS Model Based on Supervised Learning Approaches 4th IEEE International Conference on Computing for Sustainable Global Development, New Delhi, India, 01-03 March 2017.</p> | <p>Shalini Chaurasia C Ramakrishna</p> |
| <p>"Prevention of EDoS Attack using Hybrid Filtering Technique (EDoS Guard)", 2nd International Conference on Sustainable Computing Techniques in Engineering, Science and Management, Goa, India, 27-28 January 2017. [SCOPUS indexed].</p> | <p>Shruti Wadhwa C Ramakrishna Challa, Poonam Saini</p> |
| <p>"Prevention of DDoS & EDOS using Hybrid Filtering Technique in a Cloud Environment in Joint International Conference on Artificial Intelligence and Evolutionary Computations in Engineering Systems (ICAIECES-2017) & Power, Circuit and Information Technologies (ICPCIT-2017) Madanapalle, Andhra Pradesh, India, 27-29 April 2017. [SCOPUS indexed].</p> | <p>Shruti Wadhwa C Ramakrishna Poonam Saini</p> |
| <p>"A Comparative Analysis of SVM and its Stacking with other Classification Algorithm for Intrusion Detection & Quot", International Conference on Advances in Computing, Communication & Automation, 2016, Tulas Institute Dehradun, India, pp. 1-6, 8-9 April 2016.</p> | <p>N Chand P Mishra C Ramakrishna E Pilli Govil</p> <p style="text-align: right;">M</p> |
| <p>"Performance Analysis of Supervised Learning based Intrusion Detection System", 2nd International Conference on Sustainable Computing Techniques in Engineering, Management and Science, at Jain Engineering College, Belgaum (Near Goa), India, 27- 28, January 2017. [SCOPUS Indexed].</p> | <p>Shalini Chaurasia C Ramakrishna</p> |
| <p>"AJIGJAX: A Hybrid Image Based Model for Captcha/CaRP," 3rd IEEE Uttar Pradesh Section International Conference on Electrical, Computer and Electronics, Indian Institute of Technology (Banaras Hindu University) Varanasi, India, 9-11 December, 2016 [Won First Prize].</p> | <p>Nitisha Payal C Ramakrishna</p> |
| <p>"Big Data Analytics using Multi-Classifer Approach with RHadoop,& Quot", 9th International Conference on Contemporary Computing, 2016, Jaypee Institute of Information Technology, Noida, India, August 11-13, 2016.</p> | <p>P Hiranandani N Chand Pillli M Gupta C Ramakrishna R Joshi</p> <p style="text-align: right;">E</p> |
| <p>"Recommendation Generation Using Typicality Based Collaborative Filtering,& Quot", 7th IEEE International Conference on Cloud Computing, Data Science & amp; Engineering, Noida, India, 12-13 January, 2017. [SCOPUS Indexed].</p> | <p>Sharandeep Kaur C Ramakrishna S Solanki N Chawla S Sharma K Kaur</p> |
| <p>"Recommending Music Using Interaction Based Social Proximity Factor", Proceedings of IEEE International Conference on Engineering and Technology Coimbatore, pp. 257-260, 16 December, 2016.</p> | <p>K Kaur S Sharma S Solanki Ramakrishna</p> <p style="text-align: right;">C</p> |

| | |
|---|---|
| “User Interactive Recommender System for Electronic Products Using Fuzzy Numbers”, Proceedings of 10th Springer International Conference on Advanced Computing and Communication Technologies, Panipat, India, 18-20 November 2016. [Scopus indexed]. | Shalini Sharma, C Ramakrishna, S. Solanki, S. Kaur, K. Kaur |
| “Preferred Device Early Availability for Faster User Response”, Confluence-2017:7th International Conference on Cloud Computing, Data Science & Engineering, 12-13 Jan 2017, Amity University, UP, India, ISBN: 978-1-5090-3519-9, pp. 335-340. | Amit Kumar Rakesh Kumar |
| “Optimal Resource Allocation Approach in Cloud Computing Environment”, 2nd IEEE International Conference on Next Generation Computing Technologies (NGCT - 2016), 14-16 October 2016, University of Petroleum and Energy Studies, Dehradun (India), ISBN Number: 978-1-5090-3257-0. | Pawan Kumar Rakesh Kumar |
| “An Enhanced Approach for Movie Recommender System using Association Rule Mining”, International Conference on Communication Computing and Networking. | Mariya Khurshid Rakesh Kumar Shano Solanki |
| “Min-Parent: An Effective Approach to Enhance Resource Utilization in Cloud Environment”, IEEE International Conference on Advances in Computing, Communication & Automation (ICACCA-2016), Dehradun, UK, April 2016. | Raj Kumar Mala Kalra Sudeep Tanwar Sudhanshu Tyagi Neeraj Kumar |
| “Load Balancing in Cloud Data Center Using Modified Active Monitoring Load Balancer”, IEEE International Conference on Advances in Computing, Communication & Automation (ICACCA-2016), Dehradun, UK, April 2016. | Ankit Kumar Mala Kalra |
| “Deadline Constrained Scheduling of Scientific Workflows on Cloud using Hybrid Genetic Algorithm”, IEEE International Conference on Cloud Computing, Data Science and Engineering (Confluence 2017), Amity University, Noida, January, 2017. | Gursleen Kaur Mala Kalra |
| “Cost-effective and Reliable Scheduling of Workflows in Cloud using Intelligent Water Drops Algorithm”, Proceedings of International Conference on Communication, Computing and Networking (ICCCN-2017), pp 293-299, NITTTR, Chandigarh, March 2017, ISBN: 978-8-193-38970-6. | Mala Kalra Sarbjeeet Singh |
| “Workflow Scheduling in Cloud Environment: A Comprehensive Review, Open Issues and Future Research Directions”, Proceedings of International Conference on Communication, Computing and Networking (ICCCN-2017), pp 202-211, NITTTR, Chandigarh, March 2017, ISBN: 978-8-193-38970-6. | Gursleen Kaur Mala Kalra |
| “Survey on Energy Efficient Techniques for Green Cloud Computing”, Proceedings of International Conference on Communication, Computing and Networking (ICCCN-2017), pp 233-240, NITTTR, Chandigarh, March 2017, ISBN: 978-8-193-38970-6. | Raksha Kiran Karda Mala Kalra Sarbjeeet Singh |
| “A Study on Virtualization in Green Cloud”, Proceedings of International Conference on Communication, Computing and Networking (ICCCN-2017), pp 212-219, NITTTR, Chandigarh, March 2017, ISBN: 978-8-193-38970-6. | Anjum Mohd Aslam Mala Kalra Sarbjeeet Singh |
| “A Review of Fault-Tolerant Workflow Scheduling Techniques”, Proceedings of International Conference on Communication, Computing and Networking (ICCCN-2017), pp 220-225, NITTTR, Chandigarh, March 2017, ISBN: 978-8-193-38970-6. | Urvashi Nag Mala Kalra Sarbjeeet Singh |
| “Discrete Binary Cat Swarm Optimization for Scheduling Workflow Applications in Cloud Systems”, 3rd IEEE International Conference on "Computational Intelligence and Communication Technology" (IEEE-CICT 2017), February, 2017, ABES Engineering College, Ghaziabad. | Bhopender Singh Mala Kalra Poonam Singh |
| “Internal crack detection in kidney bean seeds using X-ray imaging technique”, International Conference on Advances in Computing, Communications and Informatics (ICACCI), 21-24 September, 2016. | Surbhi Sood Shveta Mahajan, Amit Doegar Amitava Das |

| | |
|---|---|
| “GA Based Blind Deconvolution Technique of Image Restoration using Upstrum Domain of Motion Blur,” International Conference on Science, Engineering Law & Management, 06-07 January, 2017, Malaysia. | Maitreyee Dutta |
| “Design of Band Pass Digital FIR Filter using FCSD on FPGA for Satellite”, IEEE 4th International Conference on Computing for Sustainable Global Development, pp. 989-993, 2016. (Scopus Indexed). | Nirbhay Kumar Singh Rajesh Mehra Shallu |
| “Design Analysis of FIR Filter on FPGA for Communication Applications”, IEEE 4th International Conference on Computing for Sustainable Global Development, pp. 4871-4876, 2016. (Scopus Indexed). | Amit Kumar Rana Rajesh Mehra Shallu |
| “FPGA Based FIR Band Pass filter using Kaiser Window for Satellite Communication”, IEEE International Conference on Next Generation Computing Technologies (NGCT-2016), pp. 409-413, 2016. (Scopus Indexed). | Vivek Kumar Rajesh Mehra Shallu |
| “FPGA Based Design of Wave Digital Filter for 4G Application”, IEEE 4th International Conference on Computing for Sustainable Global Development, pp. 4940-4946, 2016. (Scopus Indexed). | Priya Singla Rajesh Mehra Shallu |
| “Butterworth Filter Design for ECG on FPGA”, IEEE 4th International Conference on Computing for Sustainable Global Development, pp. 4877-4882, 2016. (Scopus Indexed). | Ranjeet Singh Chauhan Rajesh Mehra Shallu |
| “FPGA Based IIR Filter Design Analysis for Audio Application”, IEEE 4th International Conference on Computing for Sustainable Global Development, pp. 4889-4894, 2016. (Scopus Indexed). | Shefali Bharti Rajesh Mehra Shallu |
| “Area and Speed Efficient Layout Design of Shift Registers using Nanometre Technology”, International Conference on Advances in Sensors, Actuators, Metering and Sensing (ALLSENSORS), pp. 58-62, ISBN-978-1-61208-543-2, 2017. | Rajesh Mehra Priya Kaushal Ayushi Gagneja |
| “Denoising and SNR Improvement of ECG Signals Using Wavelet Based Techniques”, 2nd IEEE International Conference on Next Generation Computing Technologies, pp. 678-682, October 2016. (Scopus Indexed). | Tanuj Yadav Rajesh Mehra |
| “Prototype Design of Computationally Efficient Digital Down Converter for 3G Applications” for presentation in 10th International Conference on Advanced Engineering Computing and Applications in Sciences, 09-13 October, 2016 at Venice Italy. | Rajesh Mehra |
| “Implementation and Designing of FIR Filters using Kaiser Window for De-Noising of Electrocardiogram Signals on FPGA”, IEEE Seventh Power INDIA International Conference (PIICON) 2016. (Scopus Indexed). | Laxmi Mehra Rajesh Chandni |
| “Reconfigurable FIR Filter for Denoising of ECG” IEEE 7th Power India International Conference (PIICON), November 2016. (Scopus Indexed) | Bhupender Singh Rajesh Mehra Chandni |
| “FPGA Based Implementation of Pulsed Radar with Time Delay in Digital Beam Forming using Partially Serial Architecture”, 3rd IEEE International Conference CICT, 2017. (Scopus Indexed). | Rabil Khanna Rajesh Mehra Chandni |
| “FPGA Based Decimator using Fully Parallel Technique for Hearing Aid Applications”, 3rd IEEE International Conference CICT, 2017. (Scopus Indexed). | Karuna Grover Rajesh Mehra Chandni |
| “Prototype Design of Computationally Efficient Digital Down Converter for 3G Applications”, International Conference on “Advances in Sensors, Actuators, Metering and Sensing (ALL SENSORS), pp-52-57, ISBN: 978-1-61208-506-7, 2017 | Rajesh Mehra |
| “Implementation and Designing of FIR Filters using Kaiser Window for De-noising of Electrocardiogram Signals on FPGA”, IEEE 7th Power India International Conference (PIICON), November 2016. (Scopus Indexed). | Surrender Kumar Rajesh Mehra Chandni |
| “ASIC Implementation of low pass FIR CSD Filter for Audio Applications”, International Conference on Science, Engineering, Law & Management (ICSELM), 2017. (Scopus Indexed). | Susama Rajesh Mehra Chandni |

| | |
|---|--|
| "Area and Speed Efficient Layout Design of Shift Registers using Nanometer Technology", International Conference on Advances in Sensors, Actuators, Metering and Sensing, pp. 58-62, Nice, France, March 2017. ISBN: 978-1-61208-543-2 | Rajesh Mehra |
| "Comparative Analysis of 2-Dimensional Codes for OCDMA System" in Proceedings, 47th Mid Term Symposium on Modern Information and Communication Technologies for Digital India (MICTDI) Chandigarh, India pp 13, 2016. | Mukesh Kumar Umesh Kumar Tiwari Kanika Sharma Sandeep Singhai |
| "Study of Chirped FBG Demultiplexer for UDWDM Passive Optical Network" Proceeding of 47th International Symposium on MICTDI , Chandigarh, pp-9, April 2016. | Chhavi Saini Umesh Tiwari Kanika Sharma Sandeep Singhai |
| "Comparative Analysis of Hierarchical Clustering Schemes for Wireless Sensor Network – A Review" 47th Mid- term Symposium on Modern Information & Communication Technologies for Digital India (MICTDI), pp.2 April 2016. | Ravi Kumar Anand Kanika Sharma |
| "A Review on Energy Efficient and Traffic Handling in Mobile Sensor Networks by usage of Hybrid Compressive Sensing and Improved MEMAC", IEEE Internal Conference on Computing and Sustainable Global Development, 01 - 03 March, 2017. | Rachit Manchanda Kanika Sharma |
| "Review on Reducing Energy Consumption and Improving the Lifetime of LEACH Protocol for Wireless Sensor Networks", IEEE Internal Conference on Computing and Sustainable Global Development, 01 - 03 March, 2017. | Bharti Goyal Kanika Sharma |
| "Review on Data Gathering in Wireless Sensor Networks with Compressive Sensing", IEEE Internal Conference on Computing and Sustainable Global Development, 01 - 03 March, 2017. | Aman Jindal Kanika Sharma |
| "Soft Computing Technique Implementation and Challenges in Antenna Engineering", IEEE International Conference on Micro Electronics and Telecommunication Engineering, pp-167-172, 2016. | Anamika Sharma Garima Saini |
| "Miniaturization of Microstrip Patch Antenna using Polygon Shaped Slot", Proceedings of 47th IETE Mid-term Symposium on Modern Information and Communication Technologies for Digital India, Volume 6, Issue 07, pp. 2000-2003, July, 2016. | Vaishali Kamboj Garima Saini Ashish Saini |
| "Four Slots SRR Loaded PIFA for 5GHz", Proceedings of 47th IETE Mid-term Symposium on Modern Information and Communication Technologies for Digital India, pp. 3, 2016. | Neha Yadav Garima Saini |
| "Effect of Split Ring Resonator slot Position on Planar Inverted-F Antenna", Proceedings of 47th IETE Mid-term Symposium on Modern Information and Communication Technologies for Digital India, Volume 6, Issue 08, pp. 2224-2226, August, 2016. | Neha Yadav Garima Saini |
| "Miniaturization of Microstrip Patch Antenna using Polygon Shaped Slot", Proceedings of 47th IETE Mid-term Symposium on Modern Information and Communication Technologies for Digital India, Volume 6, Issue 07, pp. 2000-2003, July, 2016. | Vaishali Kamboj Garima Saini Ashish Saini |
| "Recent improvement in Feeding Structure of Impulse Radiating Antenna", Proceedings of 47th IETE Mid term Symposium on Modern information and Communication Technologies for Digital India, 9th - 10th April 2016. | Sarabjeet Kaur Garima Saini |
| "A PAPR Reduction Analysis of Various Technique in OFDM System", International Conference on Micro Electronics and Telecommunication Engineering, pp. 349-354, 2016. | Arushi Garg Garima Saini |
| "Silicone Rubber Superstrate Loaded Patch Antenna Design using Slotting Technique", IOP Conference Series: Materials Science and Engineering , pp. 1-8, 2016, ISSN No: 1757899X. | Bhupinder Kaur Garima Saini Ashish Saini |

| | |
|--|--|
| “Effect of Polyurethane Resin over Microstrip Patch Antenna”, 3rd National Conference on Multifunctional Advanced Materials Science, pp. 22-23, May 2016. | Bhupinder Kaur Garima Saini Ashish Saini |
| “Wideband Planar Inverted-F antenna with Circular Split Ring Resonator Loading”, International Conference on Engineering and Applied Sciences, pp. 220-227, 8th – 10th June 2016, Hong Kong. | Garima Saini SS Pattnaik |
| “SRR Loaded Multiband Planar Inverted F Antenna”, International Conference on Science, Engineering, Law & Management, 06-07 January, 2017, Malaysia. (Awarded Best Paper Award). | Garima Saini SS Pattnaik |
| “Perceptions of Students Regarding Quality of Instruction in Technical Institutions in India”, National Conference on Technical & Vocational Education in India: Challenges & Opportunities, NITTTR, Chandigarh, 17 March, 2017. | PK Tulsi SP Bedi Sunil Dutt TN Thukral Amandeep Kaur |
| “Perceptions of Students Regarding Evaluation of Students’ Performance”, National Conference on Technical & Vocational Education in India: Challenges & Opportunities, NITTTR, Chandigarh, 17 March, 2017. | PK Tulsi SP Bedi Sunil Dutt TN Thukral Amandeep Kaur |
| “Strategies Adopted by Technical Institutions to Promote Research Culture: Perceptions of Students”, National Conference on Technical & Vocational Education in India: Challenges & Opportunities, NITTTR, Chandigarh, 17 March, 2017. | PK Tulsi SP Bedi Sunil Dutt TN Thukral Amandeep Kaur |
| “Impact of Training Programmes organized by NITTTR on Technical Education System”, National Conference on Technical & Vocational Education in India: Challenges & Opportunities, NITTTR, Chandigarh, 17 March, 2017. | PK Tulsi MP Poonia |
| “Stator Condition Assessment in Three Phase Induction Motor using Inrush Current Analysis”, 47th Midterm Symposium on Modern Information and Communication Technologies for Digital India (MICTDI-2016). IETE Chandigarh Centre and CSIR-CSIO, Chandigarh, April, 2016. | N Prasad Gupta Amandeep Sharma Lini Mathew Prashant Kumar Pankaj Verma |
| “Review on Superconducting Fault Current Limiter”, 47th Midterm Symposium on Modern Information and Communication Technologies for Digital India (MICTDI-2016). IETE Chandigarh Centre and CSIR-CSIO, Chandigarh, April, 2016. | Shilpi Yadav Lini Mathew Kuldeep Singh Rajput |
| “Energy Conservation Opportunities in Institutional Buildings – A case Study in India”, IEEE International Conference on Power and Renewable Energy (ICPRE 2016) held at Shanghai, China, October, 2016 (Awarded Excellent Paper). | Ashmita Rupal Poonam Syal Sanjay Sharma |
| “Discrete Wavelet Packet Based Elbow Movement Classification Using Fine Gaussian SVM”, 1st IEEE International Conference on Power Electronics, Intelligent Control and Energy Systems (ICPEICES), pp. 1-5, Delhi, July 2016. DOI: 10.1109/ICPEICES.2016.7853657. | Prateek Viridi Yogendra Narayan Preeti Kumari Lini Mathew |
| “Binary Movement Classification of SEMG Signal using Linear SVM and Wavelet Packet Transform”, 1st IEEE International Conference on Power Electronics, Intelligent Control and Energy Systems (ICPEICES), pp. 1-4, Delhi, July 2016. DOI: 10.1109/ICPEICES.2016.7853657. | Babita Preeti Kumari Yogendra Narayan Lini Mathew |
| “Educational and Employment Challenges for Visually Challenged – An exploratory investigation in India”, International Conference on Educational Futures, NITTTR, Chandigarh, November, 2016. | Poonam Syal Renuka Sharma Abhishek Syal |
| “Measurement of Soil Attributes Using NIR Spectroscopy: A Review”, International Conference on Recent Innovations in Sciences, Management, Education and Technology, JCD Memorial College, Sirsa, Haryana, 27th August, 2016. | Vikash Yadav Ritula Thakur |

| | |
|--|---|
| “A Novel Method for Rapid and Non-Destructive Determination of Moisture Content in Fruits”, International Conference on Agricultural Sciences and Food Technologies for Sustainable Productivity and Nutritional Security, 25-27 August, 2016. | Ritula Thakur Babankumar |
| “Optical Sensing of Soil Macronutrients”, National Conference on Signal Processing & Smart Sensor Network, SRMS Women’s College of Engineering & Technology, 19 April, 2016. | Jyoti Singh Babankumar Ritula Thakur |
| “Chemometric Modeling and Signal Processing Approach for Raman Spectra”, National Conference on Signal Processing & Smart Sensor Network, SRMS Women’s College of Engineering & Technology, 19 April, 2016. | Namarat Gandhi Babankumar Ritula Thakur |
| “Enhanced Howland Based Constant Current Source for Soil ECa Measurement”, National Conference on Signal Processing & Smart Sensor Network, SRMS Women’s College of Engineering & Technology, 19 April, 2016. | Ritula Thakur Babankumar |
| “A Novel Six Level Inverter for Single-Phase Stand-Alone Photovoltaic System”, 18th European conference on power electronics and application, pp1-8, October 2016. | SK Rai P Chaturvedi Shimi SL |
| “SHE-PWM based Multilevel T-Type Inverter Topology for Single-Phase Photovoltaic Applications”, IEEE International conference on power electronics , drives and energy systems, Trivandrum , India , 14-17 December, 2016. | SK Rai P Chaturvedi Shimi SL |
| “A Multilevel Inverter Topology for Single-Phase PV System”, IEEE 7th Power India International Conference, Govt. Engineering college Bikaner, Rajasthan, India, 25-27 November, 2016. | SK Rai P Chaturvedi Shimi SL |
| “Phasor Measurement Unit and its Application to Smart Grid”, National Conference on Recent Advancement in Communication system and data Engineering, Jamshedpur, October, 2016. | Arindam Chowdhury Shimi SL Mithilesh Kumar |
| “Real Time Speed Control of Induction Motor using New Generation DSP Controller”, 2nd IEEE Conference on Innovative Applications of Computational Intelligence on Power, Energy and Controls with their Impact on Humanity (CIPECH-16), KIET Group of Institutions, Ghaziabad, 18-19 November, 2016 (Published in Book of Proceeding). | Gopal Lal Jat Kartar Singh Abhay Mahajan Shimi SL |
| “A Simple Feed Forward Fuzzy Direct Torque Control of DSP Based Induction Motor Drive”, IEEE Conference on Electrical Power and Energy Systems (ICEPES-16), Maulana Azad National Institute of Technology, Bhopal, India. 14-16 December, 2016 (Published in Book of Proceeding). | Gopal Lal Jat Abhay Mahajan Kartar Singh Shimi SL |
| “Lighting Audit through MATLAB Graphical User Interface (GUI)”, 2nd., International Conference on Advances in Computing, Communication, & Automation (ICACCA), IEEE Explore, pp. 1-6, Sept.-October., 2016. | Ranjay Kumar Ojha Lini Mathew Tilak Thakur |
| “Design and development of a Graphical User Interface for Real Time Monitoring and Analysis of Vital Human Body Parameters”, 1st IEEE., International Conference on Power Electronics, Intelligent Control and Energy Systems (ICPEICES), pp. 1-8, Delhi, July 2016. DOI: 10.1109/ICPEICES.2016.7853657. | Prabhjot Kaur Lini Mathew |
| “Design an Intelligent Controller for a Process Control System”, International Conference on Innovation and Challenges in Cyber Security (ICICCS-INBUSH), pp. 217-223, Greater Noida, February 2017. DOI: 10.1109/CICCS.2016.7542302. | Meenakshi Sharma Pallavi Verma Lini Mathew |
| “Droop Control of Solar PV, Grid and Critical Load Using Suppressing DC Current Injection Technique without Battery Storage”, International Conference on Advanced Material Technologies (ICAMT 2016), Visakhapatnam, India, December 2016. (icamt2016.org/papers/MT0462.pdf). | Jayachandra Dama Lini Mathew G.Srikanth |
| “Detection, Localization and Reduction of Power Quality Disturbances Using Various Mother Wavelet , Transform”, 3rd International Conference on Recent | Amit Singh Lini Mathew Navneet K Singh |

| | |
|--|---|
| Developments in Science, Engineering and Technology (REDSET 2016), Gurgaon, India, October, 2016. | |
| “Design and Implementation of Three Phase Three Level Inverter Based DSTATCOM”, 4th International Conference on Power, Control and Embedded System (ICPCES 2017), MNNIT, Allahabad, India, March, 2017. | Anju Bala Geeta Thakur Lini Mathew |
| Analysis of Postural Transitions and Implementation of Control of Lower Limb Exoskeleton Device”, IEEE International Conference on Computing, Communication and Control Technology (IC4T-2016), Lucknow, India, November, 2016. | Devendra Mohan Ratan Das Neelesh Kumar Lini Mathew |
| “Detection, Localization and Reduction of Power Quality Disturbances Using Wavelet Transform”, 1st International Conference on Computer, Communication and Management Technologies (ICCCMT-2016), Allahabad, India. | Amit Singh Lini Mathew Navneet K Singh |
| “Integrating Environmental Impact Assessment System for Construction Projects in India with Green Building Practices to Achieve Sustainable Development”, International Conference on Clean Energy at McGill University, Montreal, Canada, 22-24 August, 2016. | SK Dhameja |
| “Business Opportunities in Chandigarh, Urban Observatory Workshop by UK India Joint Network on Sustainable Cities and Urbanisation in India”, Hotel Mount View, Chandigarh on 18th January, 2017. | SK Dhameja |
| “Business Start-up through Incubation in TVET Sector, National Conference on Technical & Vocational Education and Training in India : Challenges and Opportunities”, CPSC Manila and NITTTR Chandigarh, 17th March, 2017. | SK Dhameja |
| “Entrepreneurship and Development in Punjab: Transitions in Economic Landscape”, International Conference on “50 Years of Economic Development in Punjab” organized by the Department of Economics, Punjabi University, Patiala (Punjab) in collaboration with CIPT, New Delhi, 25 – 26 March, 2017 at Punjabi University, Patiala (Punjab). | Piyush Verma Amardev Singh Ridhi Arora |
| “Recycling of Titanium and its Alloys for sustainable Development – An overview”, International Conference on Interdisciplinary Research for Sustainable Development 2016, Chandigarh, India. | Rishi Gaur SS Banwait |
| “Optimisation of Spur Gear Design for Defect Minimisation : A Case Study”, 30th International Conference on advances and Trends in Engineering Materials and their Applications, Ottawa, Canada, October, 2016. | Pavitar Pal SS Banwait |
| “Investigation of Surface Roughness of Single Point Diamond Turned Germanium Substrate by Coherence Correlation Interferometry and Image Processing; IOP”, Conf. Series: Materials Science and Engineering 149 (2016) 012032 doi:10.1088/1757-899X/149/1/012032. | Shivani Gupta Neha Khatri Vinod Karar SS Dhami |
| “A Hybrid Controller for Position Control of a Pneumatic Actuator under Variable Loading Conditions”, 3rd International Conference on Mechatronics and Mechanical Engineering (ICMME2016), Shanghai, China, 21-23 October, 2016. | SS Dhami |
| “Condition Based Maintenance of Bearings and Gears for Fault Detection – A Review; (2016)”, 7th International Conference on Materials Processing & Characterization, Elsevier, Hyderabad, 17-19 March, 2017. | Kumar S Goyal D Dang RK Dhami SS Pabla BS |
| “Statistical and Frequency Analysis of Acoustic Signals for Condition Monitoring of Ball Bearing; (2016)”, 7th International Conference on Materials Processing & Characterization, Elsevier, Hyderabad, 17-19 March, 2017. | Kumar S Goyal D Dhami SS |
| “Intelligent Predictive Maintenance of Dynamic Systems using Condition Monitoring and Signal Processing Techniques - A Review; (2016)”, International Conference on Advances in Computing, Communication, & Automation (ICACCA | Vanraj Goyal D Saini A |

| | | |
|---|-----|--|
| 2016), Dehradun, IEEE, DOI: 10.1109/ICACCA.2016.7578870, April, 2016. | 8-9 | Dhami SS Pabla BS |
| “Effect of Cryogenic Treatment and Electrodeposited Ni-TiO ₂ on Tungsten Carbide Tools” for presentation in International Conference on Advances and Trends in Engineering Materials and their Application, Toronto, Canada, 04-08 July, 2016 | | BS Pabla |
| “Prediction of Multi-Response Parameters in Material Removal Processes using Soft Computing – A Review; (2016)”, International Conference on Advances in Computing, Communication, & Automation (ICACCA 2016), Dehradun, IEEE, DOI: 10.1109/ICACCA.2016.7578855, April 8-9, 2016. | | Saini A Goyal D Vanraj Pabla BS Dhami SS |
| “Optimization of Cutting Parameters for Minimizing the Surface Roughness and Specific Energy: Review Paper”, CPIE International Conference at NIT, Jalandhar, 19-21 December, 2016. | | Sachin Sharma PS Rao |
| “Minimization of Specific Energy Consumption and Surface Roughness in Wet Machining by Optimizing the Cutting Parameters”, CPIE International Conference at NIT, Jalandhar, 19 - 21 December 2016. | | Sachin Sharma PS Rao Amit Singh |
| “DEM Simulation and Analysis Powder Material Velocity and Mass Flow Rate in Hopper Models of Different Hopper Angles”, CPIE International Conference at NIT, Jalandhar, 19-21 December, 2016. | | Veneet Kumar PS Rao Dinesh Pal |
| “CFD Analysis of Nozzle Based System To Synthesized Submicron Particle”, CPIE International Conference at NIT, Jalandhar, 19 -21 December, 2016 | | Sachin Sharma PS Rao Parmod Kumar |
| “Impact of Residential Building Towers on Ambient Air in Peri Urban Areas of Chandigarh, UT, India”, in ISER 67th International Conference on Science, Technology, Engineering & Management (ICSTEM) at New York 15-16 Oct. 2016. | | RK Wats |
| “Correlation between Enhancing Stresses and Trends of Self Medication among Young Girls in Chandigarh”, 3rd International Conference on Public Mental Health & Neurosciences - ICPMN-2016, Bangalore, December 14-15, 2016. | | RK Wats |
| “IPO Financing: An Alternative Source of Financing for SMEs in Current Era”, IORS Journal of Business and Management, Volume 18, Issue 7 (July 2016) PP 119-125. | | Gupta Versha JS Saini |
| "Viscoelastic Properties of Old Rubber Tyres: A Seismically Innovative Approach for Load Bearing Structures", ICSSR Sponsored National Seminar on Disaster Risk Reduction in North-Western India, 6-7 March, 2017 at Department of Geography, Punjab University Chandigarh. | | Amit Goyal Pankaj Agarwal |
| "Use of Co-Polymer of Styrene Butadiene Rubber-A Seismically Innovative Approach towards Energy Dissipation", 11th International Symposium on Plasticity and Impact Mechanics, Implast 2016, IIT Delhi. | | Amit Goyal Pankaj Agarwal |
| "Innovative Approach Towards Earthquake Resistant Construction", International Conference on Educational Future, 18-19 November, 2016 at NITTTR, Sector-26, Chandigarh. | | Amit Goyal Pankaj Agarwal |
| "Climate Change and Sustainable Development: Regional and Grassroots Initiatives", National Seminar on "Disaster Risk Reduction in North-Western India" organized by Geography Department of Panjab University on 6-7 March 2017. | | UN Roy |
| “An Efficient Multi-Keyword Synonym-Based Fuzzy Ranked Search over Outsourced Encrypted Cloud Data,” 9th International Conference on Advanced Computing and Communication Technologies, India, Panipat, 27-29 November 2015 | | Vandana Saini C Ramakrishna Neelam S Khan |
| “Dynamic Cluster based Privacy-Preserving Multi-Keyword Search over Encrypted Cloud Data,” 6th International Conference on Cloud System and Big Data Engineering, 14-15 Jan 2016, Amity University, Noida, India | | Gagan C Ramakrishna Rohit Hand |

| | | |
|--|---|--------------|
| “Botnet Analysis Using Ensemble Classifier,” International Conference on Recent Trends in Engineering And Material Sciences (ICEMS-2016), Jaipur National University, Jaipur, India, March 17-19, 2016 | Bijalwan Chand C Ramakrishna | N E Pilli |
| “Survey on Recent DDoS Mitigation Techniques and Comparative Analysis,” 2nd IEEE International Conference on Computational Intelligence and Communication Technologies (CICT-2016), ABES Engineering College, Ghaziabad, 12-13 February, 2016 | Ankur Rai C Ramakrishna | |
| “Dynamic Cluster based Privacy-Preserving Multi-Keyword Search over Encrypted Cloud Data,” 6th International Conference on Cloud System and Big Data Engineering, 14-15 Jan 2016, Amity University, Noida, India | Gagan C Ramakrishna Rohit Hand | |
| “Data Security and Optimization in Health Care Using Cloud Computing: A Review,” IETE National Conference on ICT in Health Care, MNIT, Jaipur, India, 05 March, 2016 | Vartika Kulshrestha Seema Verma C Ramakrishna | |
| “Big Data Analysis Techniques and Challenges in cloud Computing Environment”, International Conference on Communication, Information and Computing Technology (ICICT-15), 12-13 May, 2015 | Pawan Kumar Aditya Bhardwaj Amit Doegar | |
| “Independent Task Scheduling in Cloud Environment Using Big Bang- Big Crunch Approach”, IEEE International Conference on Recent Advances in Engineering and Computational Science Panjab University, Chandigarh, 21-22 December 2015 | Vandana Kumari Mala Kalra Sarbjeeet Singh | |
| “Energy Optimized VM Placement in Cloud Environment”, IEEE International Conference- CONFLUENCE – 2016, Amity University, Noida, 14-15 January 2016 | Amandeep Kaur Mala Kalra | |
| “Vision Based Computer Mouse Control Using Hand Gestures”, IEEE International Conference on Soft Computing Techniques and Implementations (ICSCTI), pp. 85-89, October 2015. | Sandeep Thakur Rajesh Mehra Buddhi Prakash | |
| “Reducing Computational Cost of ECG Signal Using Multirate Signal Processing”, IEEE International Conference on Soft Computing Techniques and Implementations (ICSCTI), pp. 51-56, October 2015. | S K Mirania Rajesh Mehra G P Pal | |
| “Blind Audio Source Separation Using Wiener Filtering Approach”, IEEE Conference, pp.1-6, 2015. | Pardeep Sharma Rajesh Mehra Naveen Dubey | |
| “Design, Performance and Cost Analysis of Various Band Pass IIR Filters for Myriametre Band Applications”, IEEE, 2015. | Manish K Soni Rajesh Mehra Rajesh Kumar | |
| “Adaptive Filter Design for ECG Noise Reduction Using LMS Algorithm”, IEEE Conference, 2015. | Ishika Sharma Rajesh Mehra Monika Singh | |
| “An Improved Digital Image Watermarking Technique using DCT for protecting Distribution Rights”, IEEE International Conference on Contemporary Computing, 2015. | Gaurav Gupta Amit M Joshi Kanika Sharma | |
| “Antennas for Cognitive Applications: Concepts and Design Approaches”, International conference on Electronics Design Innovations and Technologies, pp. 146-149, June, 2015. | Amit Verma Garima Saini | |
| “Modified Cuckoo Search-Based Image Enhancement,” Proceedings of the 4th International Conference on Frontiers in Intelligent Computing: Theory and Applications (FICTA) November, 2015, Advances in Intelligent Systems and Computing 404, pp. 625-634, DOI 10.1007/978-81-322-2695-6_53 Springer India 2016. | Lalit Maurya PK Mahapatra Garima Saini | |
| “Statistical Tuning of Cost-231 Hata Model at 1.8Ghz over Dense Urban Areas of Ghazibad”, International Conference on Computing for sustainable Global Development”, pp. 7084-7089, March, 2016. | Ranjeeta Verma Garima Saini | |
| “Development of Efficient Resource Allocation Algorithm in Chunk Based OFDMA System”, Proceedings of International Conference on Advancements in Engineering & Technology, pp. 144-147, March, 2016. | Ranjeeta Verma Garima Saini | |

| | |
|---|---|
| “Evaluation of Training Programmes offered Online in India”, International Conference on e-Learning in Workplace from 10-12 June, 2015 at New York. | PK Tulsi MP Poonia |
| “Learning Styles and Achievements of Engineering Students”, IEEE EDUCON 2016 April, 2016 at Abu Dhabi. | PK Tulsi MP Poonia Anu Priya |
| “Training of Technical Teachers in India: A Case of NITTTR”, IEEE EDUCON 2016 April, 2016, Abu Dhabi. | PK Tulsi MP Poonia Anu Priya |
| “Research at Higher Education : Problems and Actions Required” in World Summit on Accreditation (WOSA-2016”), 18-19 March, 2016, NBA at Hotel Leela Ambience, Gurgaon. | PK Tulsi MP Poonia |
| “Assessment of Fault Diagnosis Techniques of Induction Motors”, in International Conference on Innovation in Engineering science And Management (ICIESM – 2016), ICC, New Delhi, January 2016. | Amandeep Sharma S. Chatterji Lini Mathew Niranjana Gupta |
| “Sustainable Skill Development and Workforce Training for Persons with Disability: An Exploratory Study in the United States”, International Conference on Sustainable Skill Development: Challenges and Future Perspectives, held on 18-19 February, 2016, NITTTR, Chandigarh. | Abhishek Syal Poonam Syal Dmitri Leybman Sabiha Shirol |
| “Energy Conservation Measures – A case Study of Cement Unit”, - 2nd IEEE International Conference on recent advances in Engineering & Computational Sciences organized by UIET, Chandigarh, Punjab University Chandigarh, held on 21-22 December, 2015. | Poonam Syal Amritpal Singh |
| “Modelling and Simulation of Hybrid Power Flow Controller Implemented on Multi Machine System”, 2nd International Conference (IEEE Sponsored) on Recent Advances in Engineering and Computational Sciences (RAECS-2015), UIET, Panjab University, Chandigarh, India, December 2015. | Lini Mathew S Chatterji |
| “Speech Recognition Based Robotic Arm with Six Degrees of Freedom”, International Conference on recent Advance in Computing, Communication & Electrical Technology (RACCET 2015), HR Group of Institutions, Ghaziabad, U.P., April 2015. | Farooq A. Tantray Shimi SL Lini Mathew |
| “Design and Implementation of Smart Industrial Automation System using VHDL on FPGA”, International Conference on Recent Trends in Electrical Engineering (ICRTEE-15), Patil College of Engineering & Technology, Nagpur, 22-23 April 2015. | Deepak Kumar Lini Mathew |
| “Design of FPGA Based PID Controller for Industrial Application”, International conference on Recent Trends in Electrical Engineering (ICRTEE-15), Patil College of Engineering & Technology, Nagpur, 22-23 April 2015. | Ashutosh Chahande Lini Mathew |
| “Hybrid Control of Robotic Arm using EEG and EMG signals: A Review”, International Conference on Emerging & Futuristic Trends in Engineering & Technology, Maharaja Agrasen University, Baddi, H.P., May, 2015. | Ram Murti Singh Sumit Kumar Yogendra Narayan Mohd. Junaid Khan Lini Mathew S Chatterji |
| “Literature Review on Solar Maximum Power Point Tracking (MPPT) System”, International Conference on Trends in Engineering, Maharaja Agrasen University, Baddi, H.P., May, 2015. | Mohd. Junaid Khan Yogendra Narayan Lini Mathew S Chatterji |
| “Intelligent Cooling System for Three Level Inverter”, International Conference on Communication, Control and Intelligent Systems (CCIS), at GLA University, Mathura, November 2015. | Alok Deep Jyoti Singh Yogendra Narayan S Chatterji Lini Mathew |

| | |
|--|--|
| “Development of a Software Module for Feature Extraction and Classification of EMG Signals”, International Conference on Communication, Control and Intelligent Systems (CCIS), GLA University, Mathura, November 2015. | Chanchal Garg Yogendra Narayan Lini Mathew |
| “Robotic Arm Controlling using Automated Balancing Platform”, International Conference on Communication, Control and Intelligent Systems (CCIS), GLA University, Mathura, November 2015. | Alok Deep Singh Jyoti Singh Yogendra Narayan S Chatterji Lini Mathew |
| “A Review Soil pH Sensing Techniques and Technologies”, National Conference ARTEC-2015, SRMS Women’s College of Engineering & Technology, Bareilly, 25th April 2015. | Sachin Kumar B S Bansod Manish Kumar Ritula Thakur |
| “A Review: Determination of Water Quality Index for Portable Water Using FIS, National Conference on Advances & Research Trends in Electronics & Communication (ARTEC-2015)”, SRMS Women’s College of Engineering & Technology, Bareilly, 25th April 2015. | Danish Akhtar Ritula Thakur |
| “A Safe Route Synthesis of Antimony Nanostructures for Fabrication of Electrodes”, National Conference on Nanoscience and Instrumentation Technology (NCNIT-2015), Kurukshetra, 19-20, June 2015. | Manish Kumar B S Bansod Sachin Kumar Zeba Parveen Jaspreet Kaur Ritula Thakur |
| “In Situ Embedded Arsenic Sensor Based on rGO/MnOx Nanocomposite Modified Glassy Carbon Electrode”, Proceedings of NCNIT, NIT, Kurukshetra, pp 19-20, June 2015. | Pooja Devi B S Bansod Manpreet Kaur Ritula Thakur |
| “Nano Carbon/Manganese Oxide Nanocomposite for Electrochemical Detection of arsenic in Water- A Step towards Portable Real Time Sensor”, International Conference on Signal Processing, Computing and Control, Jaypee University of Information Technology, Solan, H.P. 24th-26th September, 2015. | Pooja Devi BS Bansod Manpreet Kaur Ritula Thakur |
| “Need of ICT for Sustainable Development of Power Sector”, International Conference on ICT for Sustainable Development (ICT4SD - 2015), Ahmedabad, 3-4 July 2015. | Prashant Kumar Shimi S L Lini Mathew Pushpendra Singh |
| “Advanced Power System Configuration for Sustainable Grid , International Conference on Solar and Smart Grid”, KIIT University, Bhubaneswar, 5-6 February 2016. | Prashant Kumar Shimi S L Lini Mathew Pushpendra Singh |
| “Harmonic Elimination in a Solar Powered Cascaded Multilevel Inverter Using Genetic Algorithm and Differential Evolution Optimization Techniques”, Proceedings of the ASME 2015 International Mechanical Engineering Congress & Exposition IMECE2015, Houston, Texas, November 13-19, 2015, | Shimi S L Tilak Thakur Jagdish Kumar |
| “Emerging Global Trends – Women and Rural Entrepreneurship”, National Seminar on Entrepreneurship Education in TVET Sector of Bhutan (8th October, 2015) | SK Dhameja |
| “Application of Blue Ocean Strategy for Entrepreneurship in TVET” in International Conference on TVET Skills for Poverty Alleviation, Entrepreneurship and Employability, CPSC Manila, 22-23 June, 2015. | SK Dhameja |
| “Gesture Based Control of a Simulated Robot Manipulator 2015 ASME”, International Design Engineering Conference, August, 2015 Boston, USA | SS Dhami Ashutosh Sharma Rohit Kumar Parveen Kalra |
| “Electrochemical Honning-An Innovative Approach”, 2nd DAAAM International Conference at University of Zadar, Croatia , 21-24 October, 2015 | PS Rao PK Jain |

| | |
|---|------------------------------|
| “Sustainable Skill Development”, International Conference on Sustainable Skill Development NITTTTR, Chandigarh, 18-19 March, 2016 | Rakesh Wats |
| “Stress, Stressors and De-Stressors among College (Science) Students-A Case Study of DAV College, Panjab University, Chandigarh”, International Conference on Public Mental Health & Neurosciences (ICPMN 2015) Bengaluru, 9-10 December, 2015 | Rakesh Wats |
| “Comparison of Mental Well Being Amongst the Technical and Non-Technical Sciences Students”, International Conference on Public Mental Health & Neurosciences (ICPMN 2015) Bengaluru, 9-10 December, 2015 | Rakesh Wats |
| “Experiences of Implementing Community Development through Polytechnics [CDTP] Scheme and Strategic Actions for its Sustainability: - A Case Study, International Conference on Sustainable Skill Development: Challenges and Future Perspectives”, 18-19 February, 2016 at NITTTTR, Chandigarh | UN Roy YK Anand |
| “Action Research and Intervention for Improved Water and Sanitation and Sustainable Rural Development”, National Seminar on Population and Development: Issues and Challenges in 21st Century, held at Nagpur from 18-19 March, 2016 | UN Roy |
| “Shake Table Testing of Seismic Resistant Inter-Linked Block Masonry System with Vicoelastic Energy Dissipator Links”, Proceeding of the International Seminar on emerging Building Material and Construction Technologies, March 2016, New Delhi, 251-258. | Amit Goyal Pankaj Agarwal |

CONFERENCE (NATIONAL/INTERNATIONAL) PUBLICATIONS BY INSTITUTE FACULTY

[CONTRIBUTIONS OF NEWLY JOINED FACULTY TO OTHER ORGANIZATIONS AFTER JOINING NITTTTR CHANDIGARH]

| Details of the Paper Published | Author (s) Name |
|--|---|
| “Design and Investigation of TFET Biosensor for High Sensitivity”, National Conference on Biomedical Engineering, Dept. of ECE, NITTTTR Chandigarh, 22-24 Jan 2020 | Girish Wadhwa and Balwinder Raj, |
| “Design of Waste Heat Recovery System for Green Environment”, 2nd International Conference on Recent Innovations in Computing (ICRIC-2020), March 20-21, 2020, Central University of Jammu, J & K. (Scopus Indexed) | Meenakshi Sood, Pramod Kumar, Shruti Jain |
| Anomaly Detection and Qualitative Analysis of Diseases in Tomato Plant Using Texture Features, 2nd International Conference on Recent Innovations in Computing (ICRIC-2020), March 20-21, 2020, Central University of Jammu, J & K. (Scopus Indexed) | Anjna, Meenakshi Sood Pradeep Kumar Singh |

PATENTS PUBLISHED

1. Real Time Non-Contact Vibration Measuring System for Structural Health Monitoring (Ref. Application No. 3567/DEL/2015 A dated 21/10/2016
Name of Inventor : Goyal Deepam , Pabla Bahadur Singh
2. Personalised LPG Cylinder Handling System for Domestic Delivery Person (Ref. Application No. Application No.201711004209 A dated 17/02/2017
Name of Inventor : Dr. S.S. Dhama, Mr. Praveen Siyag, Dr. Harlal Singh

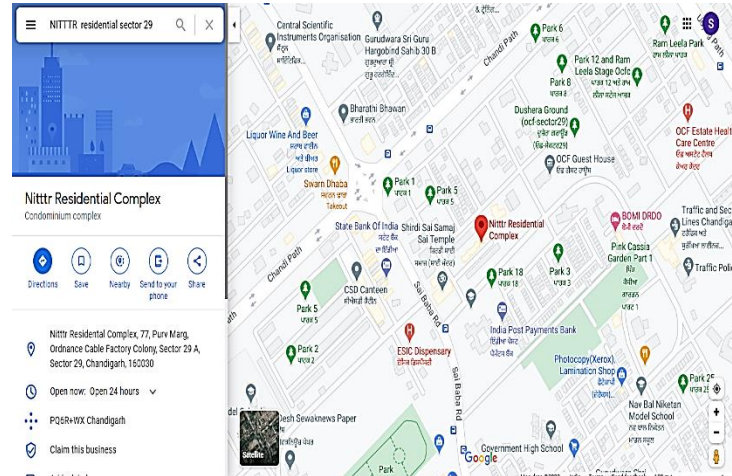
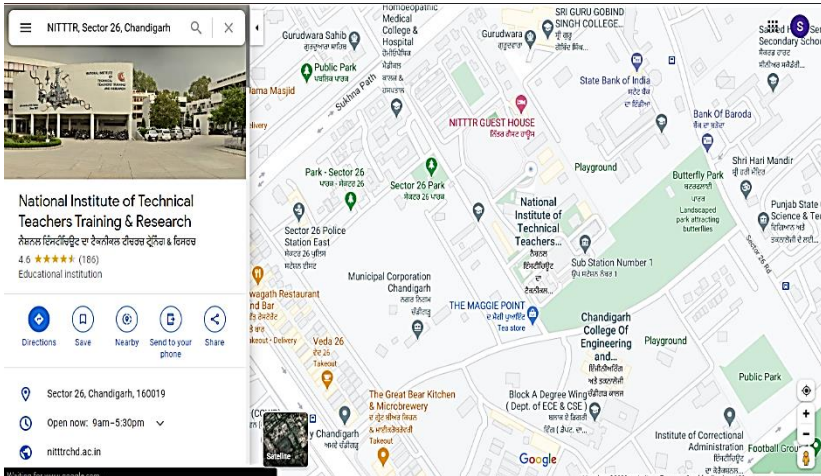
PATENTS REGISTERED

1. Indian Patent Application No. 202011003964, Title : Multilevel Inverter was filed on January 29, 2020, in the name of National Institute of Technical Teachers Training and Research [V & A Ref: 1779-P-02-IN/TIFAC Ref: T.I. (59)/TIFA/2018]
Name of Inventors : Mr. Rohit Kumar and Dr. Shimi Sudha Letha.

Annexure-IV

(42 Pages)

Infrastructure Facilities



<https://goo.gl/maps/i8FGiQC5pGiiFiDEA>

<https://goo.gl/maps/hcPg37kLM1hYLots7>

LAND DETAILS OF THE INSTITUTE

DETAIL OF LAND POSSESSED BY NITTR

| Sr. No. | Area of Land | Location | Value paid upto 31-03-2017 | Date of Allotment | Whether Lease / or Freehold | Whether Lease / Freehold Deed Prepared | Ground Rent | Remarks, if any |
|---------|--|---------------------------|--|-------------------|-----------------------------|--|---|-----------------|
| 1. | 72600.00 Sq. Yard 15 Acre | Sector 26, Chandigarh | 14,52,000/- + 1,16,200/- (Stamp Duty) | 30-04-1966 | Free Hold | Yes | NIL | |
| 2. | 4755.555 Sq. Yard 0.9828 Acre | Sector 26, Chandigarh | 3,56,667/- | 23-10-1964 | Lease Hold | No | Rs. 8,917.00 Per Year for first 33 Years | |
| 3. | 6057.959 Sq. Yard 1.2516 Acre | Sector 42B, Chandigarh | 14,28,708/- | 02-03-1988 | Lease Hold | No | Rs. 34,768.20 Per Year for first 33 Years | |
| 4. | 3622.958 Sq. Yard 0.7485 Acre | Sector 29, Chandigarh | 6,13,375/- | 22-04-1987 | Lease Hold | No | Rs. 14,971.00 Per Year for first 33 Years | |
| | 87036.482 Sq. Yard OR 17.982 Acre (11 Acre = 4843 Sq. Yard) | | 39,66,948/- | | | | | |

Handwritten signature and date: 24/12/2017

ESTATE OFFICER

Sector 26 Campus



Sector 29 Campus



Sector 42 Campus

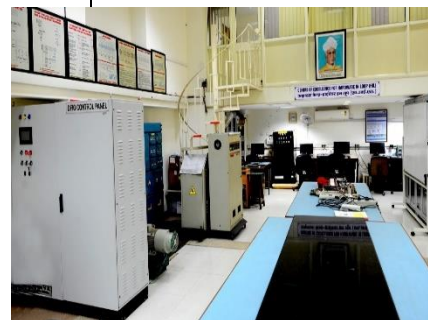


DETAILS OF CLASSROOMS AND LABORATORIES

AREA DETAIL

HOMI BHABHA ACADEMIC BLOCK

| Sr. No. | Description | No. | Length | | Breadth | | Area in Sft. | Area in Sqm. |
|------------|--|-----|--------|------|---------|------|----------------|---------------|
| | | | Feet | Inch | Feet | Inch | | |
| (A) | <u>GROUND FLOOR:</u> | | | | | | | |
| 1 | Staircase Area | 1 | 10 | 10 | 18 | 10 | 204.03 | 18.95 |
| 2 | Bathroom (Gents) | 1 | 11 | 2 | 18 | 2 | 202.86 | 18.85 |
| 3 | Dr. P Sudhakar Rao (Office Room -- Mechanical Engg. Deptt.) | 1 | 11 | 6 | 18 | 2 | 208.92 | 19.41 |
| 4 | Er. Sunil D Jassal (Office Room -- Mechanical Engg. Deptt.) | 1 | 11 | 3 | 18 | 2 | 204.38 | 18.99 |
| 5 | Machine Tool Laboratory | 1 | 35 | 10 | 50 | 0 | 1791.67 | 166.45 |
| 6 | Advanced Manufacturing Laboratory (Mechanical Engg. Deptt.) | 1 | 35 | 0 | 26 | 3 | 918.75 | 85.35 |
| 7 | Corridor Area | 1 | 5 | 2 | 132 | 4 | 683.72 | 63.52 |
| 8 | FMS Laboratory | 1 | 35 | 2 | 24 | 10 | 873.31 | 81.13 |
| 9 | Material Testing Laboratory | 1 | 17 | 8 | 35 | 6 | 627.17 | 58.26 |
| 10 | Centre of Excellence for Hardware in Loop (Electrical Machines Lab.) | 1 | 25 | 4 | 71 | 1 | 1800.78 | 167.29 |
| 11 | Computer Application Laboratory (Electrical Department) | 1 | 18 | 2 | 47 | 6 | 862.92 | 80.16 |
| 12 | Power Electronics Laboratory (Electrical Department) | 1 | 23 | 2 | 26 | 6 | 613.92 | 57.03 |
| 13 | Lounge / Lobby | 1 | 47 | 1 | 33 | 8 | 1585.14 | 147.26 |
| 14 | Lift, Staircase & Store Area | 1 | 10 | 8 | 33 | 8 | 359.11 | 33.36 |
| 15 | Auditorium Area | 1 | 49 | 0 | 75 | 0 | 3675.00 | 341.41 |
| 16 | Bathroom (Gents) near Auditorium & Telephone Exchange | 1 | 30 | 0 | 12 | 0 | 360.00 | 33.44 |



| Sr. No. | Description | No. | Length | | Breadth | | Area in Sft. | Area in Sqm. |
|------------|--|-----|--------|------|---------|------|--------------|--------------|
| | | | Feet | Inch | Feet | Inch | | |
| (B) | MEZZANINE FLOOR FLOOR: | | | | | | | |
| 1 | Dr. Poonam Syal (Office Room) | 1 | 18 | 1 | 11 | 6 | 207.96 | 19.32 |
| 2 | Dr. Amit Goyal (Office Room) | 1 | 18 | 1 | 11 | 6 | 207.96 | 19.32 |
| 3 | Steno Room | 1 | 18 | 1 | 11 | 8 | 210.97 | 19.60 |
| 4 | Mechanical Engg. Department (Staff Room) | 1 | | | | | 0.00 | 0.00 |
| 5 | Dr. A.B. Gupta (Office Room) | 1 | 23 | 9 | 12 | 0 | 285.00 | 26.48 |
| 6 | Corridor | 1 | 5 | 3 | 156 | 0 | 819.00 | 76.09 |
| 7 | Metrology Laboratory (Mechanical Engg. Deptt.) | 1 | 26 | 9 | 11 | 2 | 298.71 | 27.75 |
| 8 | Dr. Rupinder Singh Room (Mechanical Engg. Deptt.) | 1 | 25 | 5 | 11 | 9 | 298.65 | 27.74 |
| 9 | Advanced Power Electronic Laboratory | 1 | 25 | 5 | 11 | 4 | 288.06 | 26.76 |
| 10 | Industrial Instrument Laboratory | 1 | 25 | 3 | 11 | 4 | 286.17 | 26.58 |
| 11 | Dr. Lini Mathew (Office Room) | 1 | 18 | 2 | 11 | 7 | 210.43 | 19.55 |
| 12 | Dr. Hemant Sood Room (Civil Engg. Deptt.) | 1 | 11 | 6 | 18 | 2 | 208.92 | 19.41 |
| 13 | Dr. Piush Verma (Office Room -- Electrical Engg. Deptt.) | 1 | 11 | 6 | 18 | 2 | 208.92 | 19.41 |
| 14 | Dr. B.S. Pabla (Office Room -- Mechanical Engg. Deptt.) | 1 | 11 | 6 | 18 | 2 | 208.92 | 19.41 |
| 15 | Dr. S.S. Banwait (Office Room -- Mechanical Engg. Deptt.) | 1 | 11 | 6 | 18 | 2 | 208.92 | 19.41 |
| 16 | Dr. Sanjay Sharma (Office Room -- Civil Engg. Deptt.) | 1 | 11 | 6 | 18 | 2 | 208.92 | 19.41 |
| 17 | Dr. Rakesh Kumar Wats (Office Room -- Media & Continuing Education Deptt.) | 1 | 11 | 6 | 18 | 2 | 208.92 | 19.41 |
| 18 | Bathroom (Gents) | 1 | 11 | 2 | 18 | 2 | 202.86 | 18.85 |
| 19 | Staircase Area | 1 | 10 | 10 | 19 | 0 | 205.83 | 19.12 |



| Sr. No. | Description | No. | Length | | Breadth | | Area in Sft. | Area in Sqm. |
|------------|---|-----|--------|------|---------|------|--------------|--------------|
| | | | Feet | Inch | Feet | Inch | | |
| (C) | FIRST FLOOR: | | | | | | | |
| | MECHANICAL DEPARTMENT: | | | | | | | |
| 1 | Mechatronics Laboratory | 1 | 23 | 10 | 23 | 4 | 556.11 | 51.66 |
| | | 1 | 5 | 4 | 8 | 3 | 44.00 | 4.09 |
| 2 | Library (Mechanical Engineering Department) | 1 | 18 | 2 | 23 | 9 | 431.46 | 40.08 |
| 3 | CAD CAM Laboratory | 1 | 26 | 6 | 35 | 4 | 936.33 | 86.99 |
| 4 | Class Room (Mechanical Engineering Department) | 1 | 26 | 10 | 23 | 11 | 641.76 | 59.62 |
| 5 | Office-(Dr. S.S. Dhani) | 1 | 18 | 1 | 12 | 0 | 217.00 | 20.16 |
| 6 | Class Room No. 204 (Mechanical Engineering Department) | 1 | 18 | 1 | 22 | 10 | 412.90 | 38.36 |
| 7 | Simulation Center of Excellence (Mechanical Engg. Deptt.) | 1 | 24 | 2 | 25 | 5 | 614.24 | 57.06 |
| 8 | Class Room No. 201 (Electronics & Communication Engg.) | 1 | 18 | 0 | 22 | 11 | 412.50 | 38.32 |
| 9 | Class Room No. 203 (Electrical Engg. Deptt.) | 1 | 18 | 0 | 24 | 3 | 436.50 | 40.55 |
| 10 | Conference Hall - I | 1 | 24 | 0 | 47 | 6 | 1140.00 | 105.91 |
| 11 | Office-(Er. Himmi Gupta) | 1 | 11 | 3 | 25 | 7 | 287.81 | 26.74 |
| 12 | Office-(Sh. Surinder Singh, S.O.) Academic Cell | 1 | 11 | 7 | 25 | 7 | 296.34 | 27.53 |
| 13 | Academic Cell | 1 | 22 | 10 | 25 | 4 | 578.44 | 53.74 |
| 14 | Lobby Area | 1 | 23 | 9 | 35 | 6 | 843.13 | 78.33 |
| 15 | Nano-Scale Modeling & Simulation Laboratory (Applied Science) | 1 | 17 | 3 | 25 | 3 | 435.56 | 40.46 |
| 16 | Nanomaterial Characterization Laboratory | 1 | 17 | 4 | 25 | 3 | 437.67 | 40.66 |
| 17 | Class Room No. 202 | 1 | 18 | 1 | 23 | 7 | 426.47 | 39.62 |



| Sr. No. | Description | No. | Length | | Breadth | | Area in Sft. | Area in Sqm. |
|------------|--|-----|--------|------|---------|------|--------------|--------------|
| | | | Feet | Inch | Feet | Inch | | |
| (D) | SECOND FLOOR (TOP FLOOR): | | | | | | | |
| | ELECTRONICS DEPARTMENT: | | | | | | | |
| 1 | Room No. 301-(Dr. Rajesh Mehra) Office | 1 | 11 | 5 | 25 | 5 | 290.17 | 26.96 |
| 2 | Room No. 302-(Dr. Amod Kumar) Office | 1 | 10 | 9 | 25 | 3 | 271.44 | 25.22 |
| 3 | Room No. 303-(Embedded System Design Laboratory) | 1 | 23 | 10 | 25 | 4 | 603.78 | 56.09 |
| 4 | Room No. 304-(Dr. Balwinder Singh) Office | 1 | 11 | 1 | 25 | 3 | 279.85 | 26.00 |
| 5 | Room No. 305-(ECE Departmental Laboratory) | 1 | 11 | 6 | 25 | 5 | 292.29 | 27.15 |
| 6 | Room No. 306-(Dr. S.S. Gill, Head, Eltx. & Comm. Engg.) Office | 1 | 12 | 2 | 25 | 5 | 309.24 | 28.73 |
| 7 | Room No. 307-(Dr. Balwinder Singh) Office | 1 | 11 | 3 | 25 | 4 | 285.00 | 26.48 |
| 8 | Room No. 308-(VLSI Laboratory) | 1 | 23 | 7 | 25 | 5 | 599.41 | 55.69 |
| 9 | Room No. 309-(Antena Laboratory) | 1 | 23 | 6 | 25 | 5 | 597.29 | 55.49 |
| 10 | Room No. 310-(Communication Engineering Laboratory) | 1 | 24 | 8 | 25 | 5 | 626.94 | 58.24 |
| 11 | Room No. 317-(Dr. Kanika Sharma) | 1 | 11 | 5 | 18 | 0 | 205.50 | 19.09 |
| 12 | Room No. 318-(Er. Garima Saini) | 1 | 11 | 8 | 18 | 1 | 210.97 | 19.60 |
| 13 | Room No. 319-(ECE) Office | 1 | 11 | 2 | 18 | 1 | 201.93 | 18.76 |
| 14 | Room No. 320-(Digital Signal Processing Laboratory) | 1 | 18 | 2 | 36 | 1 | 655.51 | 60.90 |
| 15 | Laboratory (in Ramp Area) | 1 | 5 | 5 | 35 | 5 | 191.84 | 17.82 |
| | | 1 | 11 | 4 | 12 | 4 | 139.78 | 12.99 |
| 16 | Lobby Area | 1 | 23 | 1 | 23 | 10 | 550.15 | 51.11 |
| | APPLIED SCIENCE DEPARTMENT: | | | | | | | |
| 1 | Room No. 310-A-(Dr. Pankah Sharma) Office | 1 | 10 | 10 | 25 | 3 | 273.54 | 25.41 |
| 2 | Room No. 311-(Applied Physics Laboratory) | 1 | 25 | 3 | 35 | 9 | 902.69 | 83.86 |
| 3 | Room No. 312-(Laser & Fiber Optics Laboratory) | 1 | 23 | 10 | 11 | 9 | 280.04 | 26.02 |
| | | 1 | 23 | 10 | 23 | 9 | 566.04 | 52.59 |
| 4 | Room No. 313-(Photonics & Simulation Laboratory) | 1 | 11 | 2 | 18 | 1 | 201.93 | 18.76 |
| 5 | Room No. 314-(Applied Science) Office | 1 | 11 | 10 | 18 | 2 | 214.97 | 19.97 |
| 6 | Room No. 315-(Dr. B.C. Choudhary) Office | 1 | 11 | 6 | 18 | 0 | 207.00 | 19.23 |
| 7 | Office-(Dr. K.C. Lachwani) | 1 | 11 | 4 | 18 | 1 | 204.94 | 19.04 |
| 8 | Room No. 316-(Dr. Ashok Kumar) Office | 1 | 12 | 1 | 18 | 1 | 218.51 | 20.30 |
| 9 | BathRoom (Gents) | 1 | 11 | 6 | 18 | 6 | 212.75 | 19.76 |



CIVIL ENGINEERING DEPARTMENT

| Sr. No. | Description | No. | Length | | Breadth | | Area in Sft. | Area in Sqm. |
|--------------------------------------|--|-----|--------|------|---------|------|--------------|--------------|
| | | | Feet | Inch | Feet | Inch | | |
| (A) GROUND FLOOR: | | | | | | | | |
| 1 | Concrete Laboratory | 1 | 22 | 4 | 57 | 6 | 1284.17 | 119.30 |
| 2 | Sh. Jasbir Singh Rattan (Office Room) | 1 | 28 | 8 | 19 | 6 | 559.00 | 51.93 |
| 3 | Hydraulics Laboratory + Smt. Jyothi PM Office Room | 1 | 29 | 3 | 20 | 0 | 585.00 | 54.35 |
| 4 | Soil Engineering Laboratory | 1 | 56 | 10 | 20 | 4 | 1155.61 | 107.36 |
| 5 | Highway Engg. Laboratory | 1 | 20 | 4 | 32 | 5 | 659.14 | 61.23 |
| 6 | Highway Laboratory Store (Temporary Shed) | 1 | 26 | 8 | 15 | 9 | 420.00 | 39.02 |
| 7 | Research Scholar / Project Associate | 1 | 8 | 8 | 17 | 8 | 153.11 | 14.22 |
| (B) FIRST FLOOR: | | | | | | | | |
| 1 | Computer Laboratory (Civil Engg. Deptt.) | 1 | 18 | 2 | 20 | 5 | 370.90 | 34.46 |
| 2 | Office (Civil Engg. Deptt.) | 1 | 9 | 9 | 20 | 5 | 199.06 | 18.49 |
| 3 | Committee Room | 1 | 20 | 1 | 30 | 4 | 609.19 | 56.59 |
| 4 | Er. A.K. Duggal (Office Room) | 1 | 10 | 0 | 18 | 9 | 187.50 | 17.42 |
| 5 | Class Room No. 215 | 1 | 18 | 9 | 29 | 8 | 556.25 | 51.68 |
| 6 | Er. Vinod Kumar Sonthwal (Office Room) | 1 | 18 | 0 | 10 | 6 | 189.00 | 17.56 |
| 7 | Corridor Area | 1 | 5 | 11 | 70 | 0 | 414.17 | 38.48 |
| 8 | Staircase Area | 1 | 22 | 0 | 8 | 4 | 183.33 | 17.03 |
| 9 | Bathroom (Ladies & Gents) | 1 | 18 | 0 | 8 | 8 | 156.00 | 14.49 |
| 10 | Corridor (Lift to Ramp) | 1 | 6 | 0 | 36 | 6 | 219.00 | 20.35 |
| (C) SECOND FLOOR (TOP FLOOR): | | | | | | | | |
| 1 | Environmental Engg. Laboratory (Civil Engg. Deptt.) | 1 | 17 | 3 | 9 | 5 | 162.44 | 15.09 |
| | | 1 | 39 | 0 | 18 | 6 | 721.50 | 67.03 |
| 2 | Advance Computing Laboratory (Civil Engg. Deptt.) | 1 | 30 | 3 | 20 | 4 | 615.08 | 57.14 |
| 3 | Non Destructive & Material Testing Laboratory (Civil Engg. Deptt.) | 1 | 28 | 5 | 20 | 5 | 580.17 | 53.90 |
| 4 | Corridor Area | 1 | 35 | 11 | 8 | 9 | 314.27 | 29.20 |
| 5 | Staircase Area | 1 | 22 | 0 | 8 | 4 | 183.33 | 17.03 |



SIR J C BOSE ACADEMIC AND ADMINISTRATIVE BLOCK

(AREA OF BUILDING: 117'-8"x118'-4" = 13924 Sq.Ft.)

Less Cut-Out Area = 3058 Sq.Ft.

(COVERED LAND AREA OF BUILDING = 10866 Sq.Ft.)

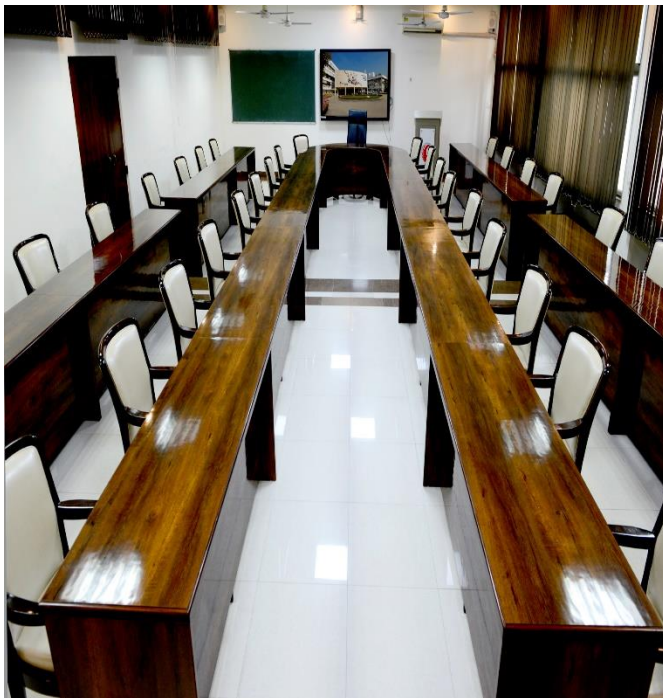
| Sr. No. | Description | No. | Length | | Breadth | | Area in Sft. | Area in Sqm. |
|------------|---|-----|--------|------|---------|------|----------------|---------------|
| | | | Feet | Inch | Feet | Inch | | |
| (A) | <u>GROUND FLOOR:</u> | | | | | | | |
| 1 | Establishment Section | 1 | 23 | 6 | 32 | 9 | 769.63 | 71.50 |
| 2 | Gallery (Establishment Section) | 1 | 10 | 3 | 44 | 6 | 456.13 | 42.37 |
| 3 | Director Office | 1 | 24 | 0 | 32 | 8 | 784.00 | 72.83 |
| 4 | Lobby toward Director Office | 1 | 10 | 2 | 22 | 2 | 225.36 | 20.94 |
| 5 | Office of P.A. to Director | 1 | 10 | 9 | 15 | 8 | 168.42 | 15.65 |
| 6 | Bathroom Room | 1 | 5 | 9 | 5 | 2 | 29.71 | 2.76 |
| 7 | Pantry (Director Office) | 1 | 11 | 4 | 7 | 3 | 82.17 | 7.63 |
| 8 | Common Bathroom (Ladies & Gents) | 1 | 23 | 9 | 16 | 9 | 397.81 | 36.96 |
| 9 | Gallery | 1 | 6 | 9 | 46 | 0 | 310.50 | 28.85 |
| 10 | Staircase & Lift Area | 1 | 14 | 2 | 14 | 8 | 207.78 | 19.30 |
| 11 | Gallery | 1 | 14 | 8 | 8 | 3 | 121.00 | 11.24 |
| | | 1 | 21 | 6 | 26 | 6 | 569.75 | 52.93 |
| | | 1 | 30 | 2 | 6 | 9 | 203.63 | 18.92 |
| | | 1 | 33 | 9 | 6 | 9 | 227.81 | 21.16 |
| 12 | Accounts & Budget Section + Hindi Cell | 1 | 46 | 9 | 33 | 1 | 1546.65 | 143.68 |
| 13 | Cash Room | 1 | 7 | 4 | 14 | 3 | 104.50 | 9.71 |
| 14 | Cash Office Record Room | 1 | 12 | 1 | 22 | 10 | 275.90 | 25.63 |
| 15 | Accounts Officer Room | 1 | 15 | 0 | 23 | 5 | 351.25 | 32.63 |
| | | 1 | 10 | 0 | 4 | 2 | 41.67 | 3.87 |
| 16 | Consultancy Room | 1 | 22 | 8 | 25 | 6 | 578.00 | 53.70 |
| 17 | Office (Faculty In-Charge Administration) | 1 | 22 | 2 | 16 | 9 | 371.29 | 34.49 |
| 18 | Board and Dispatch Section | 1 | 24 | 0 | 32 | 9 | 786.00 | 73.02 |
| 19 | Board Room | 1 | 22 | 1 | 38 | 7 | 852.05 | 79.16 |
| 20 | Bathroom (inside Board Room) | 1 | 5 | 9 | 5 | 2 | 29.71 | 2.76 |



| Sr. No. | Description | No. | Length | | Breadth | | Area in Sft. | Area in Sqm. |
|------------|--|-----|--------|------|---------|------|--------------|--------------|
| | | | Feet | Inch | Feet | Inch | | |
| (B) | FIRST FLOOR: | | | | | | | |
| 1 | Secrecy Recruitment and Digitization Section | 1 | 32 | 11 | 46 | 0 | 1514.17 | 140.67 |
| 2 | Library: | | | | | | | |
| | (a) Room No. 201 | 1 | 34 | 10 | 32 | 9 | 1140.79 | 105.98 |
| | (b) Reception | 1 | 17 | 2 | 22 | 7 | 387.68 | 36.02 |
| | (c) Room No. 205 | 1 | 11 | 1 | 15 | 2 | 168.10 | 15.62 |
| | (d) Room No. 206 | 1 | 11 | 4 | 15 | 2 | 171.89 | 15.97 |
| | (e) Issue & Return Center | 1 | 32 | 8 | 32 | 9.5 | 1071.19 | 99.51 |
| | | 2 | 2 | 0 | 10 | 0 | 40.00 | 3.72 |
| | (f) Seating Area | 1 | 32 | 8 | 46 | 3 | 1510.83 | 140.36 |
| | | 1 | 2 | 0 | 7 | 6 | 15.00 | 1.39 |
| | (g) Book Racks | 1 | 67 | 0 | 32 | 10 | 2199.83 | 204.36 |
| | | 1 | 2 | 0 | 7 | 6 | 15.00 | 1.39 |
| | | 1 | 2 | 0 | 10 | 3 | 20.50 | 1.90 |
| | | 1 | 2 | 0 | 10 | 2 | 20.33 | 1.89 |
| 3 | Common Bathroom (Ladies & Gents) | 1 | 23 | 4 | 16 | 9 | 390.83 | 36.31 |
| 4 | Gallery | 1 | 6 | 9 | 44 | 8 | 301.50 | 28.01 |
| 5 | Staircase & Lift Area | 1 | 21 | 5 | 14 | 8 | 314.11 | 29.18 |



| Sr. No. | Description | No. | Length | | Breadth | | Area in Sft. | Area in Sqm. |
|------------|--|-----|--------|------|---------|------|--------------|--------------|
| | | | Feet | Inch | Feet | Inch | | |
| (C) | SECOND FLOOR: | | | | | | | |
| 1 | EDIC Department | 1 | 32 | 8 | 35 | 4 | 1154.22 | 107.23 |
| 2 | Circulation Gallery Area (EDIC) | 2 | 6 | 9 | 43 | 10 | 591.75 | 54.97 |
| | | 2 | 2 | 0 | 9 | 0 | 36.00 | 3.34 |
| | | 2 | 6 | 9 | 46 | 3 | 624.38 | 58.00 |
| | | 4 | 8 | 11 | 2 | 4 | 83.22 | 7.73 |
| 3 | Bathroom (Ladies & Gents) | 1 | 23 | 10 | 16 | 8 | 397.22 | 36.90 |
| 4 | Staircase & Lift Area | 1 | 21 | 6 | 14 | 9 | 317.13 | 29.46 |
| 5 | CDC Department | 1 | 25 | 6 | 44 | 3 | 1128.38 | 104.83 |
| 6 | Conference Hall - II | 1 | 25 | 6 | 44 | 8 | 1139.00 | 105.81 |
| | | 1 | 2 | 0 | 7 | 4 | 14.67 | 1.36 |
| 7 | Department of Education & Education Management | 1 | 36 | 0 | 33 | 3 | 1197.00 | 111.20 |
| 8 | Professor's Room (EDIC) | 1 | 10 | 6 | 25 | 8 | 269.50 | 25.04 |
| 9 | Office Dr. S.K. Dhameja | 1 | 10 | 10 | 25 | 8 | 278.06 | 25.83 |
| 10 | Office Dr. Rajesh Mehra | 1 | 10 | 2 | 25 | 8 | 260.94 | 24.24 |
| 11 | Class Room No. 310 | 1 | 22 | 0 | 25 | 8 | 564.67 | 52.46 |
| | | 2 | 2 | 0 | 9 | 0 | 36.00 | 3.34 |
| 12 | Communication Skills Laboratory | 1 | 32 | 7 | 33 | 3 | 1083.40 | 100.65 |
| | | 1 | 2 | 0 | 7 | 2 | 14.33 | 1.33 |
| | | 2 | 10 | 0 | 2 | 0 | 40.00 | 3.72 |



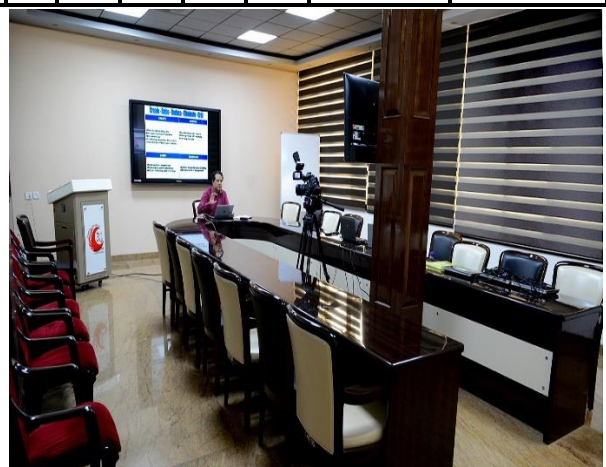
RAMANUJAN CENTRE FOR COMPUTER SCIENCE AND EDUCATIONAL TELEVISION

(COVERED LAND AREA OF BUILDING: 102'-0"x114'-9" = 11704.50 Sq.ft.)

| Sr. No. | Description | No. | Length | | Breadth | | Area in Sft. | Area in Sqm. |
|---|--|-----|--------|------|---------|------|----------------|---------------|
| | | | Feet | Inch | Feet | Inch | | |
| (A) | <u>GROUND FLOOR:</u> | | | | | | | |
| 1 | Lounge / Lobby | 1 | 32 | 8 | 29 | 5 | 960.94 | 89.27 |
| 2 | Class Room No. 101 & 102 | 1 | 40 | 2 | 18 | 3 | 733.04 | 68.10 |
| 3 | Room No. 103, Office (Dr. C Ramakrishna) | 1 | 10 | 10 | 18 | 3 | 197.71 | 18.37 |
| 4 | Room No. 104, Office (Dr. Maitreyee Dutta) | 1 | 10 | 10 | 18 | 3 | 197.71 | 18.37 |
| 5 | Room No. 105, (Power Room) | 1 | 10 | 10 | 18 | 3 | 197.71 | 18.37 |
| 6 | Corridor (in front of Room No. 102 to 106) | 1 | 52 | 1 | 10 | 3 | 533.85 | 49.60 |
| 7 | Room No. 106 (Faculty & Staff Computer Science Department) | 1 | 17 | 8 | 51 | 9 | 914.25 | 84.93 |
| | | 1 | 11 | 9 | 21 | 9 | 255.56 | 23.74 |
| 8 | Room No. 107 & 108 (Software Laboratory) | 1 | 33 | 3 | 22 | 3 | 739.81 | 68.73 |
| 9 | Room No. 109 (Office Computer Sceince Department) | 1 | 10 | 10 | 11 | 6 | 124.58 | 11.57 |
| 10 | Bathroom (Ladies & Gents) & Lift Area | 1 | 19 | 0 | 23 | 0 | 437.00 | 40.60 |
| 11 | Room No. 110 (IOT Laboratory) | 1 | 18 | 4 | 29 | 2 | 534.72 | 49.68 |
| 12 | Room No. 111 (Server Room) | 1 | 22 | 1 | 22 | 7 | 498.72 | 46.33 |
| 13 | Room No. 112 (Departmental Library) | 1 | 33 | 4 | 11 | 6 | 383.33 | 35.61 |
| 14 | Corridor (IOT Laboratory to Research Room) | 1 | 5 | 10 | 55 | 9 | 325.21 | 30.21 |
| 15 | Room No. 113 (Meeting Room) | 1 | 22 | 9 | 21 | 6 | 489.13 | 45.44 |
| 16 | Room No. 114 (Cyber Security Laboratory) | 1 | 22 | 6 | 21 | 5 | 481.88 | 44.77 |
| 17 | Room No. 115 | 1 | 11 | 4 | 18 | 3 | 206.83 | 19.21 |
| 18 | Research Laboratory | 1 | 11 | 4 | 22 | 8 | 256.89 | 23.86 |
| | | | | | | | | |
| <u>A.C. PLANT: Land Area = 46'-0"x 105'-0" (4830 Sq.Ft.)</u> | | | | | | | | |
| 1 | A.C. Plant Ducting Room | 1 | 18 | 4 | 23 | 4 | 427.78 | 39.74 |
| 2 | A.C. Plant Seating Room | 1 | 10 | 3 | 11 | 5 | 117.02 | 10.87 |
| 3 | A.C. Plant Room | 1 | 40 | 0 | 88 | 6 | 3540.00 | 328.87 |



| Sr. No. | Description | No. | Length | | Breadth | | Area in Sft. | Area in Sqm. |
|------------|--|-----|--------|------|---------|------|--------------|--------------|
| | | | Feet | Inch | Feet | Inch | | |
| (B) | FIRST FLOOR: | | | | | | | |
| 1 | Lounge / Lobby | 1 | 28 | 10 | 23 | 0 | 663.17 | 61.61 |
| | | 1 | 10 | 1 | 11 | 3 | 113.44 | 10.54 |
| 2 | Room No. 201 (Department of Media Engineering) | 1 | 20 | 6 | 19 | 9 | 404.88 | 37.61 |
| 3 | Room No. 202 (Dr. Maitreyee Dutta) | 1 | 11 | 3 | 20 | 6 | 230.63 | 21.43 |
| 4 | Room No. 203 (Photocopy Section) | 1 | 11 | 6 | 20 | 6 | 235.75 | 21.90 |
| 5 | Room No. 204 | 1 | 21 | 4 | 20 | 6 | 437.33 | 40.63 |
| 6 | Corridor | 1 | 53 | 6 | 10 | 1 | 539.46 | 50.12 |
| 7 | Room No. 205 (A.C. Duct) | 1 | 31 | 0 | 20 | 6 | 635.50 | 59.04 |
| 8 | Room No. 206 (Main Studio) | 1 | 42 | 0 | 66 | 0 | 2772.00 | 257.52 |
| 9 | Corridor (in front of Bathroom) | 1 | 10 | 1 | 51 | 0 | 514.25 | 47.77 |
| 10 | Room No. 207 (Gyanvani Room) | 1 | 10 | 5 | 12 | 3 | 127.60 | 11.85 |
| 11 | Room No. 208 | 1 | 21 | 6 | 10 | 3 | 220.38 | 20.47 |
| 12 | Room No. 209 | 1 | 11 | 3 | 10 | 3 | 115.31 | 10.71 |
| 13 | Room No. 210 (ENG Laboratory) | 1 | 19 | 10 | 10 | 3 | 203.29 | 18.89 |
| 14 | Room No. 211 (ENG Store) | 1 | 20 | 0 | 13 | 6 | 270.00 | 25.08 |
| 15 | Room No. 212 | 1 | 11 | 0 | 13 | 6 | 148.50 | 13.80 |
| 16 | Room No. 213 (Smt. Savita Bhanot) | 1 | 10 | 10 | 13 | 6 | 146.25 | 13.59 |
| 17 | Room No. 214 | 1 | 21 | 10 | 13 | 6 | 294.75 | 27.38 |
| 18 | Room No. 215 | 1 | 10 | 2 | 13 | 6 | 137.25 | 12.75 |
| 19 | Corridor (in front of Room No. 208 to 214) | 1 | 5 | 10 | 53 | 6 | 312.08 | 28.99 |
| 20 | Backside Staircase Area | 1 | 5 | 10 | 14 | 4 | 83.61 | 7.77 |
| 21 | Room No. 2016 (Golden Jubilee Smart Studio) | 1 | 31 | 3 | 20 | 6 | 640.63 | 59.51 |
| 22 | Bathroom (Ladies & Gents) & Lift Area | 1 | 19 | 0 | 23 | 0 | 437.00 | 40.60 |
| 23 | Main Staircase Area | 1 | 18 | 0 | 10 | 0 | 180.00 | 16.72 |



| Sr. No. | Description | No. | Length | | Breadth | | Area in Sft. | Area in Sqm. |
|------------|---|-----|--------|------|---------|------|--------------|--------------|
| | | | Feet | Inch | Feet | Inch | | |
| (C) | SECOND FLOOR: | | | | | | | |
| 1 | Lounge / Lobby | 1 | 21 | 4 | 24 | 9 | 528.00 | 49.05 |
| 2 | Staircase Area | 1 | 17 | 8 | 11 | 4 | 200.22 | 18.60 |
| 3 | Corridor | 1 | 6 | 9 | 33 | 10 | 228.38 | 21.22 |
| 4 | Bathroom (Ladies & Gents) & Lift Area | 1 | 22 | 6 | 18 | 10 | 423.75 | 39.37 |
| 5 | Corridor | 1 | 11 | 5 | 6 | 0 | 68.50 | 6.36 |
| 6 | Corridor | 1 | 5 | 11 | 61 | 10 | 365.85 | 33.99 |
| 7 | Backside Staircase Area | 1 | 14 | 4 | 5 | 11 | 84.81 | 7.88 |
| 8 | Room No. 301 (Dr. Sandeep Singh Gill) | 1 | 20 | 6 | 13 | 1 | 268.21 | 24.92 |
| 9 | Room No. 302 (DTP Section) | 1 | 20 | 6 | 11 | 0 | 225.50 | 20.95 |
| 10 | Room No. 303, 304 & 305 (Mini Studio) | 1 | 19 | 11 | 55 | 6 | 1105.38 | 102.69 |
| 11 | Room No. 306 (Information Management & Coordination Unit) | 1 | 8 | 1 | 10 | 6 | 84.88 | 7.88 |
| | | 1 | 13 | 10 | 24 | 9 | 342.38 | 31.81 |
| | | 1 | 6 | 7 | 5 | 10 | 38.40 | 3.57 |
| 12 | Room No. 307 | 1 | 14 | 10 | 15 | 0 | 222.50 | 20.67 |
| 13 | Room No. 308 | 1 | 17 | 6 | 14 | 10 | 259.58 | 24.12 |
| 14 | Room No. 309 | 1 | 9 | 6 | 14 | 10 | 140.92 | 13.09 |
| 15 | Room No. 310 (Non Linear Laboratory) | 1 | 10 | 9 | 25 | 9 | 276.81 | 25.72 |
| 16 | Room No. 311 (Multimedia Laboratory) | 1 | 10 | 8 | 22 | 3 | 237.33 | 22.05 |
| 17 | Room No. 312 (Conversion Laboratory Gyan Darshan) | 1 | 10 | 8 | 19 | 6 | 208.00 | 19.32 |
| 18 | Room No. 313 | 1 | 13 | 4 | 13 | 3 | 176.67 | 16.41 |
| | | 1 | 10 | 10 | 11 | 4 | 122.78 | 11.41 |
| | | 1 | 2 | 1 | 4 | 6 | 9.38 | 0.87 |
| 19 | Room No. 314 (Graphics and Animation Laboratory) | 1 | 13 | 4 | 22 | 8 | 302.22 | 28.08 |
| 20 | Room No. 315 (Er. Ashish) | 1 | 9 | 9 | 13 | 3 | 129.19 | 12.00 |
| 21 | Room No. 316 (Video Tape Library) | 1 | 13 | 3 | 23 | 0 | 304.75 | 28.31 |
| 22 | Room No. 317 | 1 | 25 | 3 | 19 | 10 | 500.79 | 46.52 |
| 23 | Room No. 318 | 1 | 10 | 6 | 19 | 10 | 208.25 | 19.35 |
| 24 | Corridor | 1 | 10 | 1 | 70 | 0 | 705.83 | 65.57 |

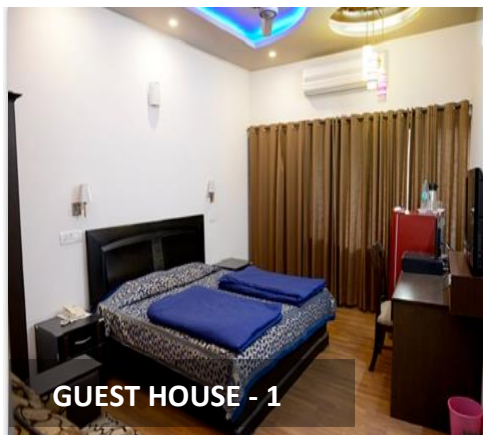
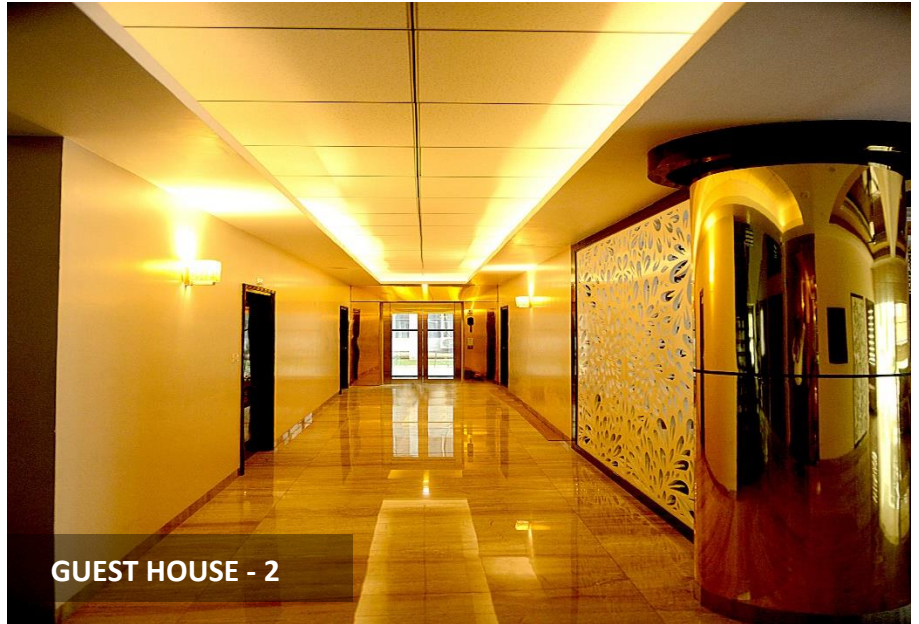
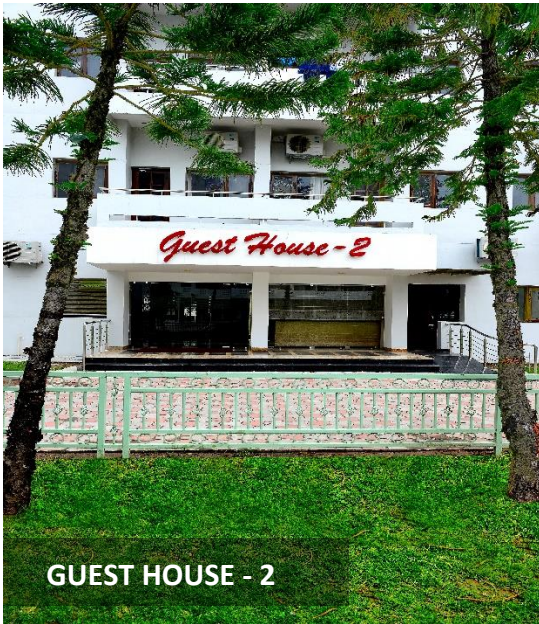


NEW LECTURE HALL

| Sr. No. | Description | No. | Length | | Breadth | | Area in Sft. | Area in Sqm. |
|--------------------------|---|-----|--------|------|---------|------|--------------|--------------|
| | | | Feet | Inch | Feet | Inch | | |
| (A) GROUND FLOOR: | | | | | | | | |
| 1 | Office Room No. V-101, Dr. Ritula Thakur, Electrical Engg. Deptt. | 1 | 17 | 1 | 23 | 4 | 398.61 | 37.03 |
| 2 | Library (Electrical Engineering Department) | 1 | 17 | 1 | 23 | 1 | 394.34 | 36.63 |
| 3 | Room No. V-103, Embedded Systems Laboratory | 1 | 17 | 1 | 23 | 4 | 398.61 | 37.03 |
| 4 | Toilet | 1 | 11 | 0 | 26 | 5 | 290.58 | 27.00 |
| (B) FIRST FLOOR: | | | | | | | | |
| 1 | Class Room no. V-201, Rural Department | 1 | 17 | 0 | 23 | 4 | 396.67 | 36.85 |
| 2 | Room No. V-202, Rural Development Department | 1 | 17 | 2 | 23 | 2 | 397.69 | 36.95 |
| 3 | Room No. V-203, Dr. U.N. Roy, Rural Department | 1 | 17 | 0 | 23 | 4 | 396.67 | 36.85 |
| 4 | Bathroom/Toilet | 1 | 11 | 0 | 26 | 5 | 290.58 | 27.00 |
| (C) SECOND FLOOR: | | | | | | | | |
| 1 | Class Room No. V-301, Electrical Engineering Department | 1 | 17 | 0 | 35 | 5 | 602.08 | 55.93 |
| 2 | Room No. V-302, | 1 | 17 | 0 | 35 | 4 | 600.67 | 55.80 |
| 3 | Toilet (Ladies & Gents) | 1 | 11 | 0 | 26 | 5 | 290.58 | 27.00 |



OTHER FACILITIES



OTHER FACILITIES



FACILITIES FOR DIFFERENTLY ABLED PERSONS

(A) Homi Bhabha Academic Block:

- Lift / Elevator exists from Ground Floor to Top Floor.
- Ramp exists near extreme gate 2 (near Auditorium).
- Ramp exists to access in S. S. Bhatnagar Auditorium.

(B) SIR J C Bose Academic and Administrative Block:

- Lift / Elevator from Ground Floor to Top Floor exists.
- Ramp exists near entrance of gate.

(C) Ramanujan Centre for Computer Science and Educational Television

- Lift / Elevator from Ground Floor to Top Floor exists.
- Ramp near entrance of gate exist

(D) Har Gobind Khurana Guest House (New Guest House):

- Ramp near entrance of gate.

(E) Raman Hall (Guest House II):

- Lift / Elevator from Ground Floor to Top Floor for providing access to persons with disabilities by making it barrier free infrastructure.
- Ramp near entrance of gate exists.

(F) Chandrasekhar Hall (Girls Hostel):

- Making provision of one Lift / Elevator from Ground Floor to Top Floor for providing access to persons with disabilities by making it barrier free infrastructure.
- Ramp near S. S. Bhatnagar Auditorium.
- One independent toilet for persons with disability at Ground Floor (near Canteen).

(G) Tagore Hall & Amartya Hall (Boys Hostel):

- Lift / Elevator from Ground Floor to Top Floor for providing access to persons with disabilities by making it barrier free infrastructure.
- Ramp to access the building.
- Each common bathroom at each floor has one independent bathroom & W.C. for persons with disability with all necessary provisions.

(H) Mother Teresa Hall:

- Provision of ramp to access the building for persons with disability.
- Each common bathroom at each floor has one independent bathroom & W.C. for persons with disability with all necessary provisions.



DETAILS OF LABORATORIES

1. Applied Science Department

The department has advanced facilities to conduct various courses in the emerging areas of applied sciences. Some of these are:

➤ Applied Physics Laboratory

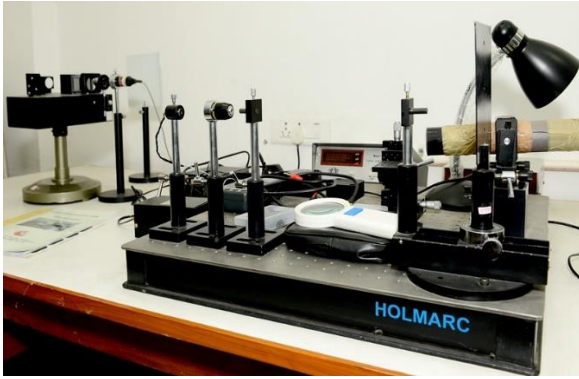
- Well established applied physics and radiation physics laboratory for graduate and post- graduate curriculum based experiments.
- Nuclear radiation detection, counting and analysis systems; GM and NaI(Tl) based, Radiation survey meters etc.



➤ Laser and Fiber Optics Laboratory

The Laser and Fiber Optics laboratory is fully equipped for experimentation in the area of Lasers, OFC and Optoelectronics to conduct M.E. project/thesis work in Electronics and Communication Engineering and Optical Instrumentation.

- He-Ne and semiconductor lasers, power meters, optical benches and advanced laser experimental set ups for study of laser beam characteristics, basic optical characteristics and effects of electric and magnetic fields of laser beams.



- Optical fiber characterization and communication trainers, optical sources, optical detectors, passive optical components, fiber splicing and connector installation tool kits, OTDR, Fusion Splicing machine and fiber reels etc.
- Optical waveguiding fundamentals educators, Critical angles and Fresnel coefficients measurements, step index and graded index waveguides, mode field and effective index measurement set ups etc.
- Digital OFC links and BER Analysis systems.
- Optical Networks Analysis System (ONAS) and ED-NET.
- WDM/DWDM Systems and in-line component characterization.
- Optical Amplifier; EDFA and ASE filter.



- Light Runner – Interactive Fiber Optics Trainer.
- Photonics Design Softwares: OptSim and ModeSys, OptiSystem , OptiGrating and OptiFiber

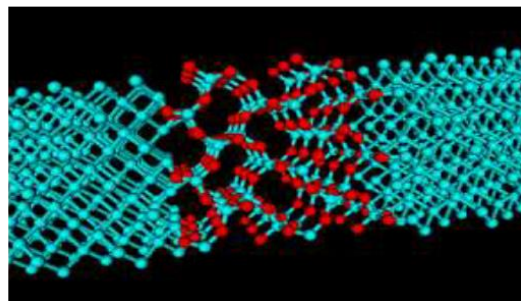
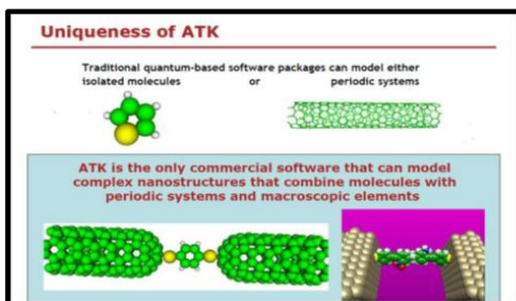
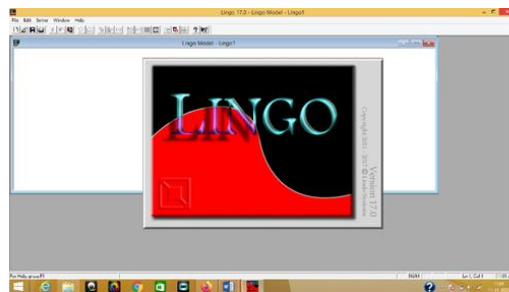
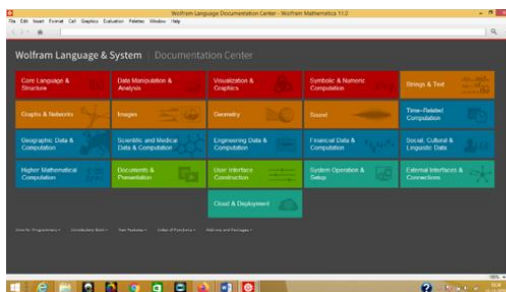
➤ **Nanomaterials Characterization Laboratory**

- Synthesis of nanoparticles ; Sol-gel method
- Atomic Force Microscope (AFM-Workshop) for Nanosize characterization- Vibrating and Non-vibrating Mode – (Advance-Tech, USA).
- Spectro-flouro photometer (PLS) for optical properties of materials (Shimadzu).



➤ **Applied Computational and Simulation Laboratory**

1. Material Explorer and Virtual NanoLab (VNL/ATK) -10 user license for nano-scale modeling and simulation softwares.
2. MATHEMATICA 11.xx – 05 user license for Mathematical Computational
3. LINGO 18.0 – 05 user license.
4. MATLAB– Institute license



➤ **Photonics and Simulation Laboratory**

1. Light Runner – An innovative and advanced industry oriented OFC training system.
2. Optisystem 13.0: Multiuser network license for latest version of OFC system design and performance evaluation simulation software.



3. Civil Engineering Department



The department has well-equipped eight laboratories:

➤ **Concrete Technology Laboratory**

In addition to conventional equipments, the laboratory is having sophisticated instruments like Automatic Compression Testing Machine -3000 kN(ACTM) Electronic Universal Testing Machine(600 kN), Concrete Permeability test Apparatus, Carbonation Test Chamber, Water impermeability tester, Abrasion Resistance of concrete and electrically operated vibrators and sieve shakers. The laboratory is well equipped with all the equipments required for designing and

testing of standard concrete, high strength grade of concrete and self compacting concrete.



➤ **Soil Engineering Laboratory**

The lab is equipped with automated instruments like Fully Automatic Triaxial Testing System, Automatic Consolidation Test Apparatus, Automatic Compactor for Soils, Nail Shear Strength Test, Electrically operated direct shear apparatus and a large number of other equipments for determining the shear strength and related parameters of soil. Field testing equipment like Standard Penetration Test (SPT) apparatus, grouting machine, core drill equipments are also available for conducting site investigation and bearing capacity determination.



➤ **Highway Engineering Laboratory**

The laboratory has equipments like Marshall Stability Apparatus for designing and testing of various bituminous mixes. Field testing equipments like Benkelman Beam Apparatus, Dynamic Cone Penetrometer, and Non Nuclear Density Guage are also available for rapid in-situ evaluation and testing of roads and runway pavements. Automatic Loading apparatus for evaluating the strength of soil subgrade and Bending Beam Rheometer for determining the properties of bitumen at sub zero temperature is also available.



➤ **Environmental Engineering Laboratory**

The laboratory is equipped with microprocessor and PC based equipments, BOD incubator and COD digestors for Water and Waste water analysis. Facilities for testing air pollution and noise pollution is also available in this laboratory.



➤ **Non Destructive/Material Testing Laboratory**

It has all the facilities for conducting insitu tests like UPV, Rebound Hammer, Carbonation, Reinforcement Diameter, Cover etc. for checking the concrete quality and integrity of structures. In addition chemical tests such as carbonation, chloride and sulphate ingress are also being tested.



➤ **Computer Application Laboratory**

The Computer Application Laboratory has various software packages like STAAD Pro Connect Edition, ETABS, Abaqus, Bentley MX Road, MIDAS Soilworks, Primavera Project Planner, MapInfo Professional Software and ArcGIS for design, analysis, project planning and mapping resources.



➤ **Surveying Laboratory**

The laboratory has equipments like Robotic Total Station, Autolevel, Microscopic Theodelite and the minor surveying equipments.



4. Computer Science and Engineering Department

The department has one laboratory cum classroom and one theory classroom for M.E students of Computer Science and Engineering. The laboratory cum classroom is well equipped with computers with latest configurations and interactive board (Eyeris). The LCD projectors are fixed at each lab.

The department has set up a cyber security lab funded by MeitY, New Delhi, GOI in 2013 for providing training on Cyber Crime and Forensic tools to Polytechnic and Engineering College teachers. Recently the department also has set up Advanced Cyber Security Laboratory with hardware tools such as WinLift, Cyber Check suite, True Imager, Write Blocker etc.

The department has a server room equipped with 6 servers (IBM, HP Brand), Switches, Racks etc. The department is handling Proxy Server, Web Server, Mail Server, and other servers for different project purposes.

The department has licensed software of NetSim Network Simulator and Emulator Software, Adobe CS suite, Visual Studio .Net, Network Simulators, Wireless sensor Network kits for research work for ME and Ph.D candidates and also they are used in Short Term Courses.

The department also has a cell for hardware maintenance. All the computers and networking equipment of the institute are maintained by the department.

The department is equipped with CCNA Academy bundle for providing CCNA training to the outside students. The Dept. has 4 CISCO Certified trainers

There are Main Seven Laboratories in the Department

1. Software Lab (Room No. 108):

The lab is equipped with 22 latest configuration PC's (HP Desktop i7, 3.4 GHz/4GB/500GB with TFT monitors / Windows 8) with internet facility. The Lab is equipped with ICT Devices for conducting ICT Mode (through Google Hangout / A-View/ PeopleLink video conferencing tools) short-term courses on various technologies like Open Source Technologies, Cloud Computing, R Language, Big Data Analytics, Windows Server 2000 Administration, Android Programming etc. and for running M.E. Classes.



The lab is equipped with licensed NetSim Network Simulator and Emulator Software for R&D

Details of ICT Devices:

- Two 60 inches and One 40 inches LED Screens
- High resolution camera
- Ceil mounted High definition 4 speakers
- E-desk with Video Conferencing Software
- With Centralized AC

2) Cyber Security Laboratory



Cyber Security Lab has been established under the project "Establishment of Cyber Security & Forensic Training Facility for Technical Teachers Training" sponsored by DeitY, Ministry of IT, Govt. of India. There are total of 16 PC's with latest configuration duly fitted with LCD projector, motorized screen and multimedia digital podium, two Monosek Servers for the research purpose. All the computers are having internet facility and the Lab is being used for conducting ME classes, research work and various short term courses on Cyber Security using open source technologies and on other emerging technologies in Computer Science and Engineering discipline.

3) IBM Software Lab for Emerging Technologies (Room No. 102)

The lab is equipped with 25 PC's with latest configuration (i7 PCs with 8GB RAM and 500 GB HDD), internet facility and with necessary software (Qualnet, NS2/3, MATLAB/SCILAB etc.). The Lab was established in collaboration with IBM India Pvt. Ltd. And training for ME. Students, Ph.D. Scholars and Faculty and Staff of the department was organised on IBM Bluemix software, IBM CE - Enablement Program – Application Security Management using IBM Rational App Scan, IBM CE - Foundation course on Big Data using IBM Infosphere Big Insights.

- One LCD Projector with screen and wall mounted white board.
- One free standing Electronic Lectern with high sensitive built in interactive 19" monitor having 1280*1024 resolution with 3.3Ghz Processor and 3 MB cache.
- One interactive Touch Screen having display area 1860.48 *1046.52mm with 3820 *2160 pixel.



4) IOT Lab

This lab is equipped with Sensors, Weather forecasting equipment, Arduino Board, IOT Commercial kits, Zolartia Motes, Gateways, etc



5) CISCO and Computer Network and Support Centre

Centre is equipped with OTDR and Accessories, Digital Multimeters, LAN Testers, Power Meters, Source Meters, Punching Tools, Clipping Tools, Connectors, UTP Rolls, Wireless Access Points, Splicing Machine, Essential Tools for Assembly and Disassembly of PCs. This lab also contains CISCO kits and routers.



6.) Research and Innovation Lab



This lab is equipped with networked computer systems with internet facility. This laboratory is equipped with Matlab, Scilab, Qualnet Simulator, Cloudsim, NS2 etc. for the research purpose. This facility is exclusively being used by M.E and Ph.D scholars.

7. Advanced Cyber Security Lab

This lab consists of 15 high end computers loaded with all open source security tools and forensic tools which are used in training to the faculty and students. This lab also contains hardware tools such as WinLift, Cyber Check suite, True Imager, Write Blocker etc.



5. Curriculum Development Centre

The department has a well-equipped Communication Skills Lab for the development of Communication Skills in the teachers. About 30 teachers can be given training at a time.



The Communication Skills Lab has following facilities:

- State of the art infrastructure for developing Listening, Speaking, Reading and Writing Skills in the teachers and students.
- Software: Language Lab software, Study Skills Success and Sky Pronunciation are available.
- Facilities such as power-point projector, white boards, video camera and telephone etc. are available to conduct the practical exercises and providing feedback to the trainees.

6. Education and Educational Management Department

Statistical Packages Practice Lab

The Statistical Packages Practice Lab of the department is equipped with:

- 16 Computer Systems with internet facility for students of M.Tech. Engineering Education Programme
- LCD Projector, Overhead Projector
- SPSS Software for data analysis
- Psychological Tests for carrying out R&D Studies.



7. Electrical Engineering

The Electrical Engineering Department is equipped with the following laboratories:

1. Electrical Machines Laboratory



In addition to various conventional ac and dc machines, one set of universal machine is also available in the laboratory. A part of the Electrical Machines Laboratory is specifically developed for Contactor Control of Electric drives wherein various trainer boards have been developed for performing different exercises in this area.

2. PLC laboratory

The PLC laboratory is equipped with PLC based control system and Advanced PLC Trainer, other interfacing devices to train students how to program and upload ladder logic code. The lab is based primarily on the Allen Bradley family of Programmable Logic Controllers, which are widely used in factories and other settings.



3. Power Electronics Laboratory



In addition to number of training boards in Power Electronics, the laboratory is equipped with trainers on solid state motor control, three-phase triggering system, microprocessor based control systems, stepper motor control, thyristor based universal control kit, etc.

Power Electronics Laboratory also has a microprocessor based energy manager, large number of measuring instruments, Solar PV Training and Research Kit and Cascade Multilevel inverter (H-Bridges) which can be interfaced with MATLAB using Dspace unit and Cyclone III FPGA development kit.

4. Embedded Systems Laboratory



The Laboratory has a set of training boards on Transducers, Process Control, Analog Motor Control, Digital Motor Control and PC based data acquisition system in addition to various sensors, transducers and measuring instruments.

5. Process Control Laboratory

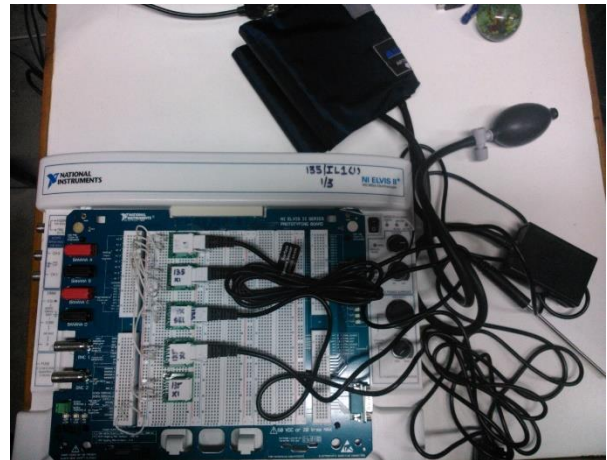


This laboratory has facilities for experiments on Microprocessor and PC based process control including flow, level, temperature etc. along with the supporting software.

6. Computer Applications Laboratory

The computer applications laboratory has various software packages such as MATLAB, LabVIEW, PSCAD, LIVEWIRE, LADSIM etc. which are used for simulation, design and analysis of various electrical and electronic systems and their control.

7. Virtual Instrumentation Laboratory



This laboratory is being developed recently and various equipments have been purchased such as NI ELVIS II with Circuit design bundle, Mechatronic Sensor board, Quanser Qnet DC motor control, Quanser Qnet rotary inverted pendulum, Quanser Qnet HVAC trainer, free scale NI Elvis microcontroller prototype board, Vernier Gran Engineering Sensor kit, Vernier Bio-instrumentation sensor, Emona ETT-211 Fotex fiber optics Communication Trainer etc.

8. Centre of Excellence for Hardware in Loop (HIL)

The department has established state-of-the-art Centre of excellence for Hardware in Loop (HIL) in collaboration with eminent industries such as Typhoon HIL and Opal-RT Limited.



It has facilities to perform hardware in loop simulations to Simulate proper interactions between the real controller under test, the simulated power grid and other virtual IED models • Simulate proper power system phenomena affecting protection system reliability • Test reaction time and validate settings of protections, while analyzing stability of the power system with cascaded events.

8. Electronics and Communication Engineering

The department has the following five well established laboratories with Internet Connectivity equipped with equipment & software to provide lab facilities to the students of Masters' Degree Regular & Modular Programs in Electronics & Communication Engineering and for smooth running of Staff Training Development Training Programs along with effective infrastructural facilities and modernized class-rooms in the department.

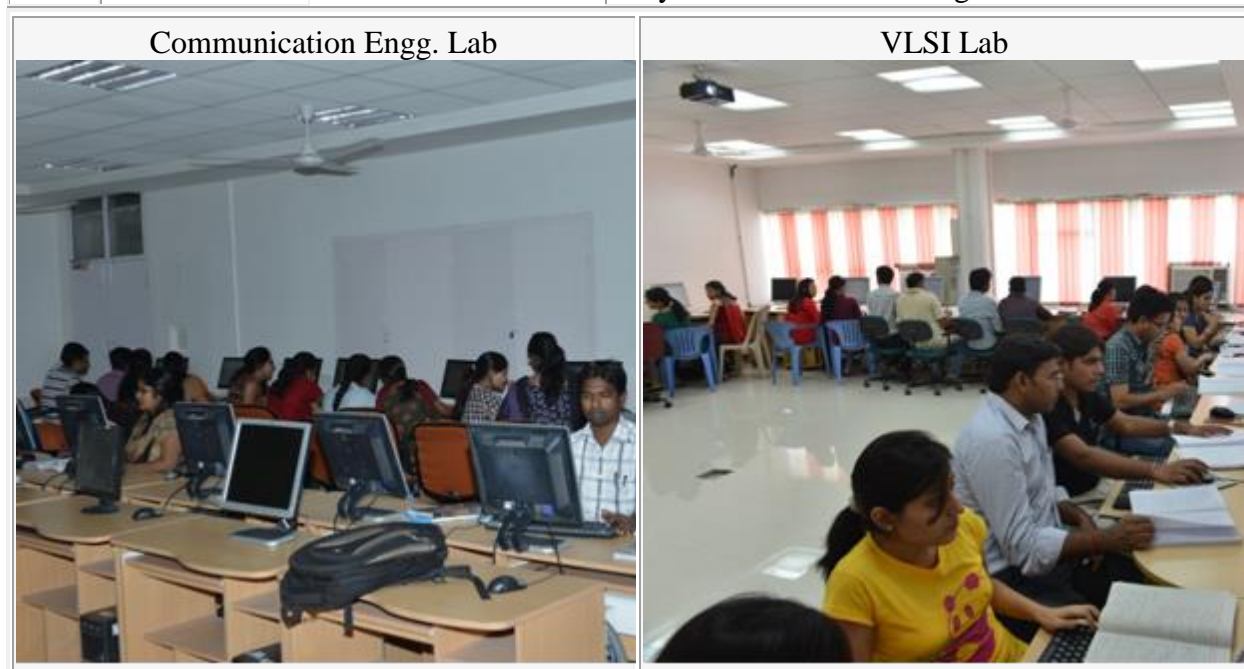
| Sr.No | Laboratories in the Department | Laboratories in the curriculum | Exclusive use/ shared | Available Floor Area (Sq m) | Number of Students (Max) | Number of Experiments | Quality of instruments | Laboratory manuals |
|-------|--------------------------------|------------------------------------|-----------------------|-----------------------------|--------------------------|-----------------------|------------------------|--------------------|
| 1 | DSP & Soft Computing Lab. | Advanced Digital Signal Processing | Shared | 84.3 | 25 | All as per syllabus | Excellent | Available |
| | | Advanced Mathematics | | | | | | |
| | | Image Processing | | | | | | |
| 2 | Communication Lab. | Advanced Digital Communication | Shared | 79.1 | 25 | All as per syllabus | Excellent | Available |
| | | Wireless and Mobile Communication | | | | | | |
| 3 | Embedded System Design Lab. | Embedded System Design | Shared | 64.3 | 25 | All as per syllabus | Excellent | Available |
| | | Digital System Design | | | | | | |

| | | | | | | | | |
|---|---------------|-----------------------------------|-----------|-------|----|---------------------|-----------|-----------|
| 4 | VLSI Lab. | VLSI | Exclusive | 64.3 | 25 | All as per syllabus | Excellent | Available |
| 5 | Research Lab. | Advanced Computer Networks | Shared | 48.0 | 12 | All as per syllabus | Excellent | Available |
| | | Cryptography and Network Security | | | | | | |
| 6 | Antenna Lab. | Antenna System | Exclusive | 24*12 | 12 | All as per syllabus | Excellent | Available |

Availability of research facilities

| Sr.No | Laboratories in the Department | Laboratories in the Curriculum | Research Facilities |
|-------|--------------------------------|------------------------------------|--|
| 1 | DSP & Soft Computing Lab. | Advanced Digital Signal Processing | Soft Computing lab is equipped with 30 desktop computers with internet facility. These systems are loaded with Matlab 2013b software which contains number of tools such as communication tools, simulating 3D dimensions, neural network toolbox, image processing toolbox, signal processing tool, image processing tool, signal processing toolbox etc. Lab is also equipped with image analysis software, ADSP - 2181 based development board ,universal Microcontroller development board, universal prototyping board (Mechatronics) and trainer kit based on 8051 |
| | | Advanced Mathematics | |
| | | Image Processing | |
| 2 | Communication Lab. | Advanced Digital Communication | Communication lab is equipped with 30 desktop computers in the lab with internet facility. Most of these computers are loaded with Matlab software, Qualnet software for GSM, UMTS network simulation. The lab is also equipped with HFSS Antenna design Simulator, wireless mobile communication kit (CDMA, GSM & Bluetooth). |
| | | Wireless and Mobile Communication | |
| 3 | Embedded System Design Lab. | Embedded System Design | The Embedded Systems Laboratory has 25 networked systems. The Laboratory has following items for R&D facilities : Embedded Kits <ul style="list-style-type: none"> • ARM Kit • Universal development board (with accessories), UPS 5 KVA, Spartan(R)-6FPGA, Advanced VLSI Proto Board, Multimedia projector and HP 8300 core 17 desktop computers. This laboratory |
| | | Digital System Design | |

| | | | |
|---|---------------|-----------------------------------|--|
| | | | has set of softwares like MATLAB, XILINX 9.2, Flow code V6 Professional 20 Users License. |
| 4 | VLSI Lab. | VLSI | The VLSI Laboratory has 20 networked computers with Internet facility. The Laboratory has a set of softwares like TCAD, Microwind , Matlab Design & Simulation of combinational and sequential circuits using Front End VLSI tools like Xilinx ISE, ISE simulator or Modelsim simulator, Back End VLSI Tools like Microwind, Mentor Graphics, Synopsis, Cadence. |
| 5 | Reasearch Lab | Advanced Computer Networks | This lab has 11 networked systems with internet facility. This lab has various softwares like wireless sensor network, library with Zigbee control, Crossbow wireless sensor network kit, WiFi application kit (IEEE 802.11b), advance Zigbee development system , wireless sensor networking development and RFID Application development system. |
| | | Cryptography and Network Security | |
| 6 | Antenna Lab | Antenna System | Antenna lab is equipped with Vector Network Analyzer(20GHz), Spectrum Analyzer (9 KHz -13GHz), Signal Generator (20GHz), Power meter, Site Analyzer, Ansys HFSS Antenna Design Simulation Software |





9. Electronics Service Centre

This centre has well equipped laboratories for repair of electronics equipment. It has facilities of various simulation softwares (TINA version 9, flow code matrix), prototype PCB design m/c, training kits on embedded system design and wireless communication systems, design and fabrication facilities and well equipped class rooms and laboratory practices.

The Electronics Service Centre has two well established laboratories with Internet Connectivity equipped with equipments & software's to provide lab. One lab is located in Homi Bhabha where the ME students use the Software for their Project Work & another lab is located in Ramanujan

Block where the students use their Hardware Project implementation. This facilities to the students of Masters' Degree Regular in Electronics & Communication Engineering and for smooth running of Staff Training Development Training Programs along with effective infrastructural facilities and modernized Lab in the department.

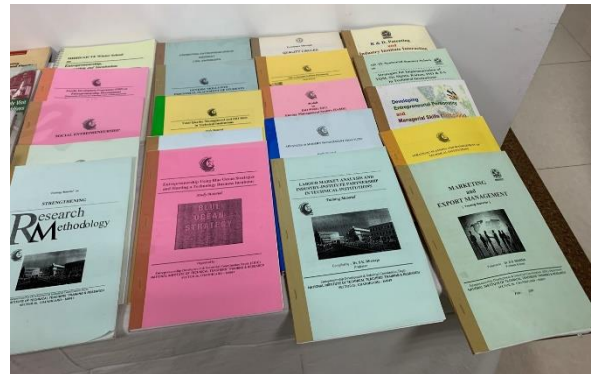
Hommi Bhabha(ESC) Lab:- PCB Machine



10. EDIC Department

The department has provision for five full-time faculty members but at the moment has three full-time highly qualified faculty members having educational background of engineering, business management and entrepreneurship, and a vast teaching and field/industrial experience.

The department has a large number of instructional resources to its credit and a good collection of books, video films, and Achievement Motivation Training kit etc. Proper infrastructural facilities also exist in terms of Library, Computer centre, Media centre, ETV centre, Class rooms, Workshops, Laboratories, Seminar/ Workshop/ Conference rooms, Guest House, Hostels, Dispensary, Mess and Canteen facilities etc. at the institute level.



11. Mechanical Engineering Department

The department has well equipped laboratories with latest equipment.

| Name of laboratory | Major facilities |
|--------------------------------|---|
| CAD/ CAM & Robotics | Server Intel Core 2 Duo Computer Systems, Software - AutoCAD, MDT, CATIA, IDEAS, ANSYS, MasterCAM, Pro/Engineer, Inventor, Rapid Prototyping Machine (RPT) Machine, |

| | |
|---|---|
| | <p>Plotter Printers Robotic Arm</p> |
| Metrology | <p>Basic Measuring Instruments Ultrasonic Thickness Gauge Force and Speed Measurement Kits Digital Height Gauge Surface Roughness Tester Digital Vernier Caliper Screw Gauge Slip Gauges Thread Gauges Temperature Measurement Kit Speed Measurement Kit</p> |
| Workshop | <p>Lathe Machine Milling Machine Grinding Machine Shaper Sawing Machine Tool and Cutter Grinder Surface Grinder Experimental Kits Dynamometer-Lathe / Drill / Milling TIG / MIG Welding Set Electro Discharge Machine Ultrasonic Drilling Machine</p> |
| Material Testing | <p>Metallurgical Microscope with Computer and Software Ultrasonic Flaw Detector Digital Universal Hardness Tester Dry Sliding Wear Measuring Rig Scratch Tester Micro-Hardness Tester Universal Testing Machine Material Pro Software Cut off Machine Sample Mounting Machine Digital Based Rockwell cum Brinell Hardness Tester UV-VIS Spectrophotometer Hardenability Tester Pre-Heating Oven Electric Furnaces</p> |
| Refrigeration & Air Conditioning | <p>Experimental Refrigeration Plant (6 TON) Refrigerator Refrigeration & Air Conditioning Test Equipment</p> |

| | |
|---------------------|---|
| | Working Models of AC, Refrigerator and Water Cooler Cut Models of components of AC |
| Mechatronics | Intel Core 2 Duo Computer Systems Microcontroller based Mechatronics kit Hydraulic Trainer Programmable Controllers MATLAB Software Automation Studio Software PLC Simulation Software Pneumatic & Hydraulic Systems Simulation Software Mechatronics Training Kit Robotics Simulation Software X-Y Table, Linear Conveyor and Rotary Table Pneumatic Cylinders with DC Valves Various Sensors and Actuators Data Acquisition System |



12. Media Engineering

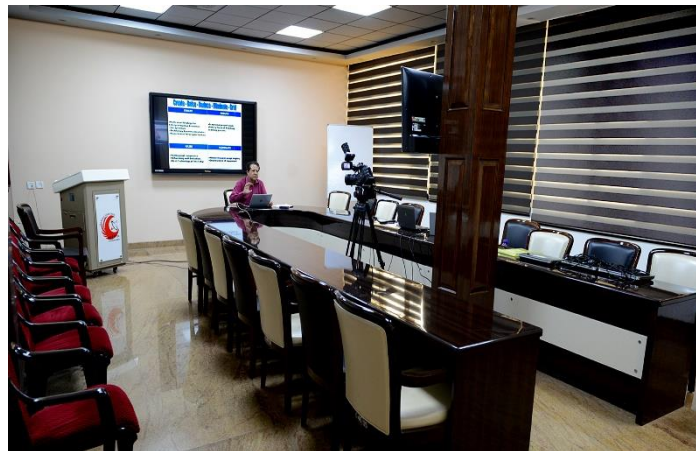
The Media Engineering department has world-class facilities such as:

a) Studios



The spacious main TV studio 54ft x 40ft x 32ft (16m x 12m x 9m) has arrangement of 132 lights operated through remote control hosting system. the studio is centrally air-conditioned and is 100% acoustically treated. It is a broadcast standard TV studio with sound locking entries and has separate PCR, ACR, LCR, VTR, CPR equipped with 3 CCD type multi-camera system for Betacam formats.

b) Golden Jubilee Room



ICT based programmes are organized in this room which is well equipped with high end cameras, interactive LED display, Electronic Lectern etc. Videos captured during ICT programmes are edited and uploaded in the NCTEL channel of Youtube.

c) Outdoor Recording Unit – ENG

There are two separate units in which each unit comprises of 3 CCD professional Camcorders, Lighting portapack, Colour Monitors and other related accessories.

d) Editing System



Two professional Betacam editing setups are available. One Betacam edit setup has A/B Roll facility with Audiomixer, Vision mixer, Videotizer remote control facility with E-file. Second Betacam edit set up has separate digital effect generator, Gemini-III Audio Mixer, Videotizer.

e) Video Cassette Library

The air-conditioned video library has a collection of 400 betacam, 660 U-Matic and 500 VHS cassettes for programme exchange and video film production.

f) Video Duplication set-up

There are full fledged facilities for transferring master programmes from U-matic and Betacam format to VHS format through multi-output terminals.

g) Maintenance of Video Equipment

The maintenance of laboratory is equipped with facilities to take care of the routine maintenance and repair of Audio Video equipment.

The following facilities are extended by experienced faculty and in various disciplines at the institute and infrastructure available in laboratories and workshops.

- Prototype design and development
- Model Fabrication/Production
- Photography, transparency/slide making
- Binding and Lamination
- Information Resource Dissemination
- Desk Top Publishing

- Reprographic system
- Production of Advertising material

Clients Served

- Polytechnics of Northern Region
- Industrial Training Institutes
- Vocational Institutes
- State Institute of Education
- Haryana Agriculture Department
- Commonwealth Youth Centre

Other Potential clients:

- Engineering Colleges/Management Institutes
- Communication and Media Department of Universities
- National Institutes of Health, Science and Technology Science Parks
- Model Fabrication units of College of Arts and other institutions
- Design Centres of industry
- Training Centres of Industry
- Rural Development, Science and Technology Development Agencies
- Energy Development Departments in States
- Special Education Institutes/Organizations.

13. Rural Development Department



Major infrastructural and facilities available in the Department include:

- Water Testing Lab
- Rural Technology Demonstration Centre
- Rural Technologies Yard

- Community Development Information Centre
- IIT sponsored Technology Park for Emerging Technologies for Rural Development.

14. Solar Power Plant



The institute has two rooftop solar PV power plants with following specifications:
35 kW Peak (15kWp Grid Interactive & 20 kWp Stand Alone)
50 kW Peak (Grid Interactive)

Annexure – V

(3 Pages)

राष्ट्रीय तकनीकी शिक्षक प्रशिक्षण एवं अनुसंधान संस्थान

निदेशक का कार्यालय

e-mail: dirnitrtrchd@yahoo.com, directornitrtrchd.ac.in



निर्देशक कार्यालय/

दिनांक: 10 अप्रैल 2020

ALLOCATION OF ADDITIONAL DUTIES - 15.04.2020 ONWARDS

| Sl. No. | Duty | Chairman/Chairperson Co-Chairman/Co-Chairperson [Sarvshri/Ms.] | Support Team Members [Sarvshri /Ms.] |
|---------|--|---|---|
| 1. | Faculty Development Programme [FDP] Committee | Chairman: Dean [AR&D] Co-Chairman: C Ramakrishna | Rupinder Singh, M.Dutta, Shano Solanki, SK Gupta Member Convener: FIA |
| 2. | Institute Budget Allocation and Expenditure Monitoring Committee | Chairman: BS Pabla Co-Chairman: Lini Mathew | Deans, Associate Dean(s), HoDs Member Convener: ACO |
| 3. | Purchase Committee | Chairman: Hemant Sood Co-Chairman: Srinivasa KG | ACO, FIA, Hemant Kumar Vinayak, Mala Karla, concerned Head |
| 4. | Library Committee | Chairman: Srinivasa KG Co-Chairman: Balwinder Singh | Nominee of HODs, Nominee of ACO, SO-Stores, SO-Library Member Convener: SO-Library |
| 5. | Staff Welfare & Grievances Redressal Committee | Chairman: AB Gupta Co-Chairman: Sanjay Sharma | FIA, ACO, Maitreyee Dutta, Piush Verma, Balwinder Raj Member Convener: FIA/AdO |
| 6. | Liaison Officer for SCs/STs | Chairman: Rajesh Mehra Co-Chairman: Lini Mathew | Balwinder Singh, Ashok Kumar, Rama Chhabra, Shano Solanki Amandeep Kaur, FIA, ACO Member Convener: SO [Estt] |
| 7. | Committee to look into Harassment against Women | Chairman: Lini Mathew Co-Chairman: Poonam Syal | Pankaj Sharma, Shano Solanki, FIA, Jaikrishan, Jaspal Singh, ACO and Outside Expert Member Convener: Rita Bedi |
| 8. | Internal Audit | Auditor: SK Gupta Co-Auditor: Harsh Vardhan Samalia | Accounts Officer, FIA Member Convener: SO [Budget & Internal Audit] |
| 9. | Campus Planning & Development | Chairman: Sanjay Sharma Co-Chairman: P K Singla | HOD-EE, HOD-CSE, HOD-ECE, HOD-Media Engg, FIA/ ACO Member Convener: Estate Officer |
| 10. | Campus Repair, Maintenance & Security, including Furniture | Chairman: Amod Kumar Co-Chairman: P K Singla | H K Vinayak, SO-Hostel, SO-B&IA. SO [Estt], FIA, EO Member Convener: EO |
| 11. | Physical Verification | Chairman: SS Dhama Co-Chairman: Pankaj Sharma | HK Vinayak, Amit Doegar, Amardev Singh Member Convener: SO [Stores] |
| 12. | Student Welfare Activities [Co & Extra Curricular] & Cultural Activities | Chairman: Rupinder Singh Co-Chairman: AK Duggal | Vinod Kumar, Sunil D. Jassal, Mala Kalra, Garima Saini, Ritula Thakur, Member Convener: SO [Academic Cell] |
| 13. | Sports Committee | Chairman: Ajay Kumar Duggal Co-Chairman: Balwinder Raj | Meenakshi Sood, Ashok Kumar, Anurag Soni, Hem Raj, Vijay Sharma, Meena Sharma Member Convener: SO [Academic Cell] |
| 14. | Legal Matters Committee | Chairman: C. Ramakrishna Co-Chairman: SS Gill | FIA, Balwinder Singh, Shano Solanki Member Convener: SO [Estt] |
| 15. | Academic Cell | Chairman: Dean, AR&D Co-Chairman: Srinivasa KG | Ashok Kumar, Amit Doegar, Garima Saini Member Convener: SO [Academic Cell] |
| 16. | Centre for Developing Technical Competency [CDTC] | Chairman: BC Choudhary Co-Chairman: Rupinder Singh | Nominee of HODs Member Convener: Amardev Singh |
| 17. | Departmental Promotion Committee [DPC], MACP | Chairman: Maitreyee Dutta Co-Chairman: Amod Kumar | Lini Mathew, concerned HOD, Pankaj Sharma, Vinod Kumar, FIA, ACO Member Convener: FIA |
| 18. | Chief Vigilance Officer | SS Banwait | FIA, SO [Estt] |
| 19. | Institute Journal, Newsletter and Publicity Committee | Chairman: Sunil Dutt Co-Chairman: Balwinder Singh | HK Vinayak, Ashok Kumar Member Convener: Kanika Sharma |

| Sl. No. | Duty | Chairman/Chairperson Co-Chairman/Co-Chairperson [Sarvshri/Ms.] | Support Team Members [Sarvshri /Ms.] |
|---------|--|---|---|
| 20. | Meetings of HODs & Others as per instruction of the Authority | Chairman: Head, CSE Co-Chairman: Srinivasa KG | SS Gill, AB Gupta Support Staff: Staff of CSE |
| 21. | Meetings of FC/ BOGs /Society | Chairman: FIA Co-Chairman: ACO | SO [Estt], SO [B&IA] Support Staff: SO [Board] and Team |
| 22. | Liaison with States | Liaison Officers | Support Team |
| | ❖ Delhi | Rajesh Mehra | Ashok Kumar |
| | ❖ Haryana | Maitreyee Dutta | SK Gupta |
| | ❖ Himachal Pradesh | Pankaj Sharma | Meenakshi Sood |
| | ❖ Jammu & Kashmir | Lini Mathew | Ritula Thakur |
| | ❖ Punjab & Chandigarh | SS Dhama | Balwinder Singh |
| | ❖ Rajasthan | Piush Verma | AK Duggal |
| | ❖ Uttar Pradesh | Amod Kumar | Harsh Vardhan Samalia |
| | ❖ Uttarakhand | Hemant Sood | HK Vinayak |
| | ❖ Other than Northern States | Maitreyee Dutta | Srinivasa KG, SS Gill |
| | [All Liaison Officers (except for other than Northern States) need to visit the concerned State, conduct meeting with appropriate Govt officials (DTE/Secretary) and submit report once in every six months] | | |
| 23. | Hostel & Mess Management | Chairman: SK Gupta Co-Chairman: SS Gill | Warden [Men], Warden [Women] and EO Member Convenor: SO [Hostel] |
| 24. | Guest House | Chairman: Pankaj Sharma Co-Chairman: Balwinder Singh | SO [Store] Member Convenor: EO |
| 25. | Hostel Warden (Men) | Balwinder Singh and Ashok Kumar | EO, SO [Hostel] |
| 26. | Hostel Warden (Women) | Meenakshi Sood and Garima Saini | EO, SO [Hostel] |
| 27. | Chief Hostel Warden | SK Gupta | EO, SO [Hostel] |
| 28. | Mess and Canteen | SK Gupta | Wardens, EO, SO [Hostel] |
| 29. | Awards Committee | Chairman: Dean [ICCES] Co-Chairman: Dean [AR&D] | Liaison Officers Member-Convenor: HOD, CSE |
| 30. | Allotment and Maintenance of Vehicles | Chairman: FIA Co-Chairman: Estate Officer | SO [B&IA], Senior Most Driver Member-Convenor: Estate Officer |
| 31. | Intranet, Internet and Institute Website, Networking etc. | Chairman: HOD-CSE Co-Chairman: C Ramakrishna | HOD-EE, Amrendra Saran, Pardeep Bansal, Sangeeta Gupta Rajiv Negi, Member Convenor: Sidharatha Nanchahal |
| 32. | Performance Evaluation & Target Monitoring Committee [The Committee to submit report on every four months] | Chairman : BS Pabla Co-Chairman: Dean (AR&D) | Deans, Associate Dean(s), concerned HOD Member Convenor: HoD, CSE |
| 33. | Stakeholder Interaction, Feedback Collection and Analysis Committee | Chairman: SS Gill Co-Chairman: Pankaj Sharma | HoD (CSE)and Sangeeta Gupta |
| 34. | Industry Linkage and Collaboration | Chairman: SK Dhameja Co-Chairman: SS Gill | Nominee of HODs |
| 35. | Quality Assurance & ISO Certification | Chairman: SK Gupta Co-Chairman: Sunil Dutt | Himmi Gupta and Amit Doegar |
| 36. | Official Language Implementation | Chairman: FIA Co-Chairman: SO (Estt) | Staff of Hindi Cell Member-Convenor: Hindi Cell |
| 37. | Public Information Officer under RTI, CPGRAMS | Sunil Dutt | FIA, ACO and SO [Estt] |
| 38. | Press Interaction Committee | Chairman: Piush Verma Co-Chairman: Head CSE | FIA, Amardev Singh, HK Vinayak |
| 39. | Students Placement | Chairman: UN Roy Co-Chairman: Vinod Sonthwal | Nominees of all HODs Member Convenor: SO [Academic Cell] |
| 40. | Operation and Maintenance of PA System and Photography | Chairman: Rakesh Wats Co-Chairman: HOD-CSE | Staff of Media Engineering |
| 41. | Dispensary | Chairman: Piush Verma Co-Chairman: Sunil Jassal | FIA,SO [Hostel], SO [Stores], Member Convenor: SO [Estt] |

| Sl. No. | Duty | Chairman/Chairperson Co-Chairman/Co-Chairperson [Sarvshri /Ms.] | Support Team Members [Sarvshri /Ms.] |
|---|---|---|--|
| 42. | House Allotment Committee [Staff] | Chairman: Rajesh Mehra Co-Chairman: UN Roy | Himmi Gupta, Estate Officer, Jasvir Singh Rattan, Member Convenor: SO [Estt] |
| 43. | House Allotment Committee [Faculty] | Chairman: Rakesh Wats Co-Chairman: Lini Mathew | Poonam Syal, Balwinder Raj, FIA Member Convenor: FIA |
| 44. | Recruitment of Faculty & staff (Regular) | Chairman: BS Pabla Co-Chairman: SS Gill | M. Dutta, Rajesh Mehra, Lini Mathew, FIA |
| The Committee shall verify the rules, qualifications, terms and conditions before advertisement is published | | | |
| 45. | Digital Mission Implementation & Monitoring (including instructional resources, Product Development etc) | Chairman: C Ramakrishna Co-Chairman: HOD, Media Engg | Srinivasa KG, Balwinder Singh, Nominee of all HODs |
| 46. | Implementation and Monitoring of National Mission [Except Digital Mission] | Chairman: Dean [ICCES] Co-Chairman: Dean (AR&D) | UN Roy, HK Vinayak, Member Convenor: Head, Rural Development |
| 47. | Alumni Activities | Chairman: Poonam Syal Co-Chairman: Piush Verma | Ritula Thakur, Kanika Sharma, Mala Kalra, Rama Chhabra |
| 48. | Celebration of Various Days | PK Singla | For overall Supervision |
| | | Coordinator | Support Faculty/Staff |
| | ❖ Labour Day | Amardev Singh | Amit Doegar |
| | ❖ Anti-Terrorism Day | Amandeep Kaur | Amit Goyal |
| | ❖ International Day against Drug Abuse | All HODs | Staff of concerned Department |
| | ❖ Independence Day | FIA | EO, SO [Stores], SO [Hostel], Ashish Kumar |
| | ❖ Sadbhavana Divas | Mala Karla | SO [Estt] |
| | ❖ Teachers' Day | Kanika Sharma | PS Rao |
| | ❖ Vishwakarma Day | PS Rao | RK Goel |
| | ❖ Quami Ekta Day | SO (Estt.) | JP Tungal |
| | ❖ Martyrdom Day | Shano Solanki | Amit Goyal |
| | ❖ Institute Day | Lini Mathew | FIA, M. Dutta and Pankaj Sharma |
| | ❖ World Blood Donor Day | AK Duggal | Sunil Dutt, JP Tungal |
| | ❖ Republic Day | FIA | EO, Ashish, SO [Estt] |
| | ❖ International Day of Yoga | Ritula Thakur | Ajay Kumar Duggal and P K Singla |
| | ❖ Matribhasha Divas | FIA | Hindi Cell |
| | ❖ Sardar Vallabhbhai Patel Divas (National Unity Day) | Himmi Gupta | Amardev Singh |
| ❖ International Literacy Day | Shano Solanki | Ashok Kumar | |
| ❖ Fundamental Rights Day | Amit Goyal | Harsh Vardhan Samalia | |
| ❖ International Women's Day | Garima Saini | Meenakshi Sood | |
| ❖ Vigilance Awareness Week | CVO | SO-Estt | |
| 49. | HUB Coordinator | M. Dutta | Srinivasa KG |
| 50. | Accreditation like NBA etc/ Deemed-to-be University | Chairman : BS Pabla Co-Chairman : C Ramakrishna | Srinivasa KG, Nominee of HoDs |
| 51. | Academic Council | Chairman: Dean [AR&D] Co-Chairman: Srinivasa KG | Head-CSE and Staff of Academic Cell |
| 52. | Staff Training | Chairman: AB Gupta Co-Chairman : SS Dhami | Deans, Associate Dean(s), FIA Member Convenor: FIA |

NOTE:

- (i) Each Committee must ensure timely meetings and submit the report to authority.
- (ii) The Committee Chairman/Chairperson shall interact with member-convenor and team members to ensure that meetings are held and reports are submitted on time as desired.
- (iii) The Committee Chairman/Chairperson, if need be, can co-opt two members from staff after discussing with the Director.

P K Singla
FIA