Model Curriculum for Diploma Courses in Engineering & Technology

2019

ALL INDIA COUNCIL FOR TECHNICAL EDUCATION
Nelson Mandela Marg, Vasant Kunj, New Delhi 110070
www.aicte-india.org
MODEL CURRICULUM FOR
DIPLOMA COURSES IN
ENGINEERING & TECHNOLOGY

2019
The effectiveness of the education system is dependent on a well-developed curriculum that must be measured by the extent to which it is able to attract the young generation into the occupation of the future. Also, it must have the ability to deliver not only technical contents but also impart necessary skills that help students to learn how to cope with new challenges and prepare them for lifelong learning once they have entered the workforce. Our country produces a major chunk of technicians every year and it is very necessary that the diploma students be well updated with the latest technological skills and advancements, to meet industrial demands and contribute to nation building.

I am glad to know that AICTE has developed an outcome-based Model Curriculum with the help of academic and industry experts for various disciplines of Diploma courses in Engineering and Technology. This will be available for Universities, State Technical Education Boards and Institutions for updating and adoption. This adoption will be advantageous for students to enhance their skills and employability. The introduction of mandatory Induction program for Students belonging to diverse backgrounds will help them to adjust in the new academic environment and mandatory internship will prepare them with skills befitting industry expectations.

I appreciate AICTE’s initiative in transforming technical education by way of evolving and launching model curriculum.
MESSAGE

The quality of technical education depends on many factors but largely on-outcome based socially and industrially relevant curriculum, good quality motivated faculty, teaching learning process, effective industry internship and evaluation of students based on desired outcomes. Therefore, it was imperative that a revised AICTE model curriculum be prepared by best experts from academia and industry, keeping in view the latest industry trends and market requirements in all major diploma in engineering & technology subjects and be made available to all universities / board of technical education and diploma institutions in the country. AICTE constituted subject-wise team of 3-4 experts to revise the model curriculum of diploma courses. Similar exercise is done for programmes at UG and PG level in engineering, MBA, PGDM, Pharmacy, Architecture, etc.

The revised model diploma in engineering and technology curriculum has been designed where number of credits have been reduced to 120. It is comprising of basic sciences and engineering having focus on fundamentals, significant discipline level courses and ample electives both from the disciplines and cross disciplines. Internships have been embedded to make the student understand the industry requirements, have hands on experience and take-up project work relevant to industry in their final year. These features will allow students to develop a problem-solving approach to face the challenges in the future.

As a major initiative by AICTE, a two-week mandatory induction program for students has also been designed and has to be given at the beginning of the course. The idea behind this is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.
The Chairman of the All India Board of Technician Education (AIB-TE) along with the several teams have prepared the model curriculum for various diploma disciplines. It is with great pleasure we thank each team of experts who have developed the model curriculum for major diploma disciplines. We are sure that model curriculum will help to enhance employability and also enable youngsters to become job creators considering the outcome based learning, kept at focus while designing the scheme and syllabi.

We strongly urge the institutions / universities / boards of technical education in India to adopt this Model Curriculum for various diploma disciplines. This is a suggestive curriculum and the concerned university / institution / board should build on and exercise flexibility in readjustment of courses / credits within the overall 120 credits in respective diploma programs.

AICTE places on record special thanks to Prof. Sathans, Chairman AIB-TE for steering and overseeing the development of the curriculum.

(Prof. Anil D. Sahasrabudhe)
Chairman
All India Council for Technical Education
PREFACE

Taking cognisance of growing concern about quality of technical education in India, AICTE in its 49th council meeting held on 14.03.2017 approved a package of measures for improving quality of technical education - revision of curriculum, mandatory internships, and Student Induction Program were amongst the few.

AICTE, fully aware of the fact that diploma education should make students job ready faster, in consultation with its All India Board of Technician Education (AIBTE) constituted subject-wise Committees with experts drawn from academia and industry to prepare model curriculum of Diploma in various disciplines of Engineering. The rationale behind this exercise is standardization and development of curriculum for Diploma Programs for 4 million students across India. During the development of curriculum, the employability and employment opportunities for youth were kept in mind.

AICTE has made 7-10 weeks summer internships mandatory in the new curriculum which will equip the students with practical understanding and training about industry practices in a suitable industry or organization. To make education holistic, sports, physical activities, values and ethics have been embedded in the curriculum.

In the course of development of model curriculum, the respective Committees reviewed the existing system prevalent in polytechnic colleges besides factoring in industry requirements and market trends, employability, edge over engineering graduates, problem solving approach and need for lifelong learning.

After due deliberations, the scheme and syllabi for various engineering disciplines have been formulated. Salient features of this model curriculum are enumerated as under:

• Reduced number of credits
• Introduction of Induction Program
• Introduction of credit course on Sports & Yoga in first semester to inculcate the habit of physical and mental fitness right at the start
• Well defined learning objectives & outcomes for each course
• Inclusion of courses on socially relevant topics
• Built-in flexibility to the students in terms of program elective and open elective courses.
• A suggestive list of open electives has been drawn and provided separately as appendix II.
• Two mandatory internships to equip the students with practical knowledge and provide them exposure to real time industrial environments. Further, in one of the internships, option is provided to do internship in social sector/Govt. initiated social schemes/NGOs etc.

• Course on Entrepreneurship and Startups to encourage entrepreneurial skills.

• To the extent possible, the weightage of theory and practical (in terms of contact hours) has been balanced.

• A list of experiments, with the objective clearly spelt out, is specified for each lab course

• Provision of organizing at least one expert lecture per semester for each branch by inviting resource persons from domain specific industry

The New Curriculum has been designed to better meet the needs of the industry considering evolving technological trends and implications for the engineering workforce. This curriculum is also expected to enhance employability skills in the very process of teaching-learning, develop well trained Diploma Engineers who have the knowledge and the skills to engineer solutions for real-world problems.

I gratefully acknowledge the time and efforts of all those who contributed to this document, especially, the contributions of the Chairpersons and members of various subject-wise committees, AICTE officials – Prof. Rajive Kumar, Advisor-I, Dr. Neeraj Saxena, Advisor-II, Dr. Neetu Bhagat, Deputy Director (P&AP), Shri Manoj Singh, Asst. Director (P&AP), Mr. Dharmesh Kumar Dewangan, Young Professional (P&AP) as well as the special assistance provided by Mr. Sunil and other office staff of AICTE.

I am deeply grateful for the scholarly guidance and essential support provided by the Hon’ble Chairman, Vice-Chairman, and the Member Secretary, AICTE to all aspects of the Board’s efforts in working towards achieving this objective.

(Prof. Sathans)
Chairman
All India Board of Technician Education
ACKNOWLEDGEMENT

The development of an outcome based Model Curriculum for the Diploma Program in Engineering & Technology is a result of thoughtful deliberations at various stages of dedicated and specialized experts. The efforts were driven by need for standardization of curriculum for Diploma Programs for 4 million students entering every year. The important points kept in mind while developing the curriculum are employment opportunities for youth, market driven approach and rural development. This model curriculum has been framed to meet the expectations of an academically challenging environment, develop problem solving skills, and align with current standards and to enrich the students to make them self-enablers and/or match job requirements.

I wish to acknowledge the contribution of our esteemed experts involved in the process of developing this outcome based model curriculum. We are thankful to Chairman AIB-TE Prof. Sathans and the Heads of the committees of different branches namely Prof. O. R. Jaiswal; Prof. Madhu Murthy K.; Dr. Joshua Earnest; Prof. Shatrunjay Rawat; Dr. A. Arunagiri; Dr. Rajesh Kumar; Dr. B. C. Choudhary with their team of academic and industry experts who committed themselves towards framing this model curriculum.

I highly appreciate and thank Prof. Rajeev Sangal of IIIT Hyderabad and his team for developing a Guide to Induction Program along with mandatory and humanities courses. I am greatly gratified to Shri R. Subrahmanyam, Secretary, MHRD and Dr. S. S. Sandhu, Additional Secretary (TE) for their supervision, contribution, guidance and support throughout the development of this model curriculum.

Special thanks and gratitude to Prof. Anil D. Sahasrabdhe, Chairman; Prof M.P. Poonia, Vice Chairman and Prof. A.P. Mittal, Member Secretary, AICTE who all have been instrumental and encouraging throughout the process of developing this model curriculum.

I appreciate the officers and officials of Policy & Academic Planning Bureau, in particular the dedication put in by Dr. Neeraj Saxena, Dr. Neetu Bhagat, Shri Manoj Singh, Mr. Dharmesh Kumar Dewangan and Mr. Ankit Mishra for compiling the inputs from the experts and coordinating the whole process. I also sincerely thank all officers and officials of AICTE, who have contributed in one way or other for the development of this model curriculum.

(Prof. Rajive Kumar)
Adviser-I
Policy & Academic Planning Bureau, AICTE
### Subject-wise Committees for Model Curriculum of Diploma Courses in Engineering & Technology

#### Civil Engineering

<table>
<thead>
<tr>
<th>Name</th>
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</tr>
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<tbody>
<tr>
<td>Prof. O. R. Jaiswal</td>
<td>Chairman</td>
</tr>
<tr>
<td>Department of Applied Mechanics, Visvesvaraya National Institute of Technology, Nagpur</td>
<td></td>
</tr>
<tr>
<td>Dr. Hemant Sood</td>
<td>Member</td>
</tr>
<tr>
<td>Professor &amp; Head, Department of Civil Engineering, National Institute of Technical Teachers Training &amp; Research, Chandigarh</td>
<td></td>
</tr>
<tr>
<td>Dr. D.K Parbat, HOD Civil Engineering, Government Polytechnic, Chandrapur, Maharashtra</td>
<td></td>
</tr>
<tr>
<td>Shri Rajender Garg</td>
<td>Member</td>
</tr>
<tr>
<td>General Manager (Tech.), National Highway Authority of India, New Delhi</td>
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#### Mechanical Engineering and Production Engineering

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<thead>
<tr>
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<tbody>
<tr>
<td>Prof. Madhu Murthy K.</td>
<td>Chairman</td>
</tr>
<tr>
<td>Department of Mechanical Engineering, National Institute of Technology, Warangal</td>
<td></td>
</tr>
<tr>
<td>Prof. A. B. Gupta,</td>
<td>Member</td>
</tr>
<tr>
<td>National Institute of Technical Teachers Training &amp; Research, Sector-26, Chandigarh</td>
<td></td>
</tr>
<tr>
<td>Prof. N. Selvaraj, Professor, NIT Warangal</td>
<td></td>
</tr>
<tr>
<td>Dr. Deepak Paliwal, Mechanical Engineering, SV Polytechnic College Bhopal</td>
<td></td>
</tr>
<tr>
<td>Dr. A. Veeresh Babu, Assoc. Professor, National Institute of Technology, Warangal</td>
<td></td>
</tr>
<tr>
<td>Shri Ashish Swarup, Senior Engineer, Jaguar Land Rover India Ltd. Pune, Maharashtra</td>
<td></td>
</tr>
<tr>
<td>Dr. P. Subash Chandra Bose, Assoc. Professor, National Institute of Technology, Warangal</td>
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### Electrical Engineering

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<tr>
<td>Dr. Joshua Earnest</td>
<td>Chairman</td>
</tr>
<tr>
<td>Dr. Lini Mathew</td>
<td>Member</td>
</tr>
<tr>
<td>Dr. Dilip Lulekar</td>
<td>Member</td>
</tr>
<tr>
<td>Shri Chetna Nand Singh</td>
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### Computer Engineering and Information Technology

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<tbody>
<tr>
<td>Prof. Shatrunjay Rawat</td>
<td>Chairman</td>
</tr>
<tr>
<td>Prof. Sanjeev Sofat</td>
<td>Member</td>
</tr>
<tr>
<td>Shri Harinder Singh</td>
<td>Member</td>
</tr>
<tr>
<td>Shri Murali Mohan Josyula</td>
<td>Member</td>
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## Chemical Engineering

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<tr>
<td>Dr. A. Arunagiri, Assoc. Professor,</td>
<td>Chairman</td>
</tr>
<tr>
<td>Department of Chemical Engineering,</td>
<td></td>
</tr>
<tr>
<td>National Institute of Technology, Trichy</td>
<td></td>
</tr>
<tr>
<td>Prof. Subrata Mondal</td>
<td>Member</td>
</tr>
<tr>
<td>National Institute of Technical Teachers</td>
<td></td>
</tr>
<tr>
<td>Training &amp; Research, Kolkata, Block-FC,</td>
<td></td>
</tr>
<tr>
<td>Sector-III, Salt Lake City, Kolkata</td>
<td></td>
</tr>
<tr>
<td>Shri Ashish Bhushan</td>
<td>Member</td>
</tr>
<tr>
<td>DGM (TS &amp; QC)-PNC</td>
<td></td>
</tr>
<tr>
<td>IndianOil Corporation, Panipat Refinery</td>
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</tr>
<tr>
<td>Shri S K Sahu</td>
<td>Member</td>
</tr>
<tr>
<td>Dept. of Chemical Engineering</td>
<td></td>
</tr>
<tr>
<td>Uttakalman Gopabandhu Institute of</td>
<td></td>
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<tr>
<td>Engineering Rourkela</td>
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## Electronics Engineering

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<tr>
<td>Dr. Rajesh Kumar,</td>
<td>Chairman</td>
</tr>
<tr>
<td>Malviya National Institute of Technology,</td>
<td></td>
</tr>
<tr>
<td>Jaipur, Rajasthan</td>
<td></td>
</tr>
<tr>
<td>Dr. Maitry Dutta,</td>
<td>Member</td>
</tr>
<tr>
<td>NITTTR, Chandigarh</td>
<td></td>
</tr>
<tr>
<td>Mr. K. P. Akhole, HOD, Dept. of Electronics</td>
<td>Member</td>
</tr>
<tr>
<td>Government Polytechnic Jalgaon, Maharashtra</td>
<td></td>
</tr>
<tr>
<td>Ms. Komal Gupta, Sr. Systems Engineer,</td>
<td>Member</td>
</tr>
<tr>
<td>BrahMos Aerospace, New Delhi</td>
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<tr>
<td>Prof. Ghanshyam Singh, Professor, ECE,</td>
<td>Member</td>
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<tr>
<td>MNIT, Jaipur</td>
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### Applied Sciences & Humanities

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<tr>
<th>Name</th>
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<tr>
<td>Dr. B. C. Choudhary, Professor &amp; Head</td>
<td>Chairman</td>
<td>Dept. of Applied Science, N.I.T.T.R., Chandigarh</td>
</tr>
<tr>
<td>Dr. A.S. V. Ravi Kanth, Associate Professor</td>
<td>Member</td>
<td>Department of Mathematics National Institute of Technology, Kurukshetra</td>
</tr>
<tr>
<td>Dr. Shahida, Assistant Professor of English</td>
<td>Member</td>
<td>Department of Humanities &amp; Social Sciences, National Institute of Technology Kurukshetra</td>
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<tr>
<td>Dr. Madhu Mann, Govt. Polytechnic, Chandigarh</td>
<td>Member</td>
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<tr>
<td>Dr. G H Hugar, Asstt. Prof. (Sl. Gr) in Chemistry, CCET (Diploma Wing), Sector-26, Chandigarh</td>
<td>Member</td>
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CHAPTER 1

General Course Structure & Credit Distribution
Definition of Credit:

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<th>Time</th>
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<tr>
<td>1 Hr. Lecture (L) per week</td>
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<tr>
<td>1 Hr. Tutorial (T) per week</td>
<td>1 credit</td>
</tr>
<tr>
<td>1 Hr. Practical (P) per week</td>
<td>0.5 credit</td>
</tr>
<tr>
<td>2 Hours Practical (P) per week</td>
<td>1 credit</td>
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A. Range of Credits:

In the light of the fact that a typical Model Four-year Under Graduate degree program in Engineering has about 160 credits, the total number of credits proposed for the three-year Diploma program in Engineering & Technology is 120.

B. Structure of Diploma Engineering program:

The structure of Diploma Engineering program shall have essentially the following categories of courses with the breakup of credits as given:

<table>
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<th>Sr. No</th>
<th>Category</th>
<th>Suggested Breakup of Credits</th>
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<tbody>
<tr>
<td>1.</td>
<td>Humanities &amp; Social Sciences courses</td>
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</tr>
<tr>
<td>2.</td>
<td>Basic Science courses</td>
<td>19’</td>
</tr>
<tr>
<td>3.</td>
<td>Engineering Science courses</td>
<td>15’</td>
</tr>
<tr>
<td>4.</td>
<td>Program Core courses (Branch specific)</td>
<td>45’</td>
</tr>
<tr>
<td>5.</td>
<td>Program Elective courses (Branch specific)</td>
<td>12’</td>
</tr>
<tr>
<td>6.</td>
<td>Open Elective courses (from other technical and /or emerging subjects)</td>
<td>9’</td>
</tr>
<tr>
<td>7.</td>
<td>Project work, seminar and internship in industry or elsewhere</td>
<td>12’</td>
</tr>
<tr>
<td>8.</td>
<td>Audit Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge etc.]</td>
<td>(non-credit)</td>
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<tr>
<td></td>
<td>Total</td>
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*Minor variation is allowed as per need of the respective disciplines.

C. Course code and definition:

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<th>Course code</th>
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<td>Tutorial</td>
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<td>Practical</td>
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<td>Humanities &amp; Social Sciences Courses</td>
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<tr>
<td>AU</td>
<td>Audit Courses</td>
</tr>
<tr>
<td>SI</td>
<td>Summer Internship</td>
</tr>
<tr>
<td>PR</td>
<td>Project</td>
</tr>
<tr>
<td>SE</td>
<td>Seminar</td>
</tr>
</tbody>
</table>
D. Course level coding scheme:

Three-digit number (odd numbers are for the odd semester courses and even numbers are for even semester courses) used as suffix with the Course Code for identifying the level of the course e.g.
101, 102 ... etc. for first year
201, 202 ... Etc. for second year
301, 302 ... for third year

E. Category-wise Courses

HUMANITIES & SOCIAL SCIENCES COURSES [HS]

Note:
(i) Number of Humanities & Social Sciences Courses: 4
(ii) Credits: 8

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Code No.</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>1.</td>
<td>HS101</td>
<td>Communication Skills in English</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>HS103</td>
<td>Sports and Yoga</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>HS105</td>
<td>Communication Skills in English Lab</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>4.</td>
<td>HS302</td>
<td>Entrepreneurship and Start-ups</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Total Credits  8

BASIC SCIENCES COURSE [BS]

Note:
(i) Number of Basic Sciences Courses: 8
(ii) Credits: 19

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Code No.</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>1.</td>
<td>BS101</td>
<td>Mathematics-I</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>BS103</td>
<td>Applied Physics-I</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>BS105</td>
<td>Applied Chemistry</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>BS107</td>
<td>Applied Physics-I Lab</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>5.</td>
<td>BS109</td>
<td>Applied Chemistry Lab</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>6.</td>
<td>BS102</td>
<td>Mathematics-II</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>7.</td>
<td>BS104</td>
<td>Applied Physics-II</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>8.</td>
<td>BS106</td>
<td>Applied Physics-II Lab</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

Total Credits  19

ENGINEERING SCIENCE COURSES [ES]

Note:
(i) Number of Engineering Sciences Courses: 8
(ii) Credits: 15
### General Course Structure & Credit Distribution

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Code No.</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ES101</td>
<td>Engineering Graphics</td>
<td>0 0 3</td>
<td>I</td>
<td>1.5</td>
</tr>
<tr>
<td>2</td>
<td>ES103</td>
<td>Engineering Workshop Practice</td>
<td>0 0 3</td>
<td>I</td>
<td>1.5</td>
</tr>
<tr>
<td>3</td>
<td>ES102</td>
<td>Introduction to IT Systems</td>
<td>2 0 0</td>
<td>II</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>ES104</td>
<td>Fundamentals of Electrical &amp; Electronics Engineering</td>
<td>2 1 0</td>
<td>II</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>ES106</td>
<td>Engineering Mechanics</td>
<td>2 1 0</td>
<td>II</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>ES108</td>
<td>Introduction to IT Systems Lab</td>
<td>0 0 4</td>
<td>II</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>ES110</td>
<td>Fundamentals of Electrical &amp; Electronics Engineering Lab</td>
<td>0 0 2</td>
<td>II</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>ES112</td>
<td>Engineering Mechanics Lab</td>
<td>0 0 2</td>
<td>II</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total Credits</strong></td>
<td></td>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>

**PROGRAM CORE COURSES [PC]**

Note:
(i) Number of Program Core Courses: 20 to 30 (including lab courses)
(ii) Credits: 40 - 50

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Code No.</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>PC###</strong></td>
<td></td>
<td></td>
<td></td>
<td>40 - 50</td>
</tr>
</tbody>
</table>

** The branch code, e.g. CE for Civil Engineering
### Three-digit number for identifying the level of the course

**PROGRAM ELECTIVE COURSES [PE]**

Note:
(i) Number of Program Elective Courses: 4 to 6
   (minimum ten Branch Specific courses to be specified for the students to choose from)
(ii) Credits: 12 -16

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Code No.</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>PE###</strong></td>
<td></td>
<td></td>
<td></td>
<td>12-16</td>
</tr>
</tbody>
</table>

** The branch code, e.g. CE for Civil Engineering
### Three-digit number for identifying the level of the course.
OPEN ELECTIVE COURSES [OE]

Note:
(i) Number of Open Elective Courses: 3 to 4 (minimum ten courses to be specified out of the suggestive list of open elective courses given as Appendix III)
(ii) Credits: 9-12
(iii) The Open Elective Courses to be offered preferably in III year (one course may be offered in V Semester and two courses in VI Semester)
(iv) The students can opt only for those open elective courses that are offered by other than their respective departments

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Code No.</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>OE###</strong></td>
<td>course title</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SI201</td>
<td>Summer Internship – I (3-4 weeks) after II\textsuperscript{nd} Sem</td>
<td>0 0 4</td>
<td>IV</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>SI301</td>
<td>Summer Internship – II (4-6 weeks) after IV\textsuperscript{th} Sem</td>
<td>0 0 2</td>
<td>V</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>PR 202</td>
<td>Minor Project</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>PR302</td>
<td>Major Project</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>SE302</td>
<td>Seminar</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total Credits</strong></td>
<td></td>
<td></td>
<td>12</td>
</tr>
</tbody>
</table>

**The branch code, e.g. CE for Civil Engineering, of the branch/department offering that course
### Three-digit number for identifying the level of the course**

PROJECT WORK, SEMINAR AND INTERNSHIP IN INDUSTRY OR ELSEWHERE

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Code No.</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SI201</td>
<td>Summer Internship – I (3-4 weeks) after II\textsuperscript{nd} Sem</td>
<td>0 0 4</td>
<td>IV</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>SI301</td>
<td>Summer Internship – II (4-6 weeks) after IV\textsuperscript{th} Sem</td>
<td>0 0 2</td>
<td>V</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>PR 202</td>
<td>Minor Project</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>PR302</td>
<td>Major Project</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>SE302</td>
<td>Seminar</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total Credits</strong></td>
<td></td>
<td></td>
<td>12</td>
</tr>
</tbody>
</table>

Note:
- SI201 should be undertaken in an industry/Govt. or Pvt. Certified Agencies which are in social sector/ Govt. Skill Centres/Institutes/Schemes.
- SI301 should be undertaken in an industry only
- PR302 should be based on real/ live problems of the Industry/Govt./NGO / MSME/Rural Sector or an innovative idea having the potential of a Startup
AUDIT COURSES [AU]

Note: These are mandatory non-credit courses.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Code No.</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Semes-ter</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>AU102</td>
<td>Environmental Science</td>
<td>2 0 0</td>
<td>II</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>AU202</td>
<td>Essence of Indian Knowledge and Tradition</td>
<td>2 0 0</td>
<td>IV</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>AU302</td>
<td>Indian Constitution</td>
<td>2 0 0</td>
<td>VI</td>
<td>0</td>
</tr>
</tbody>
</table>

Total Credits 0

DESCRIPTION OF BRANCH CODES

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Branch</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Civil Engineering</td>
<td>CE</td>
</tr>
<tr>
<td>2.</td>
<td>Computer Engineering</td>
<td>CO</td>
</tr>
<tr>
<td>3.</td>
<td>Electronics and Communication Engineering</td>
<td>EC</td>
</tr>
<tr>
<td>4.</td>
<td>Electrical Engineering</td>
<td>EE</td>
</tr>
<tr>
<td>5.</td>
<td>Mechanical Engineering</td>
<td>ME</td>
</tr>
<tr>
<td>6.</td>
<td>Production Engineering</td>
<td>PE</td>
</tr>
<tr>
<td>7.</td>
<td>Information Technology</td>
<td>IT</td>
</tr>
<tr>
<td>8.</td>
<td>Chemical Engineering</td>
<td>CH</td>
</tr>
</tbody>
</table>

INDUCTION PROGRAM

Please refer Appendix IV for guidelines.
The Essence and Details of Induction program can also be understood from the 'Detailed Guide on Student Induction program', as available on AICTE Portal, although that is for UG students of Engineering & Technology (Link: https://www.aicteindia.org/sites/default/files/Detailed%20Guide%20on%20Student%20Induction%20program.pdf).

Induction program (mandatory)

<table>
<thead>
<tr>
<th>Two-week duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Physical activity</td>
</tr>
<tr>
<td>• Creative Arts</td>
</tr>
<tr>
<td>• Universal Human Values</td>
</tr>
<tr>
<td>• Literary</td>
</tr>
<tr>
<td>• Proficiency Modules</td>
</tr>
<tr>
<td>• Lectures by Eminent People</td>
</tr>
<tr>
<td>• Visits to local Areas</td>
</tr>
<tr>
<td>• Familiarization to Dept./Branch &amp; Innovations</td>
</tr>
</tbody>
</table>

F. Mandatory Visits/Workshop/Expert Lectures:

a. It is mandatory to arrange one industrial visit every semester for the students of each branch.

b. It is mandatory to conduct a One-week workshop during the winter break after fifth semester on professional/industry/entrepreneurial orientation.

c. It is mandatory to organize at least one expert lecture per semester for each branch by inviting resource persons from domain specific industry.
G. Evaluation Scheme (Suggestive only):

a. For Theory Courses:

(The weightage of Internal assessment is 40% and for End Semester Exam is 60%)
The student has to obtain at least 40% marks individually both in internal assessment
and end semester exams to pass.

b. For Practical Courses:

(The weightage of Internal assessment is 60% and for End Semester Exam is 40%)
The student has to obtain at least 40% marks individually both in internal assessment
and end semester exams to pass.

c. For Summer Internship / Projects / Seminar etc.

Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc.

Note: The internal assessment is based on the student’s performance in mid semester tests
(two best out of three), quizzes, assignments, class performance, attendance, viva-voce in practical, lab record etc.

H. Mapping of Marks to Grades

Each course (Theory/Practical) is to be assigned 100 marks, irrespective of the number of
credits, and the mapping of marks to grades may be done as per the following table:

<table>
<thead>
<tr>
<th>Range of Marks</th>
<th>Assigned Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>91-100</td>
<td>AA/A'</td>
</tr>
<tr>
<td>81-90</td>
<td>AB/A</td>
</tr>
<tr>
<td>71-80</td>
<td>BB/B'</td>
</tr>
<tr>
<td>61-70</td>
<td>BC/B</td>
</tr>
<tr>
<td>51-60</td>
<td>CC/C'</td>
</tr>
<tr>
<td>46-50</td>
<td>CD/C</td>
</tr>
<tr>
<td>40-45</td>
<td>DD/D</td>
</tr>
<tr>
<td>&lt; 40</td>
<td>FF/F (Fail due to less marks)</td>
</tr>
</tbody>
</table>

- F$^+$ (Fail due to shortage of attendance and therefore, to repeat the course)

******
First Year Curriculum Structure
(Common to all Branches)
First Year Curriculum Structure Common to All Branches
## Semester I
(Common to all Branches)

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Category of Course</th>
<th>Code No.</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Total contact hrs/week</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Basic Science</td>
<td>BS101</td>
<td>Mathematics-I</td>
<td>2 L 1 T 0 P</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>Basic Science</td>
<td>BS103</td>
<td>Applied Physics-I</td>
<td>2 L 1 T 0 P</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>Basic Science</td>
<td>BS105</td>
<td>Applied Chemistry</td>
<td>2 L 1 T 0 P</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>Humanities &amp; Social Science</td>
<td>HS101</td>
<td>Communication Skills in English</td>
<td>2 L 0 T 0 P</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>5.</td>
<td>Engineering Science</td>
<td>ES101</td>
<td>Engineering Graphics</td>
<td>0 L 0 T 3 P</td>
<td>3</td>
<td>1.5</td>
</tr>
<tr>
<td>6.</td>
<td>Engineering Science</td>
<td>ES103</td>
<td>Engineering Workshop Practice</td>
<td>0 L 0 T 3 P</td>
<td>3</td>
<td>1.5</td>
</tr>
<tr>
<td>7.</td>
<td>Basic Science</td>
<td>BS107</td>
<td>Applied Physics-I Lab</td>
<td>0 L 0 T 2 P</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>8.</td>
<td>Basic Science</td>
<td>BS109</td>
<td>Applied Chemistry Lab</td>
<td>0 L 0 T 2 P</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>9.</td>
<td>Humanities &amp; Social Science</td>
<td>HS103</td>
<td>Sports and Yoga</td>
<td>0 L 0 T 2 P</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>10.</td>
<td>Humanities &amp; Social Science</td>
<td>HS105</td>
<td>Communication Skills in English Lab</td>
<td>0 L 0 T 2 P</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

**Total Credits** 18

******

First Year Curriculum Structure Common to All Branches
<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Category of Course</th>
<th>Code No.</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Contact hrs/week</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>1</td>
<td>Basic Science</td>
<td>BS102</td>
<td>Mathematics-II</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Basic Science</td>
<td>BS104</td>
<td>Applied Physics-II</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Engineering Science</td>
<td>ES102</td>
<td>Introduction to IT Systems</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>Engineering Science</td>
<td>ES104</td>
<td>Fundamentals of Electrical &amp; Electronics Engineering</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>Engineering Science</td>
<td>ES106</td>
<td>Engineering Mechanics</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>Basic Science</td>
<td>BS106</td>
<td>Applied Physics-II Lab</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Engineering Science</td>
<td>ES108</td>
<td>Introduction to IT Systems Lab</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>Engineering Science</td>
<td>ES110</td>
<td>Fundamentals of Electrical &amp; Electronics Engineering Lab</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>Engineering Science</td>
<td>ES112</td>
<td>Engineering Mechanics Lab</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>Audit</td>
<td>AU102</td>
<td>Environmental Science</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Total Credits** 20
Detailed First Year Curriculum Contents

SEMESTER - I

| Course Code | BS101 |
| Course Title | Mathematics-I |
| Number of Credits | 3 (L:2,T:1,P:0) |
| Prerequisites | NIL |
| Course Category | BS |

Course Objectives:
This course is designed to give a comprehensive coverage at an introductory level to the subject of Trigonometry, Differential Calculus and Basic elements of algebra.

Course Content:
UNIT - I: Trigonometry
Concept of angles, measurement of angles in degrees, grades and radians and their conversions, T-Ratios of Allied angles (without proof), Sum, difference formulae and their applications (without proof), Product formulae (Transformation of product to sum, difference and vice versa). T- Ratios of multiple angles, sub-multiple angles (2A, 3A, A/2). Graphs of $\sin x$, $\cos x$, $\tan x$ and $e^x$.

Differential Calculus
Definition of function; Concept of limits. Four standard limits $\lim_{x \to a} \frac{x^n - a^n}{x - a}$, $\lim_{x \to 0} \frac{\sin x}{x}$, $\lim_{x \to a} \left(\frac{x^n - 1}{x - 1}\right)$ and $\lim_{x \to a} \left(1 + \frac{x}{a}\right)^{\frac{1}{x}}$.
Differentiation by definition of $x^n$, $\sin x$, $\cos x$, $\tan x$, $e^x$ and $\log_a x$. Differentiation of sum, product and quotient of functions. Differentiation of function of a function. Differentiation of trigonometric and inverse trigonometric functions, Logarithmic differentiation, Exponential functions.

UNIT - III: Algebra
Complex Numbers: Definition, real and imaginary parts of a Complex number, polar and Cartesian, representation of a complex number and its conversion from one form to other, conjugate of a complex number, modulus and amplitude of a complex number Addition, Subtraction, Multiplication and Division of a complex number. De-Moiver’s theorem, its application.
Partial fractions: Definition of polynomial fraction proper & improper fractions and definition of partial fractions. To resolve proper fraction into partial fraction with denominator containing non-repeated linear factors, repeated linear factors and irreducible non-repeated quadratic factors. To resolve improper fraction into partial fraction.
Permutations and Combinations: Value of $nPr$ and $nCr$.
Binomial theorem: Binomial theorem (without proof) for positive integral index (expansion and general form); binomial theorem for any index (expansion without proof) first and second binomial approximation with applications to engineering problems

References:
4. V. Sundaram, R. Balasubramanian, K.A. Lakshminarayan, Engineering Mathematics, 6/e., Vi-
Course Outcomes:
By the end of the course, the students are expected to learn
(i) The students are expected to acquire necessary background in Trigonometry to appreciate the importance of the geometric study as well as for the calculation and the mathematical analysis.
(ii) The ability to find the effects of changing conditions on a system.
(iii) Complex numbers enter into studies of physical phenomena in ways that most people cannot imagine.
(iv) The partial fraction decomposition lies in the fact that it provides an algorithm for computing the antiderivative of a rational function.

Course Objectives:
Applied Physics includes the study of a large number of diverse topics all related to materials/things that exist in the world around us. It aims to give an understanding of this world both by observation and by prediction of the way in which such objects behave. Concrete use of physical principles and analysis in various fields of engineering and technology are given prominence in the course content. The course will help the diploma engineers to apply the basic concepts and principles to solve broad-based engineering problems and to understand different technology based applications.

Teaching Approach:
• Teachers should give examples from daily routine as well as, engineering/technology applications on various concepts and principles in each topic so that students are able to understand and grasp these concepts and principles. In all contents, SI units should be followed.
• Use of demonstration can make the subject interesting and develop scientific temper in the students. Student activities should be planned on all the topics.
• Activity- Theory - Demonstrate/practice approach may be followed throughout the course so that learning may be outcome and employability based.

Course Content:
Unit 1: Physical world, Units and Measurements
Physical quantities; fundamental and derived, Units and systems of units (FPS, CGS and SI units),
Dimensions and dimensional formulae of physical quantities, Principle of homogeneity of dimensions, Dimensional equations and their applications (conversion from one system of units to other, checking of dimensional equations and derivation of simple equations), Limitations of dimensional analysis.
Measurements: Need, measuring instruments, least count, types of measurement (direct, indirect). Errors in measurements (systematic and random), absolute error, relative error, error propagation, error estimation and significant figures.

**Unit 2: Force and Motion**

Scalar and Vector quantities – examples, representation of vector, types of vectors. Addition and Subtraction of Vectors, Triangle and Parallelogram law (Statement only), Scalar and Vector Product, Resolution of a Vector and its application to inclined plane and lawn roller.

Force, Momentum, Statement and derivation of conservation of linear momentum, its applications such as recoil of gun, rockets, Impulse and its applications.

Circular motion, definition of angular displacement, angular velocity, angular acceleration, frequency, time period, Relation between linear and angular velocity, linear acceleration and angular acceleration (related numerical), Centripetal and Centrifugal forces with live examples, Expression and applications such as banking of roads and bending of cyclist.

**Unit 3: Work, Power and Energy**

Work: Concept and units, examples of zero work, positive work and negative work

Friction: concept, types, laws of limiting friction, coefficient of friction, reducing friction and its engineering applications, Work done in moving an object on horizontal and inclined plane for rough and plane surfaces and related applications.

Energy and its units, kinetic energy, gravitational potential energy with examples and derivations, mechanical energy, conservation of mechanical energy for freely falling bodies, transformation of energy (examples).

Power and its units, power and work relationship, calculation of power (numerical problems).

**Unit 4: Rotational Motion**

Translational and rotational motions with examples, Definition of torque and angular momentum and their examples, Conservation of angular momentum (quantitative) and its applications.

Moment of inertia and its physical significance, radius of gyration for rigid body, Theorems of parallel and perpendicular axes (statements only), Moment of inertia of rod, disc, ring and sphere (hollow and solid); (Formulae only).

**Unit 5: Properties of Matter**

Elasticity: definition of stress and strain, moduli of elasticity, Hooke’s law, significance of stress-strain curve.

Pressure: definition, units, atmospheric pressure, gauge pressure, absolute pressure, Fortin’s Barometer and its applications.

Surface tension: concept, units, cohesive and adhesive forces, angle of contact, Ascent Formula (No derivation), applications of surface tension, effect of temperature and impurity on surface tension.

Viscosity and coefficient of viscosity: Terminal velocity, Stoke’s law and effect of temperature on viscosity, application in hydraulic systems.

Hydrodynamics: Fluid motion, stream line and turbulent flow, Reynold’s number Equation of continuity, Bernoulli’s Theorem (only formula and numericals) and its applications.
Unit 6: Heat and Thermometry
Concept of heat and temperature, modes of heat transfer (conduction, convection and radiation with examples), specific heats, scales of temperature and their relationship, Types of Thermometer (Mercury thermometer, Bimetallic thermometer, Platinum resistance thermometer, Pyrometer) and their uses.

Expansion of solids, liquids and gases, coefficient of linear, surface and cubical expansions and relation amongst them, Co-efficient of thermal conductivity, engineering applications.

Learning Outcome:
After undergoing this subject, the student will be able to:

- Identify physical quantities, select their units for use in engineering solutions, and make measurements with accuracy by minimizing different types of errors.
- Represent physical quantities as scalar and vectors and solve real life relevant problems.
- Analyse type of motions and apply the formulation to understand banking of roads/railway tracks and conservation of momentum principle to describe rocket propulsion, recoil of gun etc.
- Define scientific work, energy and power and their units. Drive relationships for work, energy and power and solve related problems.
- Describe forms of friction and methods to minimize friction between different surfaces.
- State the principle of conservation of energy. Identify various forms of energy, and energy transformations.
- Compare and relate physical properties associated with linear motion and rotational motion and apply conservation of angular momentum principle to known problems.
- Describe the phenomenon of surface tension, effects of temperature on surface tension and solve statics problems that involve surface tension related forces.
- Describe the viscosity of liquids, coefficient of viscosity and the various factors affecting its value. Determine viscosity of an unknown fluid using Stokes’ Law and the terminal velocity.
- Define stress and strain. State Hooke’s law and elastic limits, stress-strain diagram, determine; (a) the modulus of elasticity, (b) the yield strength (c) the tensile strength, and (d) estimate the percent elongation.
- Illustrate the terms; heat and temperature, measure temperature in various processes on different scales (Celsius, Fahrenheit, and Kelvin etc.)
- Distinguish between conduction, convection and radiation; identify different methods for reducing heat losses and mode of heat transfer between bodies at different temperatures.
- State specific heats and measure the specific heat capacity of solids and liquids.

References:
1. Text Book of Physics for Class XI& XII (Part-I, Part-II); N.C.E.R.T, Delhi
7. Practical Physics by C. L. Arora, S. Chand Publication.
8. e-books/e-tools/ learning physics software/websites etc.

******
Course Code : BS105
Course Title : Applied Chemistry
Number of Credits : 3 (L: 2, T: 1, P: 0)
Prerequisites : High School Level Chemistry
Course Category : BS

Course Objectives:

There are numerous number materials are used in fabricating and manufacturing devices for the comfort of life. The selection, characterization and suitability assessment of natural raw materials essentially requires principles and concepts of Applied Chemistry for technicians. On successful completion of this course content will enable technicians to understand, ascertain and analyse and properties of natural raw materials require for producing economical and eco-friendly finished products.

- Solve various engineering problems applying the basic knowledge of atomic structure and chemical bonding.
- Use relevant water treatment method to solve domestic and industrial problems.
- Solve the engineering problems using knowledge of engineering materials and properties.
- Use relevant fuel and lubricants for domestic and industrial applications
- Solve the engineering problems using concept of Electrochemistry and corrosion.

Course Content:

- **Unit 1: Atomic Structure, Chemical Bonding and Solutions**
  Rutherford model of atom, Bohr’s theory (expression of energy and radius to be omitted), and hydrogen spectrum explanation based on Bohr’s model of atom, Heisenberg uncertainty principle, Quantum numbers – orbital concept. Shapes of s, p and d orbitals, Pauli’s exclusion principle, Hund’s rule of maximum multiplicity Aufbau rule, electronic configuration.
  Concept of chemical bonding – cause of chemical bonding, types of bonds: ionic bonding (NaCl example), covalent bond (H₂, F₂, HF hybridization in BeCl₂, BF₃, CH₄, NH₃, H₂O), coordination bond in NH₄⁺, and anomalous properties of NH₃, H₂O due to hydrogen bonding, and metallic bonding.
  Solution – idea of solute, solvent and solution, methods to express the concentration of solution- molarity (M = mole per liter), ppm, mass percentage, volume percentage and mole fraction.
- **Unit 2: Water**
  Graphical presentation of water distribution on Earth (pie or bar diagram). Classification of soft and hard water based on soap test, salts causing water hardness, unit of hardness and simple numerical on water hardness.
  Cause of poor lathering of soap in hard water, problems caused by the use of hard water in boiler (scale and sludge, foaming and priming, corrosion etc), and quantitative measurement of water hardness by ETDA method, total dissolved solids (TDS) alkalinity estimation.
  i). Water softening techniques – soda lime process, zeolite process and ion exchange process.
  ii). Municipal water treatment (in brief only) – sedimentation, coagulation, filtration, sterilization.
  Water for human consumption for drinking and cooking purposes from any water sources and enlist Indian standard specification of drinking water (collect data and understand standards).
• Unit 3: Engineering Materials

Natural occurrence of metals – minerals, ores of iron, aluminium and copper, gangue (matrix), flux, slag, metallurgy – brief account of general principles of metallurgy.

Extraction of - iron from haematite ore using blast furnace, aluminium from bauxite along with reactions. Alloys – definition, purposes of alloying, ferrous alloys and non-ferrous with suitable examples, properties and applications.

General chemical composition, composition based applications (elementary idea only details omitted):

Portland cement and hardening, Glasses Refractory and Composite materials.

Polymers – monomer, homo and co polymers, degree of polymerization, simple reactions involved in preparation and their application of thermoplastics and thermosetting plastics (using PVC, PS, PTFE, nylon – 6, nylon-6,6 and Bakelite), rubber and vulcanization of rubber.

• Unit 4: Chemistry of Fuels and Lubricants

Definition of fuel and combustion of fuel, classification of fuels, calorific values (HCV and LCV), calculation of HCV and LCV using Dulong's formula.

Proximate analysis of coal solid fuel

petrol and diesel - fuel rating (octane and cetane numbers),

Chemical composition, calorific values and applications of LPG, CNG, water gas, coal gas, producer gas and biogas.

Lubrication – function and characteristic properties of good lubricant, classification with examples, lubrication mechanism – hydrodynamic and boundary lubrication, physical properties (viscosity and viscosity index, oiliness, flash and fire point, could and pour point only) and chemical properties (coke number, total acid number saponification value) of lubricants.

• Unit 5: Electro Chemistry

Electronic concept of oxidation, reduction and redox reactions.

Definition of terms: electrolytes, non-electrolytes with suitable examples, Faradays laws of electrolysis and simple numerical problems.

Industrial Application of Electrolysis –

• Electrometallurgy
• Electroplating
• Electrolytic refining.

Application of redox reactions in electrochemical cells –

• Primary cells – dry cell,
• Secondary cell - commercially used lead storage battery, fuel and Solar cells.

Introduction to Corrosion of metals –

• definition, types of corrosion (chemical and electrochemical), H₂ liberation and O₂ absorption mechanism of electrochemical corrosion, factors affecting rate of corrosion.

Internal corrosion preventive measures –

• Purification, alloying and heat treatment and

External corrosion preventive measures: a) metal (anodic, cathodic) coatings, b) organic inhibitors.
Suggested Sessional work:

- **Unit 1: Atomic Structure, Chemical Bonding and Solutions**
  - Assignments: Writing electronic configuration of elements up to atomic number 30 (Z=30). Numerical on molarity, ppm, mass percentage, volume percentage and mole fraction of given solution.
  - Seminar: 1. Quantum numbers,
    2. Discuss the metallic properties such as malleability, ductility, hardness, high melting point, conductance of heat and electricity, magnetic properties of metals.
  - Projects: Model of molecules BeCl₂, BF₃, CH₄, NH₃, H₂O.

- **Unit 2: Water**
  - Assignments: Simple problems on hardness calculation.
  - Seminar: 1. Quality and quantity requirement of water in house and industry.
    2. Quality of control measures of effluents (BOD & COD).
  - Projects: Collect water samples from different water sources and measure of hardness of water.

- **Unit 3: Engineering Materials**
  - Assignments: Preparation of table showing different ores of iron, copper and aluminium metals along with their chemical compositions and classify into oxide sulphide halide ores.
  - Seminar: Discuss the chemical reactions taking place in blast furnace in extraction of Fe, Cu and Al metals.
  - Projects: Make table showing place of availability of different ores in India and show places on India map.

- **Unit 4: Chemistry of Fuels and Lubricants**
  - Assignments: Calculation of HCV and LCV of fuel using fuel composition in Dulong's formula.
  - Seminar: Chemical structure of fuel components influence on fuel rating.
  - Projects: Mapping of energy resources in India. Collection of data of various lubricants available in the market.

- **Unit 5: Electro Chemistry**
  - Assignments: Simple problems on Faraday's laws of electrolysis.
  - Seminar: 1. Corrosion rate and units.
    2. Corrosion preventions.
  - Projects: Mapping of area in India prone to corrosion. Collection of data of various electrochemical cells batteries used in equipment and devices and available in market. Visit to sites such as Railway station to watch corrosion area in railways and research establishment in and around the institution.

**Learning Outcomes**

At the end of the course student will be able to

1. Understand the classification and general properties of engineering materials such as met-
al, alloys, glasses, cement, refractory and composite materials using knowledge of chemical bonding.

2. Understand and assess the suitability of water source for domestic and industrial application, effluents and minimize water pollution.

3. Qualitatively analyze the engineering materials and understand their properties and applications.


5. a) Ascertain construction, mechanism efficiency of electrochemical cells, solar cell fuel cells
b) Understand corrosion and develop economical prevention techniques.

References/Suggested Learning Resources:

(a) Books:
1) Text Book of Chemistry for Class XI & XII (Part-I, Part-II); N.C.E.R.T., Delhi, 2017-18.

(b) Open source software and website address:
1 www.chemguide.co.uk/atommenu.html (Atomic structure and chemical bonding)
2 www.visionlearning.com (Atomic structure and chemical bonding)
3 www.chem1.com (Atomic structure and chemical bonding)
4 https://www.wastewaterelearning.com/elearning/ (Water Treatment)
5 www.capital-refractories.com (Metals, Alloys, Cement, and Refractory Materials)
7 www.chemcollective.org (Metals, Alloys)
8 www.wqa.org (Water Treatment)

Course Objectives:
Communication skills play an important role in career development. This course aims at introducing basic concepts of communication skills with an emphasis on developing personality of the students. Thus, the main objectives of this course are:
To develop confidence in speaking English with correct pronunciation.
To develop communication skills of the students i.e. listening, speaking, reading and writing skills.
To introduce the need for personality development- Focus will be on developing certain qualities which will aid students in handling personal and career challenges, leadership skills etc.

Course Content

Unit-1 Communication: Theory and Practice
- Basics of communication: Introduction, meaning and definition, process of communication etc.
- Types of communication: formal and informal, verbal, non-verbal and written Barriers to effective communication.
- 7 Cs for effective communication (considerate, concrete, concise, clear, complete, correct, courteous).
- Art of Effective communication,
  - Choosing words
  - Voice
  - Modulation
  - Clarity
  - Time
  - Simplification of words
- Technical Communication.

Unit-2 Soft Skills for Professional Excellence
- Importance of soft skills.
- Life skills: Self-awareness and Self-analysis, adaptability, resilience, emotional intelligence and empathy etc.
- Applying soft skills across cultures.
- Case Studies.

Unit-3: Reading Comprehension
Comprehension, vocabulary enhancement and grammar exercises based on reading of the following texts:

Section-1
Malgudi Days: R.K. Narayan
The Room on Roof: Ruskin Bond
“The Gift of the Magi” by O. Henry
“Uncle Podger Hangs a Picture” Jerome K. Jerome

Section-2
Night of the Scorpion by Nissim Ezekiel,
Stopping by Woods on a Snowy Evening by Robert Frost,
Where the Mind is Without Fear by Rabindranath Tagore,
Ode to Tomatoes by Pablo Neruda,

Unit-4: Professional Writing
The art of précis writing,
Letters: business and personnel,
Drafting e-mail, notices, minutes of a meeting etc.
Filling-up different forms such as banks and on-line forms for placement etc.
Unit-5: Vocabulary and Grammar

Vocabulary of commonly used words
Glossary of administrative terms (English and Hindi)
One-word substitution, Idioms and phrases etc.
Parts of speech, active and passive voice, tenses etc., Punctuation

References:
7. Oxford Dictionary
8. Roget’s Thesaurus of English Words and Phrases
9. Collin’s English Dictionary

Course outcomes:
At the end of this course, the participants will:
• Develop basic speaking and writing skills including proper usage of language and vocabulary so that they can become highly confident and skilled speakers and writers.
• Be informed of the latest trends in basic verbal activities such as presentations, facing interviews and other forms of oral communication.
• Also develop skills of group presentation and communication in team.
• Develop non-verbal communication such as proper use of body language and gestures.

Course Objectives:
• To understand the language of graphics which is used to express ideas, convey instructions while carrying out engineering jobs.
• To develop drafting and sketching skills, to know the applications of drawing equipments, and get familiarize with Indian Standards related to engineering drawings.
• To develop skills to visualize actual object or a part of it, on the basis of drawings.
• To develop skills to translate ideas into sketches and to draw and read various engineering curves, projections and dimensioning styles.
• To understand the basic commands and develop basic skills related to computer aided drafting, of how to draw, modify, and edit basic shapes (2D), using AUTOCAD.
Course Content

Unit – I Basic elements of Drawing
Drawing Instruments and supporting materials: method to use them with applications.
Convention of lines and their applications.
Representative Fractions – reduced, enlarged and full size scales; Engineering Scales such as plain and diagonal scale.
Dimensioning techniques as per SP-46:2003 – types and applications of chain, parallel and coordinate dimensioning.
Geometrical and Tangency constructions. (Redraw the figure)

Unit – II Orthographic projections
Introduction of projections-orthographic, perspective, isometric and oblique: concept and applications. (No question to be asked in examination).
Introduction to orthographic projection, First angle and Third angle method, their symbols.
Conversion of pictorial view into Orthographic Views – object containing plain surfaces, slanting surfaces, slots, ribs, cylindrical surfaces. (use First Angle Projection method only)

Unit – III Isometric Projections
Introduction to isometric projections.
Isometric scale and Natural scale.
Isometric view and isometric projection.
Illustrative problems related to objects containing lines, circles and arcs shape only.
Conversion of orthographic views into isometric view/projection.

Unit – IV Free Hand Sketches of engineering elements
Free hand sketches of machine elements: Thread profiles, nuts, bolts, studs, set screws, washer, Locking arrangements. (For branches other than mechanical Engineering the teacher should select branch specific elements for free hand sketching)
Free hand sketches of orthographic view (on squared graph paper) and isometric view (on isometric grid paper)

Unit – V Computer aided drafting interface
Computer Aided Drafting: concept.
Hardware and various CAD software available.
System requirements and Understanding the interface.
Components of AutoCAD software window: Title bar, standard tool bar, menu bar, object properties tool bar, draw tool bar, modify tool bar, cursor cross hair. Command window, status bar, drawing area, UCS icon.
File features: New file, Saving the file, Opening an existing drawing file, Creating templates, Quit.
Setting up new drawing: Units, Limits, Grid, Snap.
Undoing and redoing action.
**Unit – VI Computer aided drafting**

Draw basic entities like Line, Circle, Arc, Polygon, Ellipse, Rectangle, Multiline, PolyLine.

Method of Specifying points: Absolute coordinates, Relative Cartesian and Polar coordinates.

Modify and edit commands like trim, extend, delete, copy, offset, array, block, layers.

Dimensioning: Linear, Horizontal Vertical, Aligned, Rotated, Baseline, Continuous, Diameter, Radius, Angular Dimensions.

Dim scale variable.

Editing dimensions.

Text: Single line Text, Multiline text.

Standard sizes of sheet. Selecting Various plotting parameters such as Paper size, paper units, Drawing orientation, plot scale, plot offset, plot area, print preview.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Practical Exercises</th>
<th>Unit No.</th>
<th>Approx. Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Draw horizontal, Vertical, 30 degree, 45 degree, 60 and 75 degrees lines, different types of lines, dimensioning styles using Tee and Set squares/drafter. (do this exercise in sketch book)</td>
<td>I</td>
<td>02</td>
</tr>
<tr>
<td>2</td>
<td>Write alphabets and numerical (Vertical only) (do this exercise in sketch book)</td>
<td>I</td>
<td>02</td>
</tr>
<tr>
<td>3</td>
<td>Draw regular geometric constructions and redraw the given figure (do this exercise in sketch book) Part I</td>
<td>II</td>
<td>02</td>
</tr>
<tr>
<td>4</td>
<td>Draw regular geometric construction and redraw the given figure (do this exercise in sketch book) Part II</td>
<td>II</td>
<td>02</td>
</tr>
<tr>
<td>5</td>
<td>Draw a problem on orthographic projections using first angle method of projection having plain surfaces and slanting. Part I</td>
<td>III</td>
<td>02</td>
</tr>
<tr>
<td>6</td>
<td>Draw another problem on orthographic projections using first angle method of projection having slanting surfaces with slots. Part II</td>
<td>III</td>
<td>02</td>
</tr>
<tr>
<td>7</td>
<td>Draw two problems on orthographic projections using first angle method of projection having cylindrical surfaces, ribs. Part I</td>
<td>III</td>
<td>02</td>
</tr>
<tr>
<td>8</td>
<td>Draw two problems on Isometric view of simple objects having plain and slanting surface by using natural scale. Part I</td>
<td>IV</td>
<td>02</td>
</tr>
<tr>
<td>9</td>
<td>Draw some problems on Isometric projection of simple objects having cylindrical surface by using isometric scale. Part I</td>
<td>IV</td>
<td>02</td>
</tr>
<tr>
<td>10</td>
<td>Draw free hand sketches/conventional representation of machine elements in sketch book such as thread profiles, nuts, bolts, studs, set screws, washers, Locating arrangements. Part I</td>
<td>V</td>
<td>02</td>
</tr>
<tr>
<td>11</td>
<td>Problem based Learning: Given the orthographic views of at least three objects with few missing lines, the student will try to imagine the corresponding objects, complete the views and draw these views in sketch book. Part I</td>
<td>III, II, V</td>
<td>02</td>
</tr>
<tr>
<td>12</td>
<td>Draw basic 2D entities like: Rectangle, Rhombus, Polygon using AutoCAD (Print out should be a part of progressive assessment). Part I</td>
<td>V</td>
<td>02</td>
</tr>
<tr>
<td>13</td>
<td>Draw basic 2D entities like: Circles, Arcs, circular using AutoCAD (Printout should be a part of progressive assessment). Part II</td>
<td>V</td>
<td>02</td>
</tr>
<tr>
<td>14</td>
<td>Draw basic 2D entities like: Circular and rectangular array using AutoCAD (Printout should be a part of progressive assessment). Part III</td>
<td>V</td>
<td>02</td>
</tr>
</tbody>
</table>
15. Draw blocks of 2D entities comprises of Rectangle, Rhombus, Polygon, Circles, Arcs, circular and rectangular array, blocks using AutoCAD (Print out should be a part of progressive assessment). Part IV  

16. Draw basic branch specific components in 2D using AutoCAD (Print out should be a part of term work). Part I  

17. Draw complex branch specific components in 2D using AutoCAD (Print should be a part of progressive assessment). Part I  

**Total** 34

### Suggested Learning Resources


### Software/Learning Websites

1. [https://www.youtube.com/watch?v=TJ4jGyD-WCw](https://www.youtube.com/watch?v=TJ4jGyD-WCw)
2. [https://www.youtube.com/watch?v=dmt6_n7Ggcg](https://www.youtube.com/watch?v=dmt6_n7Ggcg)
3. [https://www.youtube.com/watch?v=_MQScn1XL0M](https://www.youtube.com/watch?v=_MQScn1XL0M)
4. [https://www.youtube.com/watch?v=3WXPanCq9LJ](https://www.youtube.com/watch?v=3WXPanCq9LJ)
5. [https://www.youtube.com/watch?v=fvjk7PbAuo](https://www.youtube.com/watch?v=fvjk7PbAuo)
6. [http://www.me.umn.edu/coursesme2011/handouts/engg%20graphics.pdf](http://www.me.umn.edu/coursesme2011/handouts/engg%20graphics.pdf)
7. [https://www.machinedesignonline.com](https://www.machinedesignonline.com)

### Course Outcomes

Following outcomes will be achieved:

1) Select and construct appropriate drawing scales, use drawing equipment’s, and understand Indian Standards of engineering drawing

2) Draw views of given object and components

3) Sketch orthographic projections into isometric projections and vice versa.

3) Apply computer aided drafting tools to create 2D engineering drawings

*****
Course Code : ES103
Course Title : Engineering Workshop Practice
Number of Credits : 1.5 (L: 0, T: 0, P: 3)
Prerequisites : NIL
Course Category : ES

Course Objectives:
- To understand basic engineering processes for manufacturing and assembly.
- To understand, identify, select and use various marking, measuring, and holding, striking and cutting tools and equipment's
- To understand and interpret job drawings, produce jobs, and inspect the job for specified dimensions
- To understand the various types of wiring systems and acquire skills in house wiring
- To understand, operate, control different machines and equipment’s adopting safety practices

Course Content:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Details Of Practical Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Carpentry: i) Demonstration of different wood working tools / machines. ii) Demonstration of different wood working processes, like plaining, marking, chiseling, grooving, turning of wood etc. iii) One simple job involving any one joint like mortise and tenon dovetail, bridle, half lap etc.</td>
</tr>
<tr>
<td>II</td>
<td>Fitting: i) Demonstration of different fitting tools and drilling machines and power tools ii) Demonstration of different operations like chipping, filing, drilling, tapping, sawing, cutting etc. iii) One simple fitting job involving practice of chipping, filing, drilling, tapping, cutting etc.</td>
</tr>
<tr>
<td>III</td>
<td>Welding: i) Demonstration of different welding tools / machines. ii) Demonstration on Arc Welding, Gas Welding, MIG, MAG welding, gas cutting and rebuilding of broken parts with welding. iii) One simple job involving butt and lap joint</td>
</tr>
<tr>
<td>IV</td>
<td>Sheet Metal Working: i) Demonstration of different sheet metal tools / machines. ii) Demonstration of different sheet metal operations like sheet cutting, bending, edging, end curling, lancing, soldering, brazing, and riveting. iii) One simple job involving sheet metal operations and soldering and riveting.</td>
</tr>
<tr>
<td>V</td>
<td>Electrical House Wiring: Practice on simple lamp circuits (i) one lamp controlled by one switch by surface conduit wiring. (ii) Lamp circuits- connection of lamp and socket by separate switches, (iii) Connection of Fluorescent lamp/tube light, (iv) simple lamp circuits-install bedroom lighting. And (v) Simple lamp circuits- install stair case wiring.</td>
</tr>
<tr>
<td>VI</td>
<td>Demonstration: i) Demonstration of measurement of Current, Voltage, Power and Energy. ii) Demonstration of advance power tools, pneumatic tools, electrical wiring tools and accessories. iii) Tools for Cutting and drilling</td>
</tr>
</tbody>
</table>

References:
2. B.S. Raghuwanshi, Workshop Technology, Dhanpat Rai and sons, New Delhi 2014
Course outcomes
At the end of the course, the student will be able to:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Acquire skills in basic engineering practice to identify, select and use various marking, measuring, and holding, striking and cutting tools &amp; equipment's and machines</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Understand job drawing and complete jobs as per specifications in allotted time</td>
</tr>
<tr>
<td>CO3</td>
<td>Inspect the job for the desired dimensions and shape</td>
</tr>
<tr>
<td>CO4</td>
<td>Operate, control different machines and equipment's adopting safety practices</td>
</tr>
</tbody>
</table>

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Course Code       : BS107
Course Title      : Applied Physics-I Labs
Number of Credits : 1 (L: 0, T: 0, P: 2)
Prerequisites     : NIL
Course Category   : BS

Course Objectives
Study of Applied Physics aims to give an understanding of physical world by observations and predictions. Concrete use of physical principles and analysis in various fields of engineering and technology is very prominence. The course aims to supplement the factual knowledge gained in the lecture by first hand manipulation of apparatus. This will develop scientific temper and help to apply the basic concepts and principles in solving engineering and technology based problems. In addition, students get necessary confidence in handling equipment and thus learn various skills in measurement.

List of Practical’s/Activities (To perform minimum 10 practical’s).

1. To measure length, radius of a given cylinder, a test tube and a beaker using a Vernier caliper and find volume of each object.
2. To determine diameter of a wire, a solid ball and thickness of cardboard using a screw gauge.
3. To determine radius of curvature of a convex and a concave mirror/surface using a spherometer.
4. To verify triangle and parallelogram law of forces.
5. To find the co-efficient of friction between wood and glass using a horizontal board.
6. To determine force constant of a spring using Hook’s Law.
7. To verify law of conservation of mechanical energy (PE to KE).
8. To find the moment of inertia of a flywheel.
9. To find the viscosity of a given liquid (Glycerin) by Stoke’s law.
10. To find the coefficient of linear expansion of the material of a rod.
11. To determine atmospheric pressure at a place using Fortin’s barometer.
12. To measure room temperature and temperature of a hot bath using mercury thermometer and convert it into different scales.
Learning Outcome:
After undergoing this lab work, the student will be able to:

- Select right kind of measuring tools (Meter scale, Vernier caliper, Screw gauge, Spherometer etc.) for determining dimensions of physical quantities and make measurements with accuracy and precision.
- Differentiate various shapes and determine dimensions of plane, curved and regular surfaces/bodies.
- Apply and Verify laws of forces and determine resultant force acting on a body.
- Appreciate role of friction and measure co-efficient of friction between different surfaces.
- Describe and verify Hook’s law and determine force constant of spring body.
- Identify various forms of energy, energy transformations and verify law of conservation of energy.
- Understand rotational motion and determine M.I. of a rotating body (flywheel)
- Understand Stoke’s law for viscous liquids and determine viscosity of a given liquid.
- Understand how materials expand on heating and determine linear expansion coefficient for a given material rod.
- Understand working and use Fortin’s barometers for determining pressure at a place.
- Understand use of thermometers to measure temperature under different conditions and different scales of temperature measurements.

SUGGESTED STUDENT ACTIVITIES & STRATEGIES
Apart from classroom and laboratory learning following are the suggested student related activities which can be undertaken to accelerate the attainment of various outcomes of the course

a. Make survey of different physical products and compare the following points
   - Measurements of dimensions
   - Properties
   - Applications
b. Library survey regarding engineering materials/products used in different industries
c. Seminar on any relevant topic.

Teachers should use the following strategies to achieve the various outcomes of the course.

- Different methods of teaching and media to be used to attain classroom attention.
- Massive open online courses (MOOCs) may be used to teach various topics/sub topics.
- 15-20% of the topics which are relatively simpler of descriptive in nature should be given to the students for self-learning and assess the development of competency through classroom presentations.
- Micro-projects may be given to group of students for hand-on experiences.

References:
1. Text Book of Physics for Class XI & XII (Part-I, Part-II); N.C.E.R.T., Delhi
3. Practical Physics by C. L. Arora, S. Chand Publication.
4. e-books/e-tools/ learning physics software/YouTube videos/websites etc.

******
**Course Objectives:**
There are numerous number of materials used in fabricating and manufacturing devices for the comfort of life. The selection, characterization and suitability assessment of natural raw materials essentially requires principles and concepts of Applied Chemistry for technicians. The course aims to supplement the factual knowledge gained in the lectures by first hand manipulation of processes and apparatus. This will develop scientific temper and help to apply the basic concepts and principles in solving engineering problems.

**LIST OF PRACTICALS:**
Perform any 12 (twelve) Laboratory Practicals.

**Volumetric and Gravimetric analysis:**
1. Preparation of standard solution of oxalic acid or potassium permanganate.
2. To determine strength of given sodium hydroxide solution by titrating against standard oxalic acid solution using phenolphthalein indicator.
3. Standardization of KMnO₄ solution using standard oxalic acid and Determine the percentage of iron present in given Hematite ore by KMnO₄ solution.
4. Iodometric estimation of copper in the copper pyrite ore.
5. Volumetric estimation of total acid number (TAN) of given oil.
6. Volumetric estimation of:
   a) Total hardness of given water sample using standard EDTA solution.
   b) Alkalinity of given water sample using 0.01M sulphuric acid
7. Proximate analysis of coal
   a) Gravimetric estimation moisture in given coal sample
   b) Gravimetric estimation ash in given coal sample

**Instrumental analysis**
8. Determine the conductivity of given water sample.
10. Determination of calorific value of solid or liquid fuel using bomb calorimeter.
11. Determination of viscosity of lubricating oil using Redwood viscometer.
12. Determination of flash and fire point of lubricating oil using Able’s flash point apparatus.
13. To verify the first law of electrolysis of copper sulfate using copper electrode.
14. Construction and measurement of emf of elector chemical cell (Daniel cell).
15. To study the effect of dissimilar metal combination.
Teachers should use the following strategies to achieve the various outcomes of the course.

- Different methods of teaching and media to be used to attain classroom attention.
- Massive open online courses (MOOCs) may be used to teach various topics/sub topics.
- 15-20% of the topics which are relatively simpler of descriptive in nature should be given to the students for self-learning and assess the development of competency through classroom presentations.
- Micro-projects may be given to group of students for hand-on experiences
- Encouraging students to visit to sites such as Railway station and research establishment around the institution.

Learning Outcomes:

At the end of the course student will be able to

- To express quantitative measurements accurately.
- To practice and adapt good measuring techniques.
- To use various apparatus for precise measurements.
- To understand and differentiate different methods of quantitative analysis.
- To know and understand principles of quantitative analysis using instruments.
- To construct different electrochemical cells used in developing batteries.
- To understand and appreciate methods of corrosion abetments.

Reference Books:


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<table>
<thead>
<tr>
<th>Course Code</th>
<th>HS103</th>
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</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Sports and Yoga</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>1(L:0,T:0,P:2)</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>NIL</td>
</tr>
<tr>
<td>Course Category</td>
<td>HS</td>
</tr>
</tbody>
</table>

Course Objectives:

- To make the students understand the importance of sound health and fitness principles as they relate to better health.
- To expose the students to a variety of physical and yogic activities aimed at stimulating their continued inquiry about Yoga, physical education, health and fitness.
- To create a safe, progressive, methodical and efficient activity based plan to enhance improvement and minimize risk of injury.
- To develop among students an appreciation of physical activity as a lifetime pursuit and a means to better health.
Course Content:

- **Introduction to Physical Education**
  - Meaning & definition of Physical Education
  - Aims & Objectives of Physical Education
  - Changing trends in Physical Education

- **Olympic Movement**
  - Ancient & Modern Olympics (Summer & Winter)
  - Olympic Symbols, Ideals, Objectives & Values
  - Awards and Honours in the field of Sports in India (Dronacharya Award, Arjuna Award, Dhyanchand Award, Rajiv Gandhi Khel Ratna Award etc.)

- **Physical Fitness, Wellness & Lifestyle**
  - Meaning & Importance of Physical Fitness & Wellness
  - Components of Physical fitness
  - Components of Health related fitness
  - Components of wellness
  - Preventing Health Threats through Lifestyle Change
  - Concept of Positive Lifestyle

- **Fundamentals of Anatomy & Physiology in Physical Education, Sports and Yoga**
  - Define Anatomy, Physiology & Its Importance

- **Kinesiology, Biomechanics & Sports**
  - Meaning & Importance of Kinesiology & Biomechanics in Physical Edu. & Sports
  - Newton’s Law of Motion & its application in sports.
  - Friction and its effects in Sports.

- **Postures**
  - Meaning and Concept of Postures.
  - Causes of Bad Posture.
  - Advantages & disadvantages of weight training.
  - Concept & advantages of Correct Posture.
  - Common Postural Deformities – Knock Knee; Flat Foot; Round Shoulders; Lordosis, Kyphosis, Bow Legs and Scoliosis.
  - Corrective Measures for Postural Deformities
• **Yoga**
  - Meaning & Importance of Yoga
  - Elements of Yoga
  - Introduction - Asanas, Pranayama, Meditation & Yogic Kriyas
  - Yoga for concentration & related Asanas (Sukhasana; Tadasana; Padmasana & Shashankasana)
  - Relaxation Techniques for improving concentration - Yog-nidra

• **Yoga & Lifestyle**
  - Asanas as preventive measures.
  - Hypertension: Tadasana, Vajrasana, Pavan Muktasana, Ardha Chakrasana, Bhujangasana, Sharasana.
  - Back Pain: Tadasana, Ardh Matsyendrasana, Vakrasana, Shalabhasana, Bhujangasana.

• **Training and Planning in Sports**
  - Meaning of Training
  - Warming up and limbering down
  - Skill, Technique & Style
  - Meaning and Objectives of Planning.
  - Tournament – Knock-Out, League/Round Robin & Combination.

• **Psychology & Sports**
  - Definition & Importance of Psychology in Physical Edu. & Sports
  - Define & Differentiate Between Growth & Development
  - Adolescent Problems & Their Management
  - Emotion: Concept, Type & Controlling of emotions
  - Meaning, Concept & Types of Aggressions in Sports.
  - Psychological benefits of exercise.
  - Anxiety & Fear and its effects on Sports Performance.
  - Motivation, its type & techniques.
  - Understanding Stress & Coping Strategies.
• **Doping**
  - Meaning and Concept of Doping
  - Prohibited Substances & Methods
  - Side Effects of Prohibited Substances

• **Sports Medicine**
  - First Aid – Definition, Aims & Objectives.
  - Sports injuries: Classification, Causes & Prevention.
  - Management of Injuries: Soft Tissue Injuries and Bone & Joint Injuries

• **Sports / Games**
  Following sub topics related to any one Game/Sport of choice of student out of: Athletics, Badminton, Basketball, Chess, Cricket, Kabaddi, Lawn Tennis, Swimming, Table Tennis, Volleyball, Yoga etc.
  - History of the Game/Sport.
  - Specifications of Play Fields and Related Sports Equipment.
  - Important Tournaments and Venues.
  - Sports Personalities.
  - Proper Sports Gear and its Importance.

**References:**
1. Modern Trends and Physical Education by Prof. Ajmer Singh.
2. Light On Yoga By B.K.S. Iyengar.
3. Health and Physical Education – NCERT (11th and 12th Classes)

**Course Outcomes:**
On successful completion of the course the students will be able to:
(i) Practice Physical activities and Hatha Yoga focusing on yoga for strength, flexibility, and relaxation.
(ii) Learn techniques for increasing concentration and decreasing anxiety which leads to stronger academic performance.
(iii) Learn breathing exercises and healthy fitness activities
(iv) Understand basic skills associated with yoga and physical activities including strength and flexibility, balance and coordination.
(v) Perform yoga movements in various combination and forms.
(vi) Assess current personal fitness levels.
(vii) Identify opportunities for participation in yoga and sports activities.
(viii) Develop understanding of health-related fitness components: cardiorespiratory endurance, flexibility and body composition etc.
(ix) Improve personal fitness through participation in sports and yogic activities.
(x) Develop understanding of psychological problems associated with the age and lifestyle.
(xii) Demonstrate an understanding of sound nutritional practices as related to health and physical performance.

(xiii) Assess yoga activities in terms of fitness value.

(xiv) Identify and apply injury prevention principles related to yoga and physical fitness activities.

(xv) Understand and correctly apply biomechanical and physiological principles related to exercise and training.

Course Code | HS105
--------------|---------
Course Title  | Communication Skills in English - Lab
Number of Credits | 1 (L: 0, T: 0, P: 2)
Prerequisites  | NIL
Course Category | HS

Course Objectives:
Communication skills play an important role in career development. This lab course aims at actively involving students in various activities to improve their communication skills with an emphasis on developing personality of the students. Thus, the objectives of this course are:

1. To develop listening skills for enhancing communication.
2. To develop speaking skills with a focus on correct pronunciation and fluency.
3. To introduce the need for Personality development - Focus will be on developing certain qualities which will aid students in handling personal and career challenges, leadership skills etc. for that purpose group discussion, extempore and other activities should be conducted during lab classes.

Course Content:
Unit I Listening Skills
Listening Process and Practice: Introduction to recorded lectures, poems, interviews and speeches, listening tests.

Unit II Introduction to Phonetics
Sounds: consonant, vowel, diphthongs, etc. transcription of words (IPA), weak forms, syllable division, word stress, intonation, voice etc.

Unit III Speaking Skills
Standard and formal speech: Group discussion, oral presentations, public speaking, business presentations etc. Conversation practice and role playing, mock interviews etc.

Unit IV Building vocabulary
Etymological study of words and construction of words, phrasal verbs, foreign phrases, idioms and phrases. Jargon/ Register related to organizational set up, word exercises and word games to enhance self-expression and vocabulary of participants.

Recommended Readings:


**Learning Outcome:**

- At the end of this course the students will be able to communicate effectively with an increase in their confidence to read, write and speak English fluently.

- They will also demonstrate a significant increase in word power.

- The variety of exercises and activities that will be conducted in the Language Lab will develop their skills needed to participate in a conversation like listening carefully and respectfully to others’ viewpoints; articulating their own ideas and questions clearly and over all students will be able to prepare, organize, and deliver an engaging oral presentation.

- They will also develop non-verbal communication such as proper use of body language and gestures.

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<table>
<thead>
<tr>
<th>Course Code</th>
<th>BS102</th>
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</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Mathematics - II</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>4 (L: 3, T: 1, P: 0)</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>NIL</td>
</tr>
<tr>
<td>Course Category</td>
<td>BS</td>
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</tbody>
</table>

**Course Objectives:**
This course is designed to give a comprehensive coverage at an introductory level to the subject of matrices, Integral Calculus coordinate geometry, Basic elements of vector algebra and First Order Differential Equations.

**Course Content:**

**UNIT - I: Determinants and Matrices**
Elementary properties of determinants up to 3rd order, consistency of equations, Crammer’s rule. Algebra of matrices, Inverse of a matrix, matrix inverse method to solve a system of linear equations in 3 variables.

**UNIT - II: Integral Calculus**
Integration as inverse operation of differentiation. Simple integration by substitution, by parts and by partial fractions (for linear factors only). Use of formulas $\int_0^{\pi/2} \sin^n x \, dx$, $\int_0^{\pi/2} \cos^n x \, dx$ and $\int_0^{\pi/2} \sin^m x \cdot \cos^n x \, dx$ for solving problems Where m and n are positive integers.
Applications of integration for i. Simple problem on evaluation of area bounded by a curve and axes. ii. Calculation of Volume of a solid formed by revolution of an area about axes. (Simple problems).

**UNIT - III: Co-Ordinate Geometry**
Equation of straight line in various standard forms (without proof), inter section of two straight lines, angle between two lines. Parallel and perpendicular lines, perpendicular distance formula.
General equation of a circle and its characteristics. To find the equation of a circle, given:
i. Centre and radius,
ii. Three points lying on it and
iii. Coordinates of end points of a diameter;
Definition of conics (Parabola, Ellipse, Hyperbola) their standard equations without proof. Problems on conics when their foci, directories or vertices are given.

**UNIT - IV: Vector Algebra**
Definition notation and rectangular resolution of a vector. Addition and subtraction of vectors. Scalar and vector products of 2 vectors. Simple problems related to work, moment and angular velocity.

**UNIT-V: Differential Equations**
Solution of first order and first degree differential equation by variable separation method (simple problems). MATLAB – Simple Introduction.

References:

Course Outcomes:
By the end of the course the students are expected to learn
(i) the students are expected to acquire necessary background in Determinants and Matrices so as to appreciate the importance of the Determinants are the factors that scale different parameterizations so that they all produce same overall integrals, i.e. they are capable of encoding the inherent geometry of the original shape.
(ii) the cumulative effect of the original quantity or equation is the Integration
(iii) the coordinate geometry provides a connection between algebra and geometry through graphs of lines and curves.
(iv) Tell the difference between a resultant and a concurrent force to model simple physical problems in the form of a differential equation, analyze and interpret the solutions.

Course Code : BS104
Course Title : Applied Physics -II
Number of Credits : 3 (L: 2, T: 1, P: 0)
Prerequisites : High School Level Physics
Course Category : BS

Course Objectives
Applied Physics aims to give an understanding of this world both by observation and by prediction of the way in which objects behave. Concrete use of physical principles and analysis in various fields of engineering and technology are given prominence in the course content. The course will help the diploma engineers to apply the basic concepts and principles to solve broad-based engineering problems and to understand different technology based applications.

Teaching Approach
Teachers should give examples from daily routine as well as, engineering/technology applications on various concepts and principles in each topic so that students are able to understand and grasp these concepts and principles. In all contents, SI units should be followed.
Use of demonstration can make the subject interesting and develop scientific temper in the students. Student activities should be planned on all the topics.
Activity- Theory - Demonstrate/practice approach may be followed throughout the course so that learning may be outcome and employability based.

Course Content

UNIT - 1: Wave motion and its applications
Wave motion, transverse and longitudinal waves with examples, definitions of wave velocity, frequency and wave length and their relationship, Sound and light waves and their properties, wave equation \( y = r \sin(\omega t) \) amplitude, phase, phase difference, principle of superposition of waves and beat formation.

Simple Harmonic Motion (SHM): definition, expression for displacement, velocity, acceleration, time period, frequency etc. Simple harmonic progressive wave and energy transfer, study of vibration of cantilever and determination of its time period, Free, forced and resonant vibrations with examples.

Acoustics of buildings – reverberation, reverberation time, echo, noise, coefficient of absorption of sound, methods to control reverberation time and their applications, Ultrasonic waves – Introduction and properties, engineering and medical applications of ultrasonic.

UNIT - 2: Optics
Basic optical laws; reflection and refraction, refractive index, Images and image formation by mirrors, lens and thin lenses, lens formula, power of lens, magnification and defects. Total internal reflection, Critical angle and conditions for total internal reflection, applications of total internal reflection in optical fiber.

Optical Instruments; simple and compound microscope, astronomical telescope in normal adjustment, magnifying power, resolving power, uses of microscope and telescope, optical projection systems.

UNIT - 3: Electrostatics
Coulombs law, unit of charge, Electric field, Electric lines of force and their properties, Electric flux, Electric potential and potential difference, Gauss law: Application of Gauss law to find electric field intensity of straight charged conductor, plane charged sheet and charged sphere.

Capacitor and its working, Types of capacitors, Capacitance and its units. Capacitance of a parallel plate capacitor, Series and parallel combination of capacitors (related numerical), dielectric and its effect on capacitance, dielectric break down.

UNIT - 4: Current Electricity

Ohm’s law and its verification, Kirchhoff’s laws, Wheatstone bridge and its applications (slide wire bridge only), Concept of terminal potential difference and Electro motive force (EMF)

Heating effect of current, Electric power, Electric energy and its units (related numerical problems), Advantages of Electric Energy over other forms of energy.

UNIT - 5: Electromagnetism
Types of magnetic materials; dia, para and ferromagnetic with their properties, Magnetic field and its units, magnetic intensity, magnetic lines of force, magnetic flux and units, magnetization.

Concept of electromagnetic induction, Faraday’s Laws, Lorentz force (force on moving charge in mag-
netic field). Force on current carrying conductor, force on rectangular coil placed in magnetic field. Moving coil galvanometer; principle, construction and working, Conversion of a galvanometer into ammeter and voltmeter.

UNIT - 6: Semiconductor Physics
Energy bands in solids, Types of materials (insulator, semi-conductor, conductor), intrinsic and extrinsic semiconductors, p-n junction, junction diode and V-I characteristics, types of junction diodes. Diode as rectifier – half wave and full wave rectifier (centre taped). Transistor; description and three terminals, Types- pnp and npn, some electronic applications (list only). Photocells, Solar cells; working principle and engineering applications.

UNIT - 7: Modern Physics
Lasers: Energy levels, ionization and excitation potentials; spontaneous and stimulated emission; population inversion, pumping methods, optical feedback, Types of lasers; Ruby, He-Ne and semiconductor, laser characteristics, engineering and medical applications of lasers. Fiber Optics: Introduction to optical fibers, light propagation, acceptance angle and numerical aperture, fiber types, applications in; telecommunication, medical and sensors. Nanoscience and Nanotechnology: Introduction, nanoparticles and nanomaterials, properties at nanoscale, nanotechnology, nanotechnology based devices and applications.

Learning Outcome:
After undergoing this subject, the student will be able to;

a) Describe waves and wave motion, periodic and simple harmonic motions and solve simple problems. Establish wave parameters: frequency, amplitude, wavelength, and velocity and able to explain diffraction, interference, polarization of waves.
b) Explain ultrasonic waves and engineering, medical and industrial applications of Ultrasonics. Apply acoustics principles to various types of buildings for best sound effect.
c) State basic optical laws, establish the location of the images formed by mirrors and thin converging lens, design and assemble microscope using lenses combination.
d) Describe refractive index of a liquid or a solid and will be able to explain conditions for total internal reflection.
e) Define capacitance and its unit, explain the function of capacitors in simple circuits, and solve simple problems.
f) Differentiate between insulators, conductors and semiconductors, and define the terms: potential, potential difference, electromotive force.
g) Express electric current as flow of charge, concept of resistance, measure of the parameters: electric current, potential difference, resistance.
h) List the effects of an electric current and its common applications, State Ohm’s law, calculate the equivalent resistance of a variety of resistor combinations, distinguish between AC and DC currents, determine the energy consumed by an appliance,
i) State the laws of electromagnetic induction, describe the effect on a current-carrying conductor when placed in a magnetic field.
j) Explain the operation of appliances like moving coil galvanometer, simple DC motors.
k) Apply the knowledge of diodes in rectifiers, power adapters and various electronic circuits. Use the knowledge of semiconductors in various technical gadgets like mobile phones, com-
puters, LED, photocells, solar lights etc.

l) Illustrate the conditions for light amplification in various LASER and laser based instruments and optical devices.

m) Appreciate the potential of optical fiber in fields of medicine and communication.

n) Express importance of nanoscience and nanotechnology and impact of nanotechnology to the society.

References:

1. Text Book of Physics for Class XI & XII (Part-I, Part-II); N.C.E.R.T., Delhi
10. e-books/e-tools/ learning physics software/websites etc.

Course Code : ES 102
Course Title : Introduction to IT Systems
Number of Credits : 2 (L: 2, T: 0, P: 0)
Prerequisites (Course code) : NIL
Course Category : ES

Course Objectives:
This course is intended to make new students comfortable with computing environment - Learning basic computer skills, Learning basic application software tools, Understanding Computer Hardware, Cyber security awareness

Course Content:

UNIT 1:
Basic Internet skills: Understanding browser, efficient use of search engines, awareness about Digital India portals (state and national portals) and college portals.
General understanding of various computer hardware components – CPU, Memory, Display, Keyboard, Mouse, HDD and other Peripheral Devices.

UNIT 2:
OS Installation (Linux and MS Windows), Unix Shell and Commands, vi editor.

UNIT 3:
HTML4, CSS, making basic personal webpage.

UNIT 4:
Office Tools: OpenOffice Writer, OpenOffice Spreadsheet (Calc), OpenOffice Impress.

UNIT 5: Information security best practices.
Class lectures will only introduce the topic or demonstrate the tool, actual learning will take place in the Lab by practicing regularly.

Suggested Lab Work:
This is a skill course. Topics/concepts taught in the class should be practiced in the Lab same week and practiced regularly during the semester till student becomes confident about it. This course is all about some theory and a lot of practice.

References:
- R.S. Salaria, Computer Fundamentals, Khanna Publishing House
- Ramesh Bangia, PC Software Made Easy – The PC Course Kit, Khanna Publishing House
- Online Resources, Linux man pages, Wikipedia
- Mastering Linux Shell Scripting: A practical guide to Linux command-line, Bash scripting, and Shell programming, by Mokhtar Ebrahim, Andrew Mallett

Course outcomes:
At the end of the course student will be able to comfortably work on computer, install and configure OS, assemble a PC and connect it to external devices, write documents, create worksheets, prepare presentations, protect information and computers from basic abuses/attacks.

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<tr>
<th>Course Code</th>
<th>ES104</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Fundamentals of Electrical and Electronics Engineering</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3 (L: 2, T: 1, P: 0)</td>
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<tr>
<td>Prerequisites</td>
<td>NIL</td>
</tr>
<tr>
<td>Course Category</td>
<td>ES</td>
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</table>

Course Objectives:
To provide basic knowledge of the different elements and concepts of electrical engineering field and to learn basic concepts of various active and passive electronic components, Signals, Op-Amp and their applications, Digital Electronics and their applications to help students deal with electrical and electronics engineering principles and applications in industrial processes of different fields.

Course Content:
UNIT I Overview of Electronic Components & Signals:

UNIT II Overview of Analog Circuits:
Operational Amplifiers-Ideal Op-Amp, Practical op amp, Open loop and closed loop configurations, Application of Op-Amp as amplifier, adder, differentiator and integrator.


Unit IV Electric and Magnetic Circuits:
EMF, Current, Potential Difference, Power and Energy; M.M.F, magnetic force, permeability, hysteresis loop, reluctance, leakage factor and BH curve; Electromagnetic induction, Faraday’s laws of electromagnetic induction, Lenz’s law; Dynamically induced emf; Statically induced emf; Equations of self and mutual inductance; Analogy between electric and magnetic circuits.

Unit V A.C. Circuits:
Cycle, Frequency, Periodic time, Amplitude, Angular velocity, RMS value, Average value, Form Factor Peak Factor; impedance, phase angle, and power factor; Mathematical and phasor representation of alternating emf and current; Voltage and Current relationship in Star and Delta connections; A.C in resistors, inductors and capacitors; A.C in R-L series, R-C series, R-L-C series and parallel circuits; Power in A. C. Circuits, power triangle.

Unit VI Transformer and Machines: General construction and principle of different type of transformers; Emf equation and transformation ratio of transformers; Auto transformers; Construction and Working principle of motors; Basic equations and characteristic of motors.

References:
1. Ritu Sahdev, Basic Electrical Engineering, Khanna Publishing House

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Course Code : ES 106  
Course Title : Engineering Mechanics  
Number of Credits : 3 (L: 2, T: 1, P: 0)  
Prerequisites : NIL  
Course Category : ES

Course Objectives:
Following are the objectives of this course:
1) To obtain resultant of various forces 
2) To calculate support reactions through conditions of equilibrium for various structures  
3) To understand role of friction in equilibrium problems 
4) To know fundamental laws of machines and their applications to various engineering problems

Course Contents:
Unit – I Basics of mechanics and force system
   Significance and relevance of Mechanics, Applied mechanics, Statics, Dynamics.  
   Space, time, mass, particle, flexible body and rigid body. 
   Scalar and vector quantity, Units of measurement (SI units) - Fundamental units and derived units. 
   Force – unit, representation as a vector and by Bow’s notation, characteristics and effects of a force, Principle of transmissibility of force, Force system and its classification.  
   Resolution of a force - Orthogonal components of a force, moment of a force, Varignon’s Theorem.  
   Composition of forces – Resultant, analytical method for determination of resultant for concurrent, non-concurrent and parallel co-planar force systems – Law of triangle, parallelogram and polygon of forces.

Unit– II Equilibrium
   Equilibrium and Equilibrant, Free body and Free body diagram, Analytical and graphical methods of analysing equilibrium  
   Lami’s Theorem – statement and explanation, Application for various engineering problems.  
   Types of beam, supports (simple, hinged, roller and fixed) and loads acting on beam (vertical and inclined point load, uniformly distributed load, couple). 
   Beam reaction for cantilever, simply supported beam with or without overhang – subjected to combination of Point load and uniformly distributed load.  
   Beam reaction graphically for simply supported beam subjected to vertical point loads only.

Unit– III Friction
   Friction and its relevance in engineering, types and laws of friction, limiting equilibrium, limiting friction, co-efficient of friction, angle of friction, angle of repose, relation between co-efficient of friction and angle of friction.  
   Equilibrium of bodies on level surface subjected to force parallel and inclined to plane.  
   Equilibrium of bodies on inclined plane subjected to force parallel to the plane only.
Unit – IV Centroid and centre of gravity

Centroid of geometrical plane figures (square, rectangle, triangle, circle, semi-circle, quarter circle)

Centroid of composite figures composed of not more than three geometrical figures

Centre of Gravity of simple solids (Cube, cuboid, cone, cylinder, sphere, hemisphere) Centre of Gravity of composite solids composed of not more than two simple solids.

Unit – V Simple lifting machine

Simple lifting machine, load, effort, mechanical advantage, applications and advantages. Velocity ratio, efficiency of machines, law of machine.

Ideal machine, friction in machine, maximum Mechanical advantage and efficiency, reversible and non-reversible machines, conditions for reversibility

Velocity ratios of Simple axle and wheel, Differential axle and wheel, Worm and worm wheel, Single purchase and double purchase crab winch, Simple screw jack, Weston’s differential pulley block, geared pulley block.

Suggested Learning Resources:


Course outcomes:

After completing this course, student will be able to:

1. Identify the force systems for given conditions by applying the basics of mechanics.
2. Determine unknown force(s) of different engineering systems.
3. Apply the principles of friction in various conditions for useful purposes.
4. Find the centroid and centre of gravity of various components in engineering systems.
5. Select the relevant simple lifting machine(s) for given purposes.

*****

Course Code : BS 106
Course Title : Applied Physics II Lab
Number of Credits : 1 (L: 0, T: 0, P: 2)
Prerequisites : NIL
Course Category : BS

Course Objectives:

Concrete use of physical principles and analysis in various fields of engineering and technology is very prominence. The course aims to supplement the factual knowledge gained in the lecture by first hand manipulation of apparatus. This will develop scientific temper and help to apply the basic concepts and principles in solving engineering and technology based problems. In addition, students get
necessary confidence in handling equipment and thus learn various skills in measurement.

**List of Practicals/Activities:** (To perform minimum 12 Practicals)

1. To determine and verify the time period of a cantilever.
2. To determine velocity of ultrasonic in different liquids using ultrasonic interferometer.
3. To verify laws of reflection from a plane mirror/ interface.
4. To verify laws of refraction (Snell’s law) using a glass slab.
5. To determine focal length and magnifying power of a convex lens.
6. To verify Ohm’s law by plotting graph between current and potential difference.
7. To verify laws of resistances in series and parallel combination.
8. To find the frequency of AC main using electrical vibrator.
9. To verify Kirchhoff’s law using electric circuits.
10. To study the dependence of capacitance of a parallel plate capacitor on various factors and determines permittivity of air at a place.
11. To find resistance of a galvanometer by half deflection method.
12. To convert a galvanometer into an ammeter.
13. To convert a galvanometer into a voltmeter.
14. To draw V-I characteristics of a semiconductor diode (Ge, Si) and determine its knee voltage.
15. To verify inverse square law of radiations using a photo-electric cell.
16. To measure wavelength of a He-Ne/diode laser using a diffraction grating.
17. To measure numerical aperture (NA) of an optical fiber.
18. Study of an optical projection system (OHP/LCD) - project report.

**Suggested Student Activities & Strategies**

Apart from classroom and laboratory learning following are the suggested student related activities which can be undertaken to accelerate the attainment of various outcomes of the course.

a. Make survey of different physical products and compare the following points
   - Measurements of dimensions
   - Properties
   - Applications

b. Library survey regarding engineering materials/products used in different industries

c. Seminar on any relevant topic.

Teachers should use the following strategies to achieve the various outcomes of the course.

- Different methods of teaching and media to be used to attain classroom attention.
- Massive open online courses (MOOCs) may be used to teach various topics/sub topics.
- 15-20% of the topics which are relatively simpler or descriptive in nature should be given to the students for self-learning and assess the development of competency through classroom presentations/projects.
- Micro-projects on relevant may be given to group of students for hand-on experiences.

**Learning Outcome:**

After undergoing this subject, the student will be able to;

a) Apply concept of vibrations and determine the time period of vibrating objects.
b) Use of equipment for determining velocity of ultrasonics in different liquids.

c) Verify optical laws; reflection, refraction from plane interfaces and surfaces.

d) Apply knowledge of optics to determine focal length and magnifying power of optical lenses.

e) Understand uses of electrical components and meters and verify Ohm’s law for flow of current.

f) Quantify resistances and verify laws of series and parallel combination of resistances.

g) Apply concept of electrical vibrations in determine frequency of AC main.

h) Analyse electrical circuits and verify Kirchhoff’s law governing electrical circuits.

i) Measure resistance of a galvanometer and how it is converted into an ammeter and voltmeter.

j) Investigate characteristics of semiconductor diodes, photoelectric cells and determine operational parameters associated with their performance.

k) Work with laboratory lasers and understand method to measure the wavelength of the light emitted from a laser.

l) Handle optical fibers and determine numerical aperture of given optical fiber.

m) Understand construction and working of an optical projection system.

**Recommended Books:**

1. Text Book of Physics for Class XI & XII (Part-I, Part-II); N.C.E.R.T., Delhi


3. Practical Physics by C. L. Arora, S. Chand & Company Ltd.

4. e-books/e-tools/learning physics software/youtube videos/websites etc.

**Course Code:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>ES 108</th>
</tr>
</thead>
</table>

**Course Title:** Introduction to IT Systems Lab

**Number of Credits:** 2 (L: 0, T: 0, P: 4)

**Prerequisites (Course code):** NIL, should be doing ES102 in parallel

**Course Category:** ES

**Course Objectives:**

This Lab course is intended to practice whatever is taught in theory class of ‘Introduction of IT Systems’ and become proficient in using computing environment - basic computer skills, basic application software tools, Computer Hardware, cyber security features, etc.

**Course Content:**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Topics for Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Browser features, browsing, using various search engines, writing search queries</td>
</tr>
<tr>
<td>2</td>
<td>Visit various e-governance/Digital India portals, understand their features, services offered</td>
</tr>
<tr>
<td>3</td>
<td>Read Wikipedia pages on computer hardware components, look at those components in lab, identify them, recognise various ports/interfaces and related cables, etc.</td>
</tr>
<tr>
<td>4</td>
<td>Install Linux and Windows operating system on identified lab machines, explore various options, do it multiple times</td>
</tr>
</tbody>
</table>
5. Connect various peripherals (printer, scanner, etc.) to computer, explore various features of peripheral and their device driver software.

6. Practice HTML commands, try them with various values, make your own Webpage.

7. Explore features of Open Office tools, create documents using these features, do it multiple times.

8. Explore security features of Operating Systems and Tools, try using them and see what happens.

This is a skill course. More you practice, better it will be.

References:
1. Online resources, Linux man pages, Wikipedia.
5. IT Essentials PC Hardware and Software Companion Guide, Davis Anfinson and Ken Quamme, CISC Press, Pearson Education.
6. PC Hardware and A+ Handbook, Kate J. Chase PHI (Microsoft).

Course outcomes:
At the end of the course student will be able to comfortably work on computer, install and configure OS, assemble a PC and connect it to external devices, write documents, create worksheets, prepare presentations, protect information and computers from basic abuses/attacks.

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Course Code: ES110
Course Title: Fundamentals of Electrical and Electronics Engineering Lab
Number of Credits: 1 (L: 0, T: 0, P: 2)
Prerequisites: NIL
Course Category: ES

Suggested Practicals/Exercises:
The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Practical Outcomes (PrOs)</th>
<th>Approx. Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Determine the permeability of magnetic material by plotting its B-H curve.</td>
<td>02*</td>
</tr>
<tr>
<td>2.</td>
<td>Measure voltage, current and power in 1-phase circuit with resistive load.</td>
<td>02*</td>
</tr>
<tr>
<td>3.</td>
<td>Measure voltage, current and power in R-L series circuit.</td>
<td>02*</td>
</tr>
<tr>
<td>4.</td>
<td>Determine the transformation ratio (K) of 1-phase transformer.</td>
<td>02</td>
</tr>
<tr>
<td>5.</td>
<td>Connect single phase transformer and measure input and output quantities.</td>
<td>02</td>
</tr>
<tr>
<td>6.</td>
<td>Make Star and Delta connection in induction motor starters and measure the line and phase values.</td>
<td>02</td>
</tr>
<tr>
<td>7.</td>
<td>Identify various passive electronic components in the given circuit</td>
<td>02</td>
</tr>
<tr>
<td>8.</td>
<td>Connect resistors in series and parallel combination on bread board and measure its value using digital multimeter.</td>
<td>02</td>
</tr>
<tr>
<td>9.</td>
<td>Connect capacitors in series and parallel combination on bread board and measure its value using multimeter.</td>
<td>02*</td>
</tr>
<tr>
<td>S. No.</td>
<td>Practical Outcomes (PrOs)</td>
<td>Approx. Hrs.</td>
</tr>
<tr>
<td>-------</td>
<td>------------------------------------------------------------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>10.</td>
<td>Identify various active electronic components in the given circuit.</td>
<td>02</td>
</tr>
<tr>
<td>11.</td>
<td>Use multimeter to measure the value of given resistor.</td>
<td>02</td>
</tr>
<tr>
<td>12.</td>
<td>Use LCR-Q tester to measure the value of given capacitor and inductor.</td>
<td>02</td>
</tr>
<tr>
<td>13.</td>
<td>Determine the value of given resistor using digital multimeter to confirm with colour code.</td>
<td>02*</td>
</tr>
<tr>
<td>14.</td>
<td>Test the PN-junction diodes using digital multimeter.</td>
<td>02*</td>
</tr>
<tr>
<td>15.</td>
<td>Test the performance of PN-junction diode.</td>
<td>02</td>
</tr>
<tr>
<td>16.</td>
<td>Test the performance of Zener diode.</td>
<td>02</td>
</tr>
<tr>
<td>17.</td>
<td>Test the performance of LED.</td>
<td>02</td>
</tr>
<tr>
<td>18.</td>
<td>Identify three terminals of a transistor using digital multimeter.</td>
<td>02</td>
</tr>
<tr>
<td>19.</td>
<td>Test the performance of NPN transistor.</td>
<td>02*</td>
</tr>
<tr>
<td>20.</td>
<td>Determine the current gain of CE transistor configuration.</td>
<td>02</td>
</tr>
<tr>
<td>21.</td>
<td>Test the performance of transistor switch circuit.</td>
<td>02</td>
</tr>
<tr>
<td>22.</td>
<td>Test the performance of transistor amplifier circuit.</td>
<td>02</td>
</tr>
<tr>
<td>23.</td>
<td>Test Op-Amp as amplifier and Integrator</td>
<td>02</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>46</strong></td>
</tr>
</tbody>
</table>

**References:**

1. Ritu Sahdev, Basic Electrical Engineering, Khanna Publishing House, 2018

**Suggested Softwares/Learning Websites:**

- en.wikipedia.org/wiki/Transformer
- www.animations.physics.unsw.edu.au//jw/AC.html
- www.alpharubicon.com/altenergy/understandingAC.htm
- www.electronics-tutorials
- learn.sparkfun.com/tutorials/transistors
- www.pitt.edu/~qiw4/Academic/ME2082/Transistor%20Basics.pdf
Course Outcomes:
At the end of the course student will be able to:

1. Understand basic principle and operation of electric circuits and machines.
2. Solve basic problems related to electrical circuits and machines. Explain the operation of different electrical technologies.
3. Demonstrate an understanding of the control systems.
4. Understand the basic circuit elements
5. Understand different types of signal waveforms.
6. Understand logic gates and apply them in various electronic circuits.
7. Understand the basic concepts of op-amps, and their applications.
8. Use relevant electric/electronic protective devices safely.

Course Code : ES 112
Course Title : Engineering Mechanics Lab.
Number of Credits : 1 (L: 0, T: 0, P: 2)
Prerequisites : NIL
Course Category : ES

Course Objectives:
Following are the objectives of this course:
1) To obtain resultant of various forces
2) To calculate support reactions through conditions of equilibrium for various structures
3) To understand role of friction in equilibrium problems
4) To know fundamental laws of machines and their applications to various engineering problems

List of Practical to be performed:
1. To study various equipments related to Engineering Mechanics.
2. To find the M.A., V.R., Efficiency and law of machine for Differential Axle and Wheel.
3. To find the M.A., V.R., Efficiency and law of machine for Simple Screw Jack.
8. Determine resultant of concurrent force system applying Law of Polygon of forces using force table.
10. Determine resultant of parallel force system graphically.
11. Verify Lami's theorem.
12. Study forces in various members of Jib crane.
13. Determine support reactions for simply supported beam.
15. Determine coefficient of friction for motion on horizontal and inclined plane.
16. Determine centroid of geometrical plane figures.
Suggested Learning Resources:

Course outcomes:
After completing this course, student will be able to
1. Identify the force systems for given conditions by applying the basics of mechanics.
2. Determine unknown force(s) of different engineering systems.
3. Apply the principles of friction in various conditions for useful purposes.
4. Find the centroid and centre of gravity of various components in engineering systems.
5. Select the relevant simple lifting machine(s) for given purposes.

Course Code : AU102
Course Title : Environmental Science
Number of Credits : 0 (non-credit) (L:2, T:0, P:0)
Prerequisites : High School Science
Course Category : AU

Course Objectives:
Technicians working in industries or elsewhere essentially require the knowledge of environmental science so as to enable them to work and produce most efficient, economical and eco-friendly finished products.

- Solve various engineering problems applying ecosystem to produce eco – friendly products.
- Use relevant air and noise control method to solve domestic and industrial problems.
- Use relevant water and soil control method to solve domestic and industrial problems.
- To recognize relevant energy sources required for domestic and industrial applications.
- Solve local solid and e-waste problems.

Course Content:
Pre requisite: - High School Chemistry

Unit-1 Ecosystem
- Structure of ecosystem, Biotic & Abiotic components
- Food chain and food web
- Aquatic (Lentic and Lotic) and terrestrial ecosystem
- Carbon, Nitrogen, Sulphur, Phosphorus cycle.
- Global warming -Causes, effects, process, Green House Effect, Ozone depletion

Unit- 2 Air and, Noise Pollution
- Definition of pollution and pollutant, Natural and manmade sources of air pollution (Refrigerants, I.C., Boiler)
Air Pollutants: Types, Particulate Pollutants: Effects and control (Bag filter, Cyclone separator, Electrostatic Precipitator)
Gaseous Pollution Control: Absorber, Catalytic Converter, Effects of air pollution due to Refrigerants, I.C., Boiler
Noise pollution: sources of pollution, measurement of pollution level, Effects of Noise pollution, Noise pollution (Regulation and Control) Rules, 2000

Unit- 3 Water and Soil Pollution
Sources of water pollution, Types of water pollutants, Characteristics of water pollutants Turbidity, pH, total suspended solids, total solids BOD and COD: Definition, calculation
Causes, Effects and Preventive measures of Soil Pollution: Causes-Excessive use of Fertilizers, Pesticides and Insecticides, Irrigation, E-Waste.

Unit– 4 Renewable sources of Energy
New Energy Sources: Need of new sources. Different types new energy sources. Applications of (Hydrogen energy, Ocean energy resources, Tidal energy conversion,) Concept, origin and power plants of geothermal energy

Unit-5 Solid Waste Management, ISO 14000 & Environmental Management 06 hours
Solid waste generation- Sources and characteristics of: Municipal solid waste, E- waste, biomedical waste.
Metallic wastes and Non-Metallic wastes (lubricants, plastics, rubber) from industries.
Collection and disposal: MSW (3R, principles, energy recovery, sanitary landfill), Hazardous waste
Concept of Carbon Credit, Carbon Footprint.
Environmental management in fabrication industry.
ISO14000: Implementation in industries, Benefits.

References:
(a) Suggested Learning Resources:
Books:
5. O.P. Gupta, Elements of Environmental Pollution Control, Khanna Publishing House, New Delhi

(b) Open source software and website address:
1) www.eco-prayer.org
2) www.teriin.org
3) www.cpcp.nic.in
4) www.cpcp.gov.in
5) www.indiaenvironmentportal.org.in
6) www.whatis.techtarget.com
7) www.sustainabledevelopment.un.org
8) www.conserve-energy-future.com

Teachers should use the following strategies to achieve the various outcomes of the course.

- Different methods of teaching and media to be used to attain classroom attention.
- Massive open online courses (MOOCs) may be used to teach various topics/sub topics.
- 15-20% of the topics which are relatively simpler of descriptive in nature should be given to the students for self-learning and assess the development of competency through classroom presentations.
- Micro-projects may be given to group of students for hand-on experiences
- Encouraging students to visit to sites such as Railway station and research establishment around the institution.

Course outcomes
At the end of the course student will be able to

1. Understand the ecosystem and terminology and solve various engineering problems applying ecosystem knowledge to produce eco – friendly products.
2. Understand the suitable air, extent of noise pollution, and control measures and acts.
3. Understand the water and soil pollution, and control measures and acts.
4. Understand different renewable energy resources and efficient process of harvesting.

******
Civil Engineering
Curriculum Structure
(III to VI Semesters)
## 3.1 List of Programme Core Courses [PC]

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Code No.</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CEPC201</td>
<td>Construction Materials</td>
<td>3</td>
<td>III</td>
<td>3</td>
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<tr>
<td>2.</td>
<td>CEPC203</td>
<td>Basic Surveying</td>
<td>2</td>
<td>III</td>
<td>2</td>
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<tr>
<td>3.</td>
<td>CEPC205</td>
<td>Mechanics of Materials</td>
<td>2</td>
<td>III</td>
<td>2</td>
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<tr>
<td>4.</td>
<td>CEPC207</td>
<td>Building Construction</td>
<td>2</td>
<td>III</td>
<td>2</td>
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<tr>
<td>5.</td>
<td>CEPC209</td>
<td>Concrete Technology</td>
<td>2</td>
<td>III</td>
<td>2</td>
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<tr>
<td>6.</td>
<td>CEPC211</td>
<td>Geotechnical Engineering</td>
<td>2</td>
<td>III</td>
<td>2</td>
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<tr>
<td>7.</td>
<td>CEPC213</td>
<td>Construction Materials Lab.</td>
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<td>III</td>
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<td>8.</td>
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<td>Basic Surveying Lab.</td>
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<td>III</td>
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<td>9.</td>
<td>CEPC217</td>
<td>Mechanics of Materials Lab.</td>
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<td>III</td>
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<tr>
<td>10.</td>
<td>CEPC219</td>
<td>Concrete Technology Lab.</td>
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<td>III</td>
<td>1</td>
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<tr>
<td>11.</td>
<td>CEPC221</td>
<td>Geotechnical Engineering Lab.</td>
<td>0</td>
<td>III</td>
<td>1</td>
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<td>12.</td>
<td>CEPC202</td>
<td>Hydraulics</td>
<td>2</td>
<td>IV</td>
<td>2</td>
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<tr>
<td>13.</td>
<td>CEPC204</td>
<td>Advanced Surveying</td>
<td>2</td>
<td>IV</td>
<td>2</td>
</tr>
<tr>
<td>14.</td>
<td>CEPC206</td>
<td>Theory of Structure</td>
<td>2</td>
<td>IV</td>
<td>2</td>
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<tr>
<td>15.</td>
<td>CEPC208</td>
<td>Building Planning and Drawing</td>
<td>1</td>
<td>IV</td>
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<tr>
<td>16.</td>
<td>CEPC210</td>
<td>Water Resources Engineering</td>
<td>2</td>
<td>IV</td>
<td>2</td>
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<tr>
<td>17.</td>
<td>CEPC212</td>
<td>Transportation Engineering</td>
<td>2</td>
<td>IV</td>
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<tr>
<td>18.</td>
<td>CEPC214</td>
<td>Hydraulics Lab.</td>
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<td>IV</td>
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<tr>
<td>19.</td>
<td>CEPC216</td>
<td>Advanced Surveying Lab.</td>
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<td>IV</td>
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<td>20.</td>
<td>CEPC218</td>
<td>Building Planning and Drawing Lab.</td>
<td>0</td>
<td>IV</td>
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<td>21.</td>
<td>CEPC220</td>
<td>Water Resources Engineering Lab.</td>
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<td>22.</td>
<td>CEPC222</td>
<td>Transportation Engineering Lab.</td>
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<td>IV</td>
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<tr>
<td>23.</td>
<td>CEPC301</td>
<td>Design of Steel and RCC structures</td>
<td>3</td>
<td>V</td>
<td>3</td>
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<tr>
<td>24.</td>
<td>CEPC303</td>
<td>Estimating and Costing</td>
<td>2</td>
<td>V</td>
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</tr>
<tr>
<td>25.</td>
<td>CEPC305</td>
<td>Design of Steel and RCC structures Lab.</td>
<td>0</td>
<td>V</td>
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<tr>
<td>26.</td>
<td>CEPC307</td>
<td>Estimating and Costing Lab.</td>
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<td>V</td>
<td>1</td>
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<tr>
<td>27.</td>
<td>CEPC302</td>
<td>Public Health Engineering</td>
<td>2</td>
<td>VI</td>
<td>2</td>
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<tr>
<td>28.</td>
<td>CEPC304</td>
<td>Public Health Engineering Lab.</td>
<td>0</td>
<td>VI</td>
<td>1</td>
</tr>
</tbody>
</table>

**Total Credits 45**

*****
### 3.2 List of Programme Elective Courses [PE]

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Code No.</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>Elective I (any one to be selected)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>CEPE202</td>
<td>Precast and Prestressed Concrete</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>CEPE204</td>
<td>Construction Management</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>CEPE206</td>
<td>Rural Construction Technology</td>
<td>3</td>
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<tr>
<td>Elective II (any one to be selected)</td>
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<td>Solid Waste Management</td>
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<td>Advanced Construction Technology</td>
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<td>Elective III (any one to be selected)</td>
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<td>Tendering and Accounts</td>
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*****
### 3.3 Semester-wise Detailed Curriculum

#### Semester III

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Category</th>
<th>Code No.</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Total contact hrs/week</th>
<th>Credits</th>
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<tbody>
<tr>
<td>1.</td>
<td>Program core course</td>
<td>CEPC201</td>
<td>Construction Material</td>
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<td>2.</td>
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<td>CEPC203</td>
<td>Basic Surveying</td>
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<td>CEPC205</td>
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<td>Geotechnical Engineering Lab</td>
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<td>12.</td>
<td>Summer Internship-I</td>
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<td>1.</td>
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<td>2 L 0 T 0 P</td>
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<td>CEPC204</td>
<td>Advanced Surveying</td>
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<td>3.</td>
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<td>CEPC206</td>
<td>Theory of Structure</td>
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<td>4.</td>
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<td>12.</td>
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<td>14.</td>
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<td>Essence of Indian Knowledge and Tradition</td>
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**Total Credits:** 22

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<td>Program core course</td>
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<td>Design of Steel and RCC structure</td>
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<td>2.</td>
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<td>CEPC303</td>
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**Total Credits:** 19

### Semester VI

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<td>1.</td>
<td>Program core course</td>
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**Total Credits:** 21

^one credit is carried forward from the Vth semester major project evaluation.

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SEMESTER III

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<td>Prerequisites</td>
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Course Objectives:

Following are the objectives of this course:

- To learn about various construction materials, and understand their relevant characteristics.
- To be able to identify suitability of various materials for different construction purposes.
- To know about natural, artificial, and processed materials available for various purposes of construction activities.

Course Content:

Unit – I: Overview of Construction Materials

- Scope of construction materials in Building Construction, Transportation Engineering, Environmental Engineering, Irrigation Engineering (applications only).
- Selection of materials for different civil engineering structures on the basis of strength, durability, Eco friendly and economy.
- Broad classification of materials – Natural, Artificial, special, finishing and recycled.

Unit – II: Natural Construction Materials

- Requirements of good building stone; general characteristics of stone; quarrying and dressing methods and tools for stone.
- Structure of timber, general properties and uses of good timber; different methods of seasoning for preservation of timber; defects in timber; use of bamboo in construction.
- Asphalt, bitumen and tar used in construction, properties and uses.
- Properties of lime, its types and uses.
- Types of soil and its suitability in construction.
- Properties of sand and uses
- Classification of coarse aggregate according to size

Unit- III: Artificial Construction Materials

- Constituents of brick earth, Conventional / Traditional bricks, Modular and Standard bricks, Special bricks –fly ash bricks, Characteristics of good brick, Field tests on Bricks, Classification of burnt clay bricks and their suitability, Manufacturing process of burnt clay brick, fly ash bricks, Aerated concrete blocks.
- Flooring tiles – Types, uses
- Manufacturing process of Cement - dry and wet (only flow chart), types of cement and its uses. field tests on cement.
- Pre-cast concrete blocks- hollow, solid, pavement blocks, and their uses.
- Plywood, particle board, Veneers, laminated board and their uses.
- Types of glass: soda lime glass, lead glass and borosilicate glass and their uses.
- Ferrous and non-ferrous metals and their uses.
Unit– IV: Special Construction Materials

- Types of material and suitability in construction works of following materials: Waterproofing, Termite proofing; Thermal and sound insulating materials.
- Fibers – Types – Jute, Glass, Plastic Asbestos Fibers, (only uses).
- Geopolymer cement: Geo-cement: properties, uses.

Unit– V: Processed Construction Materials

- Constituents and uses of POP (Plaster of Paris), POP finishing boards, sizes and uses.
- Paints- whitewash, cement paint, Distempers, Oil Paints and Varnishes with their uses. (Situations where used).
- Industrial waste materials- Fly ash, Blast furnace slag, Granite and marble polishing waste and their uses.
- Agro waste materials - Rice husk, Bagasse, coir fibres and their uses.
- Special processed construction materials; Geosynthetic, Ferro Crete, Artificial timber, Artificial sand and their uses.

References:

2. S.K. Sharma, Civil Engineering Construction Materials, Khanna Publishing House, Delhi

Course outcomes:

After completing this course, student will be able to:

- Identify relevant construction materials.
- Identify relevant natural construction materials.
- Select relevant artificial construction materials.
- Select relevant special type of construction materials.
- Identify and use of processed construction materials.

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<table>
<thead>
<tr>
<th>Course Code</th>
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<td>Course Title</td>
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<td>Prerequisites</td>
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Course Objectives:

Following are the objectives of this course:

- To understand types of surveying works required.
- To know the types of method and equipments to be used for different surveys.
- To know the use and operational details of various surveying equipments.

Course Content:

Unit – I Overview and Classification of Survey

- Survey- Purpose and Use.
- Types of surveying- Primary and Secondary, Classification: Plane, Geodetic, Cadastral, Hydrographic, Photogrammetry and Aerial.
- Principles of Surveying.
- Scales: Engineer’s scale, Representative Fraction (RF) and diagonal scale.

Unit – II Chain Surveying

- Instruments used in chain survey: Metric Chain, Tapes, Arrow, Ranging rod, Line ranger, Offset rod, Open cross staff, Optical square.
- Chain survey Station, Base line, Check line, Tie line, Offset, Tie station.
- Ranging: Direct and Indirect Ranging.
- Methods of Chaining, obstacles in chaining.
- Errors in length: Instrumental error, personal error, error due to natural cause, random error.
- Principles of triangulation.
- Types of offsets: Perpendicular and Oblique.
- Conventional Signs, Recording of measurements in a field book.

Unit – III Compass Traverse Survey

- Compass Traversing- open, closed.
- Technical Terms: Geographic/ True Magnetic Meridians and Bearings, Whole Circle Bearing system and Reduced Bearing system and examples on conversion of given bearing to another bearing (from one form to another), Fore Bearing and Back Bearing. Calculation of internal and external angles from bearings at a station, Dip of Magnetic needle, Magnetic Declination.
- Components of Prismatic Compass and their Functions, Methods of using Prismatic Compass- Temporary adjustments and observing bearings.
- Local attraction, Methods of correction of observed bearings - Correction at station and correction to included angles.
- Methods of plotting a traverse and closing error, Graphical adjustment of closing error.

Unit – IV Levelling and Contouring

- Basic terminologies: Level surfaces, Horizontal and vertical surfaces, Datum, Bench Marks- GTS, Permanent, Arbitrary and Temporary, Reduced Level, Rise, Fall, Line of collimation, Station, Back sight, Fore sight, Intermediate sight, Change point, Height of instruments.
- Types of levels: Dumpy, Tilting, Auto level, Digital level, Components of Dumpy Level and its fundamental axes, Temporary adjustments of Level.
- Types of Leveling Staff: Self-reading staff and Target staff.
- Reduction of level by Line of collimation and Rise and Fall Method.
- Contour, contour intervals, horizontal equivalent.
- Uses of contour maps, Characteristics of contours, Methods of Contouring: Direct and indirect.
Unit V Measurement of Area and Volume

- Components and use of Digital planimeter.
- Measurement of area using digital planimeter.
- Measurement of volume of reservoir from contour map.

Suggested learning resources


Course outcomes:
After completing this course, student will be able to:

- Select the type of survey required for given situation.
- Compute area of open field using chain, tape and cross staff.
- Conduct traversing in the field using chain and compass.
- Use levelling instruments to determine reduced level for preparation of contour maps
- Use digital planimeter to calculate the areas.

<table>
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<th>Course Code</th>
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Course Objectives:
Following are the objectives of this course:

- To learn properties of area and structural material properties.
- To understand the concept of stress and strain.
- To calculate shear force, bending moment for different shapes of structural elements and corresponding stresses.
- To understand the concept of buckling loads for short and long columns.
Course Content

Unit – I Moment of Inertia

- Moment of inertia (M.I.): Definition, M.I. of plane lamina, Radius of gyration, section modulus, Parallel and Perpendicular axes theorems (without derivations), M.I. of rectangle, square, circle, semi-circle, quarter circle and triangle section (without derivations).
- M.I. of symmetrical and unsymmetrical I-section, Channel section, T-section, Angle section, Hollow sections and built up sections about centroidal axes and any other reference axis.
- Polar Moment of Inertia of solid circular sections.

Unit– II Simple Stresses and Strains

- Definition of rigid, elastic and plastic bodies, deformation of elastic body under various forces, Definition of stress, strain, elasticity, Hook's law, Elastic limit, Modulus of elasticity.
- Type of Stresses-Normal, Direct, Bending and Shear and nature of stresses i.e. Tensile and Compressive stresses.
- Standard stress strain curve for tor steel bar under tension, Yield stress, Proof stress, Ultimate stress, Strain at various critical points, Percentage elongation and Factor of safety.
- Deformation of body due to axial force, forces applied at intermediate sections, Maximum and minimum stress induced, Composite section under axial loading.
- Concept of temperature stresses and strain, Stress and strain developed due to temperature variation in homogeneous simple bar (no composite section)
- Longitudinal and lateral strain, Modulus of Rigidity, Poisson's ratio, Biaxial and tri-axial stresses, volumetric strain, change in volume, Bulk modulus (Introduction only).
- Relation between modulus of elasticity, modulus of rigidity and bulk modulus (without derivation).

Unit– III Shear Force and Bending Moment

- Types of supports, beams and loads.
- Concept and definition of shear force and bending moment, Relation between load, shear force and bending moment (without derivation).
- Shear force and bending moment diagram for cantilever and simply supported beams subjected to point loads, uniformly distributed loads and couple (combination of any two types of loading), point of contra flexure.

Unit– IV Bending and Shear Stresses in beams

- Concept and theory of pure bending, assumptions, flexural equation (without derivation), bending stresses and their nature, bending stress distribution diagram.
- Concept of moment of resistance and simple numerical problems using flexural equation.
- Shear stress equation (without derivation), relation between maximum and average shear stress for rectangular and circular section, shear stress distribution diagram.
- Shear stress distribution for square, rectangular, circle, hollow, square, rectangular, circular, angle sections, channel section, I-section, T section. Simple numerical problems based on shear equation.
Unit– V Columns

- Concept of compression member, short and long column, Effective length, Radius of gyration, Slenderness ratio, Types of end condition for columns, Buckling of axially loaded columns.
- Euler’s theory, assumptions made in Euler’s theory and its limitations, Application of Euler’s equation to calculate buckling load.
- Rankine’s formula and its application to calculate crippling load.
- Concept of working load/safe load, design load and factor of safety.

Suggested learning resources:

Course outcomes:
After competing this course, student will be able to:

- Articulate practical applications of moment of inertia of symmetrical and unsymmetrical structural sections.
- Analyse structural behaviour of materials under various loading conditions.
- Interpret shear force and bending moment diagrams for various types of beams and loading conditions.
- Determine the bending and shear stresses in beams under different loading conditions.
- Analyse the column for various loading and end conditions.

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<table>
<thead>
<tr>
<th>Course Code</th>
<th>CEPC207</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Building Construction</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>2 (L: 2, T: 0, P: 0)</td>
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<tr>
<td>Prerequisites</td>
<td>NIL</td>
</tr>
<tr>
<td>Course Category</td>
<td>PC</td>
</tr>
</tbody>
</table>

Course Objectives:
Following are the objectives of this course:

- To identify different components of building.
- To understand different types of foundation and their significance.
- To know different types of masonry and their construction.
- To highlight the importance of communications in building planning.

Course Content
Unit – I: Overview of Building Components
Classification of Buildings as per National Building Code Group A to I, As per Types of Constructions- Load Bearing Structure, Framed Structure, Composite Structure.

Building Components - Functions of Building Components, Substructure – Foundation, Plinth.


Unit – II: Construction of Substructure

Job Layout: Site Clearance, Layout for Load Bearing Structure and Framed Structure by Center Line and Face Line Method, Precautions.

Earthwork: Excavation for Foundation, Timbering and Strutting, Earthwork for embankment, Material for plinth Filling, Tools and plants used for earthwork.


Unit- III: Construction of Superstructure


Scaffolding and Shoring: Purpose, Types of Scaffolding, Process of Erection and Dismantling. Purpose and Types of Shoring, Underpinning. Formwork: Definition of Formwork, Requirements of Formwork, Materials used in Formwork, Types of Formwork, Removal of formwork.

Unit– IV: Building Communication and Ventilation

Horizontal Communication: Doors – Components of Doors, Full Paneled Doors, Partly Paneled and Glazed Doors, Flush Doors, Collapsible Doors, Rolling Shutters, Revolving Doors, Glazed Doors. Sizes of Door recommended by BIS.


Fixtures and fastenings for doors and windows- Material used and functions of Window Sill andLintels, Shed / Chajja.

Vertical Communication: Means of Vertical Communication- Stair Case, Ramps, Lift, Elevators and Escalators. Terms used in staircase-steps, tread, riser, nosing, soffit, waist slab, bal-
uster, balustrade, scotia, hand rails, newel post, landing, headroom, winder. Types of staircase (On the basis of shape): Straight, dog-legged, open well, Spiral, quarter turn, bifurcated, Three quarter turn and Half turn, (On the basis of Material): Stone, Brick, R.C.C., wooden and Metal.

Unit- V: Building Finishes


**Suggested learning resources:**


**Course outcomes:**

After completing this course, student will be able to:

- Identify components of building structures.
- Propose suitable type of foundation for building structures.
- Select suitable type of masonry for building structures.
- Propose relevant means of communications for different types of buildings.
- Select relevant material for finishing works.

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<table>
<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Concrete Technology</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>2 (L: 2, T: 0, P: 0)</td>
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<td>Prerequisites</td>
<td>NIL</td>
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<td>Course Category</td>
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</table>
Course Objectives:
Following are the objectives of this course:

- To know properties of cement, aggregate and water used in concrete.
- To understand different characteristics of concrete.
- To learn about role of admixtures in concrete.

Course Content:
Unit – I Cement, Aggregates and Water

- Physical properties of OPC and PPC: fineness, standard consistency, setting time, soundness, compressive strength. Different grades of OPC and relevant BIS codes
- Testing of cement: Laboratory tests—fineness, standard consistency, setting time, soundness, compressive strength. Storage of cement and effect of storage on properties of cement.
- BIS Specifications and field applications of different types of cements: Rapid hardening, Low heat, Portland pozzolana, Sulphate resisting, Blast furnace slag, High Alumina and White cement.
- Aggregates: Requirements of good aggregate, Classification according to size and shape.
- Fine aggregates: Properties, size, specific gravity, bulk density, water absorption and bulking, fineness modulus and grading zone of sand, silt content and their specification as per IS 383. Concept of crushed Sand.
- Coarse aggregates: Properties, size, shape, surface texture, water absorption, soundness, specific gravity and bulk density, fineness modulus of coarse aggregate, grading of coarse aggregates, crushing value, impact value and abrasion value of coarse aggregates with specifications.
- Water: Quality of water, impurities in mixing water and permissible limits for solids as per IS: 456.

Unit – II Concrete

- Concrete: Different grades of concrete, provisions of IS 456.
- Duff Abraham water cement (w/c) ratio law, significance of w/c ratio, selection of w/c ratio for different grades, maximum w/c ratio for different grades of concrete for different exposure conditions as per IS 456.

Unit – III Concrete Mix Design and Testing of Concrete

- Concrete mix design: Objectives, methods of mix design, study of mix design as per IS 10262 (only procedural steps).
- Testing of concrete, determination of compressive strength of concrete cubes at different ages, interpretation and co-relation of test results.
- Non-destructive testing of concrete: Rebound hammer test, working principle of rebound hammer and factor affecting the rebound index, Ultrasonic pulse velocity test as per IS13311 (part 1 and 2), Importance of NDT tests.
Unit– IV Quality Control of Concrete

- Forms for concreting: Different types of form works for beams, slabs, columns, materials used for form work, requirement of good form work. Stripping time for removal of form works per IS 456.
- Waterproofing: Importance and need of waterproofing, methods of waterproofing and materials used for waterproofing.
- Joints in concrete construction: Types of joints, methods for joining old and new concrete, materials used for filling joints.

Unit– V Chemical Admixture, Special Concrete and Extreme Weather concreting

- Admixtures in concrete: Purpose, properties and application for different types of admixture such as accelerating admixtures, retarding admixtures, water reducing admixtures, air entraining admixtures and super plasticizers.
- Special Concrete: Properties, advantages and limitation of following types of Special concrete: Ready mix Concrete, Fiber Reinforced Concrete, High performance Concrete Self-compacting concrete and light weight concrete.
- Cold weather concreting: effect of cold weather on concrete, precautions to be taken while concreting in cold weather condition.
- Hot weather concreting: effect of hot weather on concrete, precautions to be taken while concreting in hot weather condition.

Suggested learning resources:

2. Shetty, M.S., Concrete Technology, S. Chand and Co. Pvt. Ltd., Ram Nagar, Delhi.

Course outcomes:

After completing this course, student will be able to:

- Use different types of cement and aggregates in concrete
- Prepare concrete of desired compressive strength.
- Prepare concrete of required specification.
- Maintain quality of concrete under different conditions.
- Apply relevant admixtures for concreting.

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<thead>
<tr>
<th>Course Code</th>
<th>CEPC211</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Geotechnical Engineering</td>
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<tr>
<td>Number of Credits</td>
<td>2 (L: 2, T: 0, P: 0)</td>
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<td>Prerequisites</td>
<td>NIL</td>
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<tr>
<td>Course Category</td>
<td>PC</td>
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</tbody>
</table>
Course Objectives:

Following are the objectives of this course:

- To understand and determine physical and index properties and classification of soil
- To estimate permeability and shear strength of soil
- To know the load bearing capacity of soil
- To learn various soil stabilization and compaction methods

Course Content:

Unit – I Overview of Geology and Geotechnical Engineering

- Introduction of Geology, Branches of Geology, Importance of Geology for civil engineering structure and composition of earth, Definition of a rock: Classification based on their genesis (mode of origin), formation. Classification and engineering uses of igneous, sedimentary and metamorphic rocks.
- Importance of soil as construction material in Civil engineering structures and as foundation bed for structures.
- Field application of geotechnical engineering for foundation design, pavement design, design of earth retaining structures, design of earthen dam.

Unit– II Physical and Index Properties of Soil

- Soil as a three phase system, water content, determination of water content by oven drying method as per BIS code, void ratio, porosity and degree of saturation, density index. Unit weight of soil mass – bulk unit weight, dry unit weight, unit weight of solids, saturated unit weight, submerged unit weight. Determination of bulk unit weight and dry unit weight by core cutter and sand replacement method, Determination of specific gravity by pycnometer.
- Consistency of soil, Atterberg limits of consistency: Liquid limit, plastic limit and shrinkage limit. Plasticity index.
- Particle size distribution test and plotting of curve, Determination of effective diameter of soil, well graded and uniformly graded soils, BIS classification of soil.

Unit– III Permeability and Shear Strength of Soil

- Definition of permeability, Darcy’s law of permeability, coefficient of permeability, factors affecting permeability, determination of coefficient of permeability by constant head and falling head tests, simple problems to determine coefficient of permeability. Seepage through earthen structures, seepage velocity, seepage pressure, phreatic line, flow lines, application of flow net, (No numerical problems).

Unit– IV Bearing Capacity of Soil

- Bearing capacity and theory of earth pressure. Concept of bearing capacity, ultimate bearing capacity, safe bearing capacity and allowable bearing pressure. Introduction to Terzaghi’s analysis and assumptions, effect of water table on bearing capacity.
- Field methods for determination of bearing capacity – Plate load and Standard Penetration Test. Test procedures as per IS:1888 & IS:2131.
- Definition of earth pressure, Active and Passive earth pressure for no surcharge condition, coefficient of earth pressure, Rankine’s theory and assumptions made for non-cohesive Soils.

Unit– V Compaction and stabilization of soil

- Concept of compaction, Standard and Modified proctor test as per IS code, Plotting of Compac-
tion curve for determining: Optimum moisture content (OMC), maximum dry density (MDD), Zero air voids line. Factors affecting compaction, field methods of compaction – rolling, ramming and vibration. Suitability of various compaction equipments-smooth wheel roller, sheep foot roller, pneumatic tyred roller, Rammer and Vibrator, Difference between compaction and consolidation.

- Concept of soil stabilization, necessity of soil stabilization, different methods of soil stabilization. California bearing ratio (CBR) test - Meaning and Utilization in Pavement Construction
- Necessity of site investigation and soil exploration: Types of exploration, criteria for deciding the location and number of test pits and bores. Field identification of soil – dry strength test, dilatancy test and toughness test.

Suggested learning resources:

5. Kasamalkar, B. J., Geotechnical Engineering, Pune Vidyarthi Griha Prakashan, Pune.

Course outcomes:

After completing this course, student will be able to:

- Identify types of rocks and sub soil strata of earth.
- Interpret the physical properties of soil related to given construction activities.
- Use the results of permeability and shear strength test for foundation analysis.
- Interpret soil bearing capacity results.
- Compute optimum values for moisture content for maximum dry density of soil through various tests.

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<table>
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<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Construction Materials Lab.</td>
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<tr>
<td>Number of Credits</td>
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<tr>
<td>Prerequisites</td>
<td>NIL</td>
</tr>
<tr>
<td>Course Category</td>
<td>PC</td>
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</table>

Course Objectives:

Following are the objectives of this course:

- To learn about various construction materials, and understand their relevant characteristics.
- To be able to identify suitability of various materials for different construction purposes.
- To know about natural, artificial, and processed materials available for various purposes of construction activities.
List of practical to be performed:

- Identify various sizes of available coarse aggregates from sample of 10 kg in laboratory and prepare report (60, 40, 20, 10 mm).
- Identify the available construction materials in the laboratory on the basis of their sources.
- Identify the grain distribution pattern in given sample of teak wood in the laboratory and draw the various patterns. (along and perpendicular to the grains).
- Prepare the lime putty by mixing lime (1 kg) with water in appropriate proportion and prepare report on slaking of lime.
- Identify various layers and types of soil in foundation pit by visiting at least 3 construction sites in different locations of city and prepare report consisting photographs and samples. Part I
- Identify various layers and types of soil in foundation pit by visiting at least 3 construction sites in different locations of city and prepare report consisting photographs and samples. Part II
- Select first class, second class and third-class bricks from the stake of bricks and prepare report on the basis of its properties.
- Measure dimensions of 10 bricks and find average dimension and weight. Perform field tests - dropping, striking and scratching by nail and correlate the results obtained.
- Identify different types of flooring tiles such as vitrified tiles, ceramic tiles, glazed tiles, mosaic tiles, anti-skid tiles, chequered tiles, paving blocks and prepare report about the specifications.
- Apply the relevant termite chemical on given damaged sample of timber.
- Identify the type of glasses from the given samples.
- Apply two or more coats of selected paint on the prepared base of a given wall surface for the area of 1m x 1m using suitable brush/rollers adopting safe practices. Part I
- Apply two or more coats of selected paint on the prepared base of a given wall surface for the area of 1m x 1m using suitable brush/rollers adopting safe practices. Part II
- Prepare the cement mortar of proportion 1:3 or 1:6 using artificial sand as a special processed construction material.
- Prepare mortar using cement and Fly ash or Granite/marble polishing waste in the proportion 1:6 or 1:3.

Suggested learning resources:

Course outcomes:
After competing this course, student will be able to:
1) Identify relevant construction materials.
2) Identify relevant natural construction materials.
3) Select relevant artificial construction materials.
4) Select relevant special type of construction materials.
5) Identify and use of processed construction materials.

Course Code : CEPC215
Course Title : Basic Surveying Lab
Number of Credits : 1   (L: 0, T: 0, P: 2)
Prerequisites : NIL
Course Category : PC

Course Objectives:
Following are the objectives of this course:
•   To understand types of surveying works required
•   To know the type of method and equipments to be used for different surveys
•   To know the use and operational details of various surveying equipments.

List of Practicals to be performed
•   Measure distance between two survey stations using chain, tape and ranging rods when two stations are inter visible.
•   Undertake reciprocal ranging and measure the distance between two stations.
•   Determine area of open field using chain and cross staff survey.
•   Measure Fore Bearing and Back Bearing of survey lines of open traverse using Prismatic Compass.
•   Measure Fore Bearing and back bearing of a closed traverse of 5 or 6 sides and correct the bearings and included angles for the local attraction.
•   Undertake Survey Project with chain and compass for closed traverse for minimum 5 sides around a building.
•   Plot the traverse on A1 size imperial drawing sheet for data collected in Survey Project mentioned at practical No.6.
•   Undertake simple leveling using dumpy level/ Auto level and leveling staff.
•   Undertake differential leveling and determine Reduced Levels by Height of instrument method and Rise and fall method using dumpy level/Auto Level and leveling staff.
•   Undertake fly leveling with double check using dumpy level/ Auto level and leveling staff.
•   Undertake Survey Project with Leveling instrument for Profile leveling and cross-sectioning for a road length of 500 m with cross-section at 30 m interval.
•   Plot the L-section with minimum 3 cross-sections on A1 size imperial sheet for data collected in Survey Project mentioned at practical No.11.
• Undertake Survey Project for plotting contour map using block contouring method for a block of 150m x 150m with grid of 10m x 10m.
• Plot the contours on A1 size imperial drawing sheet for data collected in Survey Project mentioned at practical No.13.
• Measure area of irregular figure using Digital planimeter.

Suggested learning resources:
7. Rao, P. Venugopala Akella, Vijayalakshmi, Textbook of Surveying, PHI Learning

Course outcomes:
After completing this course, student will be able to:
• Select the type of survey required for given situation.
• Compute area of open field using chain, tape and cross staff.
• Conduct traversing in the field using chain and compass.
• Use levelling instruments to determine reduced level to prepare contour maps
• Use digital planimeter to calculate the areas.

Course Code : CEPC217
Course Title : Mechanics of Material Lab.
Number of Credits : 1  (L: 0, T: 0, P: 2)
Prerequisites : NIL
Course Category : PC

Course Objectives:
Following are the objectives of this course:
• To know the procedure for the conduct of tensile and compressive strength.
• To understand the concept of stress and strain through testing of different materials.
• To calculate shear force, bending moment and their corresponding stresses.
• To understand flexural strength and abrasive properties of floor tiles.
List of Practicals to be performed:

- Study and understand the use and components of Universal Testing Machine (UTM).
- Perform Tension test on mild steel as per IS:432(1).
- Perform tension test on Tor steel as per IS:1608, IS:1139.
- Conduct compression test on sample test piece using Compression Testing Machine.
- Conduct Izod Impact test on three metals. e.g. mild steel/ brass/aluminum/ copper /cast iron etc as per IS:1598.
- Conduct Charpy Impact test on three metals. e.g. mild steel/ brass/aluminum/ copper /cast iron etc as per IS:1757.
- Determine Water Absorption on bricks per IS:3495 (part II), IS:1077 or tile IS:1237.
- Determine Compressive strength of dry and wet bricks as per IS:3495(part I), IS:1077.
- Conduct Abrasion Test on flooring tiles (any one) e.g. Mosaic tiles, Ceramic Tiles as per IS:13630 (part 7), Cement Tile as per IS: 1237.
- Perform Single Shear and double shear test on any two metals e.g. Mild steel/ brass/aluminum/copper /cast iron etc as per IS:5242.
- Conduct Compression test on timber section along the grain and across the grain as per IS:2408.
- Plot Shear force and Bending Moment diagrams for cantilever, simply supported beams.
- Plot Shear force and Bending Moment diagrams for overhanging beams for different types of loads including moment loading.
- Conduct Flexural test on timber beam on rectangular section in both orientation as per IS:1708, IS:2408.
- Conduct Flexure test on floor tiles IS:1237, IS:13630 or roofing tiles as per IS:654, IS:2690.

Suggested learning resources:


Course outcomes:

After completing this course, student will be able to:

- Test different Civil engineering materials on Universal Testing Machine.
- Analyse structural behaviour of materials under various loading conditions.
- Interpret shear force and bending moment diagrams for various types of beam sections and different loading conditions.
- Determine bending and shear stresses in beams under different loading conditions.
- Calculate flexural strength of different types of floor tiles.

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Course Objectives:
Following are the objectives of this course:

- To know properties of cement, aggregate and water used in concrete.
- To understand different characteristics of concrete.
- To learn about role of admixtures in concrete.

List of Practical to be performed:

<table>
<thead>
<tr>
<th>No.</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Determine fineness of cement by Blaine’s air permeability apparatus Or by sieving.</td>
</tr>
<tr>
<td>2</td>
<td>Determine specific gravity, standard consistency, initial and final setting times of cement.</td>
</tr>
<tr>
<td>3</td>
<td>Determine compressive strength of cement.</td>
</tr>
<tr>
<td>4</td>
<td>Determine silt content in sand.</td>
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<tr>
<td>5</td>
<td>Determine bulking of sand.</td>
</tr>
<tr>
<td>6</td>
<td>Determine bulk density of fine and coarse aggregates.</td>
</tr>
<tr>
<td>7</td>
<td>Determine water absorption of fine and coarse aggregates.</td>
</tr>
<tr>
<td>8</td>
<td>Determine Fineness modulus of fine aggregate by sieve analysis.</td>
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<tr>
<td>9</td>
<td>Determine impact value of aggregate</td>
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<tr>
<td>10</td>
<td>Determine crushing value of aggregate.</td>
</tr>
<tr>
<td>11</td>
<td>Determine abrasion value of aggregate.</td>
</tr>
<tr>
<td>12</td>
<td>Determine elongation and flakiness index of coarse aggregates</td>
</tr>
<tr>
<td>13</td>
<td>Determine workability of concrete by slump cone test.</td>
</tr>
<tr>
<td>14</td>
<td>Determine workability of concrete by compaction factor test.</td>
</tr>
<tr>
<td>15</td>
<td>To prepare concrete mix of a particular grade and determine compressive strength of concrete for 7 and 28 days.</td>
</tr>
<tr>
<td>16</td>
<td>Demonstration of NDT equipments.</td>
</tr>
</tbody>
</table>

Suggested learning resources:
2. Shetty, M.S., Concrete Technology, S. Chand and Co. Pvt. Ltd., Ram Nagar, Delhi.
Course outcomes:
After completing this course, student will be able to:

- Identify different types of cement by performing laboratory tests.
- Know the physical properties of fine and coarse aggregates.
- Prepare concrete of required specification.
- Maintain the quality of concrete applying scientific principles.
- Use relevant admixtures for improving the workability of concrete.

Course Code : CEPC221
Course Title : Geotechnical Engineering Lab.
Number of Credits : 1 (L: 0, T: 0, P: 2)
Prerequisites : NIL
Course Category : PC

Course Objectives:
Following are the objectives of this course:

- To understand and determine physical and index properties of soil.
- To estimate the permeability and shear strength of soil.
- To know the procedure for performing C.B.R test.
- To learn various compaction methods for soil stabilization.

List of Practicals to be performed:
1. Identification of rocks from the given specimen.
2. Determine water content of given soil sample by oven drying method as per IS: 2720 (Part-II).
3. Determine specific gravity of soil by pycnometer method as per IS 2720 (Part- III).
4. Determine dry unit weight of soil in field by core cutter method as per IS 2720 (Part- XXIX).
5. Determine dry unit weight of soil in field by sand replacement method as per IS 2720 (Part- XXVIII).
6. Determine Plastic and Liquid Limit along with Plasticity Index of given soil sample as per IS 2720 (Part- V).
7. Determine Shrinkage limit of given soil sample as per IS 2720 (Part- V).
8. Determine grain size distribution of given soil sample by mechanical sieve analysis as per IS 2720 (Part- IV).
9. Use different types of soil to identify and classify soil by conducting field tests-Through Visual inspection, Dry strength test, Dilatancy test and Toughness test.
10. Determine coefficient of permeability by constant head test as per IS 2720 (Part- XVII).
11. Determine coefficient of permeability by falling head test as per IS 2720 (Part- XVII).
12. Determine shear strength of soil by direct shear test as per IS 2720 (Part-XIII).
13. Determine shear strength of soil by vane shear test as per IS 2720 (Part-XXX).
14. Determine MDD and OMC by standard proctor test of given soil sample as per IS 2720 (Part-VII).

15. Determination of CBR value on the field as per IS2720 (Part - XVI).

Suggested learning resources:
1. Punmia, B.C., Soil Mechanics and Foundation Engineering, Laxmi Publication
4. Raj, P. Purushothama, Soil Mechanics and Foundation Engineering, Pearson India
5. Kasamalkar, B. J., Geotechnical Engineering, Pune Vidyarthi Griha Prakashan, Pune.

Course outcomes:
After completing this course, student will be able to:

- Identify types of rocks and sub soil strata of earth.
- Interpret the physical properties of soil related to given construction activities.
- Use the results of permeability and shear strength test for foundation analysis.
- Interpret the soil bearing capacity results.
- Compute optimum moisture content values for maximum dry density of soil through various tests.
**SEMESTER IV**

<table>
<thead>
<tr>
<th>Course Code</th>
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<tr>
<td>Course Title</td>
<td>Hydraulics</td>
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<td>Number of Credits</td>
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<td>Prerequisites</td>
<td>NIL</td>
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</table>

**Course Objectives:**

Following are the objectives of this course:

- To understand parameters associated with fluid flow and hydrostatic pressure.
- To know head loss and water hammer in fluid flowing through pipes.
- To learn different types of pumps and their uses.

**Course Content**

**Unit – I Pressure measurement and Hydrostatic pressure**

- Technical terms used in Hydraulics – fluid, fluid mechanics, hydraulics, hydrostatics and hydrodynamics - ideal and real fluid, application of hydraulics.
- Physical properties of fluid – density-specific volume, specific gravity, surface tension, capillarity, viscosity-Newton's law of viscosity.
- Various types of pressure – Atmospheric Pressure, Gauge Pressure, Absolute Pressure, Vacuum Pressure. Concept of Pressure head and its unit, Pascal's law of fluid pressure and its uses.
- Measurement of differential Pressure by different methods.
- Variation of pressure with depth, Pressure diagram, hydrostatic pressure and center of pressure on immersed surfaces and on tank walls.
- Determination of total pressure and center of pressure on sides and bottom of water tanks, sides and bottom of tanks containing two liquids, vertical surface in contact with liquid on either side.

**Unit– II Fluid Flow Parameters**

- Types of flow – Gravity and pressure flow, Laminar, Turbulent, Uniform, Non-uniform, Steady, Unsteady flow. Reynolds number.
- Discharge and its unit, continuity equation of flow.
- Energy of flowing liquid: potential, kinetic and pressure energy.
- Bernoulli's theorem : statement, assumptions, equation.

**Unit– III Flow through pipes**

- Major head loss in pipe: Frictional loss and its computation by Darcy's Weisbach equation, Use of Moody's Diagram and Nomograms.
- Minor losses in pipe: loss at entrance, exit, sudden contraction, sudden enlargement and fittings.
- Flow through pipes in series, pipes in parallel and Dupuit's equation for equivalent pipe.
- Hydraulic gradient line and total energy line.
• Water hammer in pipes: Causes and Remedial measures.
• Discharge measuring device for pipe flow: Venturi meter - construction and working.
• Discharge measurement using Orifice, Hydraulic Coefficients of Orifice.

Unit– IV Flow through Open Channel
• Geometrical properties of channel section: Wetted area, wetted perimeter, hydraulic radius for rectangular and trapezoidal channel section.
• Determination of discharge by Chezy’s equation and Manning’s equation.
• Conditions for most economical rectangular and trapezoidal channel section.
• Discharge measuring devices: Triangular and rectangular Notches.
• Velocity measurement devices: current meter, floats and Pitot’s tube.
• Specific energy diagram, Froudes’ Number

Unit– V Hydraulic Pumps
• Concept of pump, Types of pump - centrifugal, reciprocating, submersible.
• Centrifugal pump: components and working
• Reciprocating pump: single acting and double acting, components and working.
• Suction head, delivery head, static head, Manometric head
• Power of centrifugal pump.
• Selection and choice of pump.

Suggested learning resources:

Course outcomes:
After completing this course, student will be able to:
• Measure pressure and determine total hydrostatic pressure for different conditions.
• Understand various parameters associated with fluid flow
• Determine head loss of fluid flow through pipes.
• Find the fluid flow parameters in open channels.
• Select relevant hydraulic pumps for different applications.
Course Objectives:
Following are the objectives of this course:

- To know methods of plane surveying and Theodolite surveying and their uses
- To learn tacheometric surveying and curve setting
- To understand the principles of Electronic Distance Measurement equipment and Total station and their use.
- To know the concept of remote sensing, GPS and GIS

Course Content
Unit – I Plane Table Surveying

- Principles of plane table survey.
- Accessories of plane table and their use, Telescopic alidade.
- Setting of plane table; Orientation of plane table - Back sighting and Magnetic meridian method, True Meridian Method.
- Methods of plane table surveys- Radiation, Intersection and Traversing.
- Merits and demerits of plane table survey.

Unit– II Theodolite Surveying

- Types and uses of Theodolite, Components of transit Theodolite and their functions, Reading the Vernier of transit Theodolite.
- Technical terms- Swinging, Transiting, Face left, Face right.
- Fundamental axes of transit Theodolite and their relationship
- Temporary adjustment of transit Theodolite.
- Measurement of magnetic bearing of a line, Prolonging and ranging a line, deflection angle.
- Measurement of vertical Angle.
- Theodolite traversing by Included angle method and Deflection angle method.
- Checks for open and closed traverse, Calculations of bearing from angles.
- Traverse computation-Latitude, Departure, Consecutive coordinates, Independent coordinates, balancing the traverse by Bowditch’s rule and Transit rule, Gale’s Traverse table computation.

Unit– III Tacheometric surveying and Curve setting

- Principles of Tacheometry, Tacheometer and its component parts, Anallatic lens.
- Tacheometric formula for horizontal distance with telescope horizontal and staff vertical.
- Field method for determining constants of tacheometer, Determining horizontal and vertical distances with tacheometer by fixed hair method and staff held vertical, Limitations of tacheometry.
• Types of curves used in roads and railway alignments. Designation of curves.
• Setting simple circular curve by offsets from long chord and Rankine’s method of deflection angles.

Unit– IV Advanced surveying equipments
• Principle of Electronic Distance Meter (EDM), its component parts and their Functions, use of EDM.
• Use of micro optic Theodolite and Electronic Digital Theodolite.
• Use of Total Station, Use of function keys.
• Measurements of Horizontal angles, vertical angles, distances and coordinates using Total Station, Traversing, Profile Survey and Contouring with Total Station.

Unit– V Remote sensing, GPS and GIS
• Remote Sensing – Overview, Remote sensing system, Applications of remote sensing in Civil engineering, land use / Land cover, mapping, disaster management.
• Use of Global Positioning System (G.P.S.) instruments.
• Geographic Information System (GIS): Over view, Components, Applications, Software for GIS.
• Introduction to Drone Surveying.

Suggested learning resources:

Course outcomes:
After completing this course, student will be able to:
• Prepare plans using Plane Table Surveys.
• Prepare plans using Theodolite surveys.
• Find distances and elevations using Tachometer.
• Prepare plans using Total Station instrument.
• Locate coordinates of stations using GPS.

******
Course Objectives:
Following are the objectives of this course:

- To learn concept of eccentric loading and stresses in vertical members like column, chimneys, dam
- To analyze beams using various methods like slope deflection, three moment, and moment distribution
- To understand different methods of finding axial forces in trusses.

Course Content

Unit – I Direct and Bending Stresses in vertical members
- Introduction to axial and eccentric loads, eccentricity about one principal axis only, nature of stresses, Maximum and minimum stresses, resultant stresses and distribution diagram.
- Condition for no tension or zero stress at extreme fiber, Limit of eccentricity, core of section for rectangular and circular cross sections, Middle third rule.
- Chimneys of circular cross section subjected to wind pressure, Maximum and minimum stresses, resultant stresses and distribution diagram at base.
- Analysis of dams subjected to horizontal water pressure, conditions of stability, Maximum and minimum stresses, resultant stresses and distribution diagram at base.

Unit – II Slope and Deflection
- Concept of slope and deflection, stiffness of beams, Relation among bending moment, slope, deflection and radius of curvature, (no derivation).
- Double integration method to find slope and deflection of cantilever and simply supported beams subjected to concentrated load and uniformly distributed load on entire span.
- Macaulay’s method for slope and deflection, application to cantilever and simply supported beam subjected to concentrated and uniformly distributed load on entire span.

Unit- III Fixed and Continuous Beam
- Concept of fixity, effect of fixity, advantages and disadvantages of fixed beam over simply supported beam.
- Principle of superposition, Fixed end moments from first principle for beam subjected to point load, UDL over entire span.
- Application of standard formulae in finding end moments, end reactions and drawing S.F. and B.M. diagrams for a fixed beam.
- Definition, effect of continuity, nature of moments induced due to continuity, concept of deflected shape, practical examples.
- Clapeyron’s theorem of three moment (no derivation), Application of Clapeyron’s theorem maximum up to three spans and two unknown support moment only, Support at same level spans having same and uniform moment of inertia subjected to concentrated loads and uniformly distributed loads over entire span.
- Drawing SF diagrams showing point of contraflexure, shear and BM diagrams showing net BM and point of contraflexure for continuous beams.
Unit– IV Moment distribution method

• Introduction to moment distribution method, sign convention, Carry over factor, stiffness factor, distribution factor.
• Application of moment distribution method to various types of continuous beams subjected to concentrated loads and uniformly distributed load over entire span having same or different moment of inertia, supports at same level, up to three spans and two unknown support moments only.
• Introduction to portal frames – Symmetrical and unsymmetrical portal frames with the concept of Bays and stories.

Unit– V Simple trusses

• Types of trusses (Simple, Fink, compound fink, French truss, pratt truss, Howe truss, North light truss, King post and Queen post truss)
• Calculate support reactions for trusses subjected to point loads at joints
• Calculate forces in members of truss using Method of joints and Method of sections.

Suggested learning resources:

Course outcomes:
After competing this course, student will be able to:

• Analyze stresses induced in vertical member subjected to direct and bending loads.
• Analyze slope and Deflection in fixed and continuous beams.
• Analyze continuous beam under different loading conditions using the principles of Three Moments.
• Analyze continuous beam using Moment Distribution Method under different loading conditions.
• Evaluate axial forces in the members of simple truss.

*******

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CEPC208</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Building Planning and Drawing</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>1 (L: 1, T: 0, P: 0)</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>NIL</td>
</tr>
<tr>
<td>Course Category</td>
<td>PC</td>
</tr>
</tbody>
</table>

Course Objectives:
Following are the objectives of this course:

• To learn basic principles of building planning and drawing.
• To know graphical representation of various components of buildings.
• To draw complete plan and elevation of a building.
• To learn basics of perspective drawings and Computer Aided Drawings.

Course Content:

Unit – I Conventions and Symbols
• Conventions as per IS 962, symbols for different materials such as earthwork, brickwork, stonework, concrete, woodwork and glass.
• Graphical symbols for doors and windows, Abbreviations, symbols for sanitary and electrical installations.
• Types of lines-visible lines, centre line, hidden line, section line, dimension line, extension line, pointers, arrow head or dots. Appropriate size of lettering and numerals for titles, sub-titles, notes and dimensions.
• Types of scale- Monumental, Intimate, criteria for Proper Selection of scale for various types of drawing.
• Sizes of various standard papers/sheets.
• Reading and interpreting readymade Architectural building drawing (To be procured from Architect, Planning Consultants, Planning Engineer).

Unit– II Planning of Building
• Principles of planning for Residential and Public building- Aspect, Prospect, Orientation, Grouping, Privacy, Elegance, Flexibility, Circulation, Furniture requirements, Sanitation, Economy.
• Space requirement and norms for minimum dimension of different units in the residential and public buildings as per IS 962.
• Rules and bye-laws of sanctioning authorities for construction work.
• Plot area, built up area, super built up area, plinth area, carpet area, floor area and FAR (Floor Area Ratio).
• Line plans for residential building of minimum three rooms including water closet (WC), bath and staircase as per principles of planning.
• Line plans for public building-school building, primary health centre, restaurant, bank, post office, hostel, Function Hall and Library.

Unit– III Drawing of Load Bearing Structure
• Drawing of Single storey Load Bearing residential building (2 BHK) with staircase.
• Data drawing – plan, elevation, section, site plan, schedule of openings, construction notes with specifications, area statement. Planning and design of staircase- Rise and Tread for residential and public building.
• Working drawing – developed plan, elevation, section passing through staircase or WC and bath.
• Foundation plan of Load bearing structure.

Unit– IV Drawing of Framed Structure
• Drawing of Two storeyed Framed Structure (G+1), residential building (2 BHK) with staircase.
• Data drawing – developed plan, elevation, section, site plan, schedule of openings, construction notes with specifications, area statement. Planning and design of staircase- Rise and
Tread for residential and public building.

- Working drawing of Framed Structure – developed plan, elevation, section passing through staircase or WC and bath.
- Foundation plan of Framed Structure.
- Details of RCC footing, Column, Beam, Chajjas, Lintel, Staircase and slab.
- Drawing with CAD - Draw commands, modify commands, layer commands.

**Unit – V Perspective Drawing**

- Definition, Types of perspective, terms used in perspective drawing, principles used in perspective drawing
- Two Point Perspective of small objects only such as steps, monuments, pedestals.

**Suggested learning resources:**

8. Sane, Y.S., Planning and design of Building, Allied Publishers, New Delhi.

**Course outcomes:**

After completing this course, student will be able to:

1. Interpret the symbols, signs and conventions from the given drawing.
2. Prepare line plans of residential and public buildings using principles of planning.
3. Prepare submission and working drawing for the given requirement of Load Bearing Structure.
4. Prepare submission and working drawing using CAD for the given requirement of Framed Structure.
5. Draw two-point perspective drawing for given small objects.

Course Code : CEPC210
Course Title : Water Resources Engineering
Number of Credits : 2 (L: 2, T: 0, P: 0)
Prerequisites : NIL
Course Category : PC

**Course Objectives:**

Following are the objectives of this course:

- To learn estimation of hydrological parameters.
• To understand water demand of crops and provisions to meet the same.
• To know planning of reservoirs and dams.
• To design irrigation projects, canals and other diversion works.

Course Content:

Unit – I Introduction to Hydrology
• Hydrology: Definition and Hydrological cycle
• Rain Gauge: Symons rain gauge, automatic rain gauge,
• Methods of calculating average rainfall: Arithmetic mean, Isohyetal, and Theissen polygon method.
• Runoff, Factors affecting Run off, Computation of run–off.
• Maximum Flood Discharge measurement: Rational and empirical methods, Simple numerical problems.
• Yield and Dependable yield of a catchment, determination of dependable yield.

Unit– II Crop water requirement and Reservoir Planning
• Irrigation and its classification.
• Crop Water requirement: Cropping seasons, Crop period, base period, Duty, Delta, CCA, GCA, intensity of irrigation, factors affecting duty, Problems on water requirement and capacity of canal.
• Methods of application of irrigation water and its assessment.
• Surveys for irrigation project, data collection for irrigation project.
• Area capacity curve.
• Silting of reservoir, Rate of silting, factors affecting silting and control measures.
• Control levels in reservoir, Simple numerical problems on Fixing Control levels.

Unit– III Dams and Spillways
• Dams and its classification: Earthen dams and Gravity dams (masonry and concrete).
• Earthen Dams – Components with function, typical cross section, seepage through embankment and foundation and its control.
• Methods of construction of earthen dam, types of failure of earthen dam and preventive measures.
• Gravity Dams – Forces acting on dam, Theoretical and practical profile, typical cross section, drainage gallery, joints in gravity dam, concept of high dam and low dam.
• Spillways-Definition, function, location, types and components, Energy dissipaters.

Unit– IV Minor and Micro Irrigation
• Bandhara irrigation: Layout, components, construction and working, solid and open bandhara.
• Percolation Tanks – Need, selection of site.
• Lift irrigation Scheme-Components and their functions, Lay out.
• Drip and Sprinkler Irrigation- Need, components and Layout.
• Well irrigation: types and yield of wells, advantages and disadvantages of well irrigation.

Unit– V Diversion Head Works & Canals
• Weirs – components, parts, types, K.T. weir – components and construction
• Diversion head works – Layout, components and their function.
• Barrages – components and their functions. Difference between weir and Barrage.
• Canals – Classification according to alignment and position in the canal network, Cross section of canal in embankment and cutting, partial embankment and cutting, balancing depth, Design of most economical canal section.
• Canal lining - Purpose, material used and its properties, advantages.
• Cross Drainage works- Aqueduct, siphon aqueduct, super passage, level crossing.
• Canal regulators- Head regulator, Cross regulator, Escape, Falls and Outlets

Suggested learning resources:
1. Punmia, B.C., Pande, B, Lal, Irrigation and Water Power Engineering, Laxmi Publications
4. Sharma, R.K. and Sharma, TK., Irrigation Engineering, S.Chand
5. Basak, N.N., Irrigation Engineering, McGraw Hill Education
6. Asawa, G.L., Irrigation and water resource Engineering, New Age

Course outcomes:
After completing this course, student will be able to:
• Estimate hydrological parameters.
• Estimate crop water requirements of a command area and capacity of canals.
• Execute Minor and Micro Irrigation Schemes.
• Select the relevant Cross Drainage works for the specific site conditions.
• Design, construct and maintain simple irrigation regulatory structures.

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<table>
<thead>
<tr>
<th>Course Code</th>
<th>CEPC212</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Transportation Engineering</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>2 (L: 2, T: 0, P: 0)</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>NIL</td>
</tr>
<tr>
<td>Course Category</td>
<td>PC</td>
</tr>
</tbody>
</table>

Course Objectives:
Following are the objectives of this course:
• To identify the types of roads as per IRC recommendations.
• To understand the geometrical design features of different highways.
• To perform different tests on road materials.
• To identify the components of railway tracks.
Course Content:

Unit – I Overview of Highway Engineering
- Role of transportation in the development of nation, Scope and Importance of roads in India and its’ Characteristics.
- Different modes of transportation – land way, waterway, airway. Merits and demerits of roadway and railway;
- General classification of roads.
- Selection and factors affecting road alignment.

Unit – II Geometric Design of Highway
- Camber: Definition, purpose, types as per IRC – recommendations.
- Kerbs: Road margin, road formation, right of way.
- Design speed and various factors affecting design speed as per IRC – recommendations.
- Gradient: Definition, types as per IRC – Recommendations.
- Sight distance (SSD): Definition, types IRC – recommendations, simple numerical.
- Curves: Necessity, types: Horizontal, vertical curves.
- Extra widening of roads: numerical examples.
- Super elevation: Definition, formula for calculating minimum and maximum Super elevation and method of providing super-elevation.
- Standards cross-sections of national highway in embankment and cutting.

Unit – III Construction of Road Pavements
- Types of road materials and their Tests – Test on aggregates-Flakiness and Elongation Index tests, Angularity Number test, test on Bitumen- penetration, Ductility, Flash and Fire point test and Softening point test.
- Pavement – Definition, Types, Structural Components of pavement and their functions
- Construction of WBM road. Merits and demerits of WBM & WMM road.
- Construction of Flexible pavement / Bituminous Road, Types of Bitumen and its properties, Emulsion, Cutback, Tar, Terms used in BR-prime coat, tack coat, seal coat, Merits and Demerits of BR.

Unit – IV Basics of Railway Engineering
- Classification of Indian Railways, zones of Indian Railways
- Permanent way: Ideal requirement, Components; Rail Gauge, types, factors affecting selection of a gauge.
- Rail, Rail Joints - requirements, types.
- Creep of rail: causes and prevention.
- Sleepers - functions and Requirement, types - concrete sleepers and their density
- Ballast - function and types, suitability.
- Rail fixtures and fastenings – fish plate, spikes, bolts, keys, bearing plates, chairs-types of anchors and anti-creepers.
Unit– V Track geometrics, Construction and Maintenance

- Alignment- Factors governing rail alignment.
- Track Cross sections – standard cross section of single and double line in cutting and embankment. Important terms-permanent land, formation width, side drains,
- Railway Track Geometrics: Gradient, curves- types and factors affecting, grade compensation, super elevation, limits of Super elevation on curves, cant deficiency, negative cant, coning of wheel, tilting of rail.
- Branching of Tracks, Points and crossings, Turn out- types, components, functions and inspection. Track junctions: crossovers, scissor cross over, diamond crossing, track triangle.
- Station -Purpose, requirement of railway station, important technical terms, types of railway station, factors affecting site selection for railway station.
- Station yard: Classification- Passenger, goods, locomotive and marshalling yards. Function & drawbacks of marshalling yards.
- Track Maintenance- Necessity, Classification, Tools required for track maintenance with their functions, Organisation of track maintenance, Duties of permanent way inspector, gang mate and key man.

Suggested learning resources:

5. Birdi, Ahuja, Road, Railways, Bridge and Tunnel Engg , Standard Book House, New Delhi.

Course outcomes:
After completing this course, student will be able to:

- Identify the types of roads as per IRC recommendations.
- Implement the geometrical design features of different highways.
- Perform different tests on road materials.
- Identify the components of railway tracks.
- Identify the defects in railway tracks.

*****
Course Code : CEPC214  
Course Title : Hydraulics Lab.  
Number of Credits : 1     (L: 0, T: 0, P: 2)  
Prerequisites : NIL  
Course Category : PC

Course Objectives:  
Following are the objectives of this course:  
- To understand parameters associated with fluid flow and hydrostatic pressure.  
- To know head loss and water hammer in fluid flowing through pipes.  
- To learn different types of pumps and their uses.

List of Practicals to be performed:

<table>
<thead>
<tr>
<th>No.</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Use piezometer to measure pressure at a given point.</td>
</tr>
<tr>
<td>2</td>
<td>Use Bourdon’s Gauge to measure pressure at a given point.</td>
</tr>
<tr>
<td>3</td>
<td>Use U tube differential manometer to measure pressure difference between two given points.</td>
</tr>
<tr>
<td>4</td>
<td>Find the resultant pressure and its position for given situation of liquid in a tank.</td>
</tr>
<tr>
<td>5</td>
<td>Use Reynold’s apparatus to determine type of flow.</td>
</tr>
<tr>
<td>6</td>
<td>Use Bernoulli’s apparatus to apply Bernoulli’s theorem to get total energy line for a flow in a closed conduit of varying cross sections.</td>
</tr>
<tr>
<td>7</td>
<td>Use Friction factor Apparatus to determine friction factor for a given pipe.</td>
</tr>
<tr>
<td>8</td>
<td>Determine minor losses in pipe fittings due to sudden contraction and sudden enlargement.</td>
</tr>
<tr>
<td>9</td>
<td>Determine minor losses in pipe fitting due to Bend and Elbow.</td>
</tr>
<tr>
<td>10</td>
<td>Calibrate Venturi meter to find out the discharge in a pipe.</td>
</tr>
<tr>
<td>11</td>
<td>Calibrate the Orifice to find out the discharge through a tank</td>
</tr>
<tr>
<td>12</td>
<td>Use Current meter to measure the velocity of flow of water in open channel.</td>
</tr>
<tr>
<td>13</td>
<td>Use Pitot tube to measure the velocity of flow of water in open channel.</td>
</tr>
<tr>
<td>14</td>
<td>Use triangular notch to measure the discharge through open channel.</td>
</tr>
<tr>
<td>15</td>
<td>Use Rectangular notch to measure the discharge through open channel.</td>
</tr>
<tr>
<td>16</td>
<td>Determine the efficiency of centrifugal pump.</td>
</tr>
</tbody>
</table>

Suggested learning resources:  
2. S.S. Rattan, Fluid Mechanics and Hydraulic Machines, Khanna Publishing House, Delhi  

Course outcomes:  
After competing this course, student will be able to:
• Measure pressure and determine total hydrostatic pressure for different conditions.
• Understand various parameters associated with fluid flow.
• Determine head loss of fluid flow through pipes.
• Find the fluid flow parameters in open channels.
• Select relevant hydraulic pumps for different applications.

Course Code: CEPC216
Course Title: Advanced Surveying Lab
Number of Credits: 1 (L: 0, T: 0, P: 2)
Prerequisites: NIL
Course Category: PC

Course Objectives:
Following are the objectives of this course:
• To know methods of plane surveying, Theodolite surveying and their uses.
• To learn tacheometric surveying and curve setting.
• To understand the principles of Electronic Distance Measurement and Total station and their uses.
• To know the concept of Remote Sensing, GPS and GIS.

List of Practicals to be performed

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Use plane table survey to prepare plans of a plot of seven sided closed traverse by Radiation Method.</td>
</tr>
<tr>
<td>2</td>
<td>Use plane table survey to prepare plans, locate details by Intersection Method.</td>
</tr>
<tr>
<td>3</td>
<td>Use plane table survey to prepare plans, locate details by Traversing Method.</td>
</tr>
<tr>
<td>4</td>
<td>Use plane table survey to carry out Survey Project for closed traverse for minimum five sides around a building.</td>
</tr>
<tr>
<td>5</td>
<td>Use transit theodolite to measure Horizontal and Vertical angle by Direct Method.</td>
</tr>
<tr>
<td>6</td>
<td>Plot the traverse on A1 size imperial drawing sheet for the collected data from preceding Theodolite Survey Project.</td>
</tr>
<tr>
<td>7</td>
<td>Use Thedolite as a Tacheometer to compute reduced levels and horizontal distances.</td>
</tr>
<tr>
<td>8</td>
<td>Set out a circular curve by Rankine's Method of Deflection Angles.</td>
</tr>
<tr>
<td>9</td>
<td>Use micro optic Theodolite to Measure Horizontal angle by Direct Method.</td>
</tr>
<tr>
<td>10</td>
<td>Use EDM to measure horizontal distance.</td>
</tr>
<tr>
<td>11</td>
<td>Use Total station instrument to measure horizontal distances.</td>
</tr>
<tr>
<td>12</td>
<td>Use Total station instrument to measure vertical angle.</td>
</tr>
<tr>
<td>13</td>
<td>Use Total station instrument to carry out Survey Project for closed traverse for minimum five sides.</td>
</tr>
<tr>
<td>14</td>
<td>Plot the traverse on A1 size imperial drawing sheet for the collected data from preceding Total Station Survey Project.</td>
</tr>
<tr>
<td>15</td>
<td>Use GPS to locate the coordinates of a station.</td>
</tr>
</tbody>
</table>
Suggested learning resources


Course outcomes:

After completing this course, student will be able to:

• Prepare plans using Plane Table Surveys.
• Prepare plans using Theodolite surveys.
• Find distances and elevations using Tachometer.
• Make measurements using Total Station.
• Locate coordinates of survey stations using GPS

Course Code : CEPC218
Course Title : Building Planning and Drawing Lab
Number of Credits : 2 (L: 0, T: 0, P: 4)
Prerequisites : NIL
Course Category : PC

Course Objectives:

Following are the objectives of this course:

• To learn the basic principles of building planning and drawing.
• To make graphical representation of various components of buildings.
• To draw complete plan and elevation of a building.
• To learn basics of perspective drawings and Computer Aided Drawings.

List of Practicals/Drawings to be completed:

<table>
<thead>
<tr>
<th>A. Sketch Book</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
</tbody>
</table>
3. a) Measure the units of existing building (Load Bearing / Frame structure).
   b) Draw line plan of measured existing building at **serial no 3a** to the suitable scale.

4. Draw line plan to suitable scale (Minimum 1BHK, staircase, WC and Bathroom)
   a) Residential Bungalows (Minimum three plans)
   b) Apartment (Minimum two plans)

5. Draw line plans to suitable scale for any **Five** Public Buildings from the following (School Building, Primary Health Centre, Bank, Post Office, Hostel, Restaurant, Community Hall and Library).

6. Draw the following plans for a Framed Structure (One/Two BHK) from given line plan.
   a) Developed plan, Elevation
   b) Section for above developed plan.
   c) Site plan for above drawings including area statement, schedule of opening and construction notes.

**B. Full Imperial Size Sheet (A1)**

1. Draw submission drawing to the scale 1:100 of a single storey load bearing residential building (2BHK) with flat roof and staircase showing
   a) Developed plan and elevation
   b) Section passing through Stair or WC and Bath
   c) Foundation plan and schedule of openings.
   d) Site plan (1:200), area statement, construction notes.

2. Draw submission drawing, to the scale of 1:100, of (G+1) Framed Structure Residential Building (2BHK) with flat roof and staircase showing:
   a) Developed plan
   b) Elevation.
   c) Section passing through Staircase, WC and Bath
   d) Site plan (1:200) and area statement
   e) Schedule of openings and Construction Notes.

3. Draw the above mentioned drawing at serial number (B-2) using CAD software and enclose the print out.
   a) Developed plan
   b) Elevation.
   c) Section passing through Staircase, W.C. and Bath
   d) Foundation plan.
   e) Site plan (1:200), area statement, Schedule of openings and construction notes.

4. Draw working drawing for above mentioned drawing at serial number (B-2) showing: a) Foundation plan to the scale 1:50
   b) Detailed enlarged section of RCC column and footing with plinth filling.
   c) Detailed enlarged section of RCC Beam, Lintel and Chajjas.
   d) Detailed enlarged section of RCC staircase and slab.

5. Draw two point perspective drawing of small objects - steps, monuments, pedestals (any one) scale 1:50
   a) Draw plan, elevation, eye level, picture plane and vanishing points
   b) Draw perspective view.
Suggested learning resources:
2. Malik and Mayo, Civil Engineering Drawing, Computech Publication Ltd
3. M. G. Shah and C. M. Kale, Principles of Perspective Drawing, Mcgraw Hill
8. Sane, Y.S., Planning and design of Building, Allied Publishers, New Delhi.

Course outcomes:
After completing this course, student will be able to:
- Interpret the symbols, signs and conventions from the given drawing.
- Prepare line plans of residential and public buildings using principles of planning.
- Prepare working drawing for the given requirement of Load Bearing Structure.
- Prepare working drawing using CAD for the given requirement of Framed Structure.
- Draw two-point perspective drawing for given small objects.

Course Code : CEPC220
Course Title : Water Resources Engineering Lab
Number of Credits : 1   (L: 0, T: 0, P: 2)
Prerequisites : NIL
Course Category : PC

Course Objectives:
Following are the objectives of this course:
- To learn estimation of hydrological parameters.
- To understand water demand of crops and provisions to meet the same.
- To know planning of reservoirs and dams.
- To design irrigation projects, canals and other diversion works.

List of Practicals to be performed
- Calculate average rainfall for the given area using arithmetic mean method.
- Calculate average rainfall for the given area using isohyetal, Theissen polygon method.
- Compute the yield of the Catchment area demarcated in Sr.No.2.
- Delineation of contributory area for the given outlet from the given topo-sheet.
- Estimate crop water requirement for the given data.
- Estimate capacity of the canal for the given data.
- Calculate reservoir capacity from the given data.
- Calculate control levels for the given data for a given reservoir.
- Draw a labeled sketch of the given masonry/earthen dam section.
• Draw the theoretical and practical profile of the given gravity dam section.
• Prepare a presentation on the technical details of any one micro or minor irrigation scheme.
• Prepare a model of any irrigation structure using suitable material.
• Prepare a maintenance report for any major/minor irrigation project site in the vicinity of your area, based on field visit.
• Prepare summary of the technical details of any existing water resource project in the vicinity of your area.
• Draw a labeled sketch of the given diversion head works and Cross Drainage works.
• Design a canal section for the given conditions with estimation of the quantity of material required for lining.

Suggested learning resources:
1. Punmia, B.C., Pande, B, Lal, Irrigation and water power engineering, Laxmi Publications
6. Asawa, G.L., Irrigation and water resource Engineering, New Age International(P)

Course outcomes:
After completing this course, student will be able to:
• Estimate hydrological parameters.
• Estimate crop water requirements of a command area and capacity of canals.
• Execute Minor and Micro Irrigation Schemes.
• Select relevant Cross Drainage works for the specific site conditions.
• Design, construct and maintain simple irrigation regulatory structures.

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Course Code : CEPC222
Course Title : Transportation Engineering Lab
Number of Credits : 1 (L: 0, T: 0, P: 2)
Prerequisites : NIL
Course Category : PC

Course Objectives:
Following are the objectives of this course:
• To identify the types of roads as per IRC recommendations.
• To understand the geometrical design features of different highways.
• To perform different tests on road materials.
• To identify the components of railway tracks.
List of Practicals to be performed:

<table>
<thead>
<tr>
<th>No.</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Draw the sketches showing standard cross sections of Expressways, Freeways, NH/SH, MDR/ODR</td>
</tr>
<tr>
<td>2</td>
<td>Flakiness and Elongation Index of aggregates.</td>
</tr>
<tr>
<td>3</td>
<td>Angularity Number of aggregates.</td>
</tr>
<tr>
<td>4</td>
<td>Aggregate impact test</td>
</tr>
<tr>
<td>5</td>
<td>Los Angeles Abrasion test</td>
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<tr>
<td>6</td>
<td>Aggregate crushing test</td>
</tr>
<tr>
<td>7</td>
<td>Softening point test of bitumen.</td>
</tr>
<tr>
<td>8</td>
<td>Penetration test of bitumen.</td>
</tr>
<tr>
<td>9</td>
<td>Flash and Fire Point test of bitumen.</td>
</tr>
<tr>
<td>10</td>
<td>Ductility test of Bitumen.</td>
</tr>
<tr>
<td>11</td>
<td>Visit the constructed road for visual inspection to identify defects and suggest remedial measures.</td>
</tr>
<tr>
<td>12</td>
<td>Prepare the photographic report containing details for experiment No. 11.</td>
</tr>
<tr>
<td>13</td>
<td>Visit the hill road constructed site to understand its components.</td>
</tr>
<tr>
<td>14</td>
<td>Prepare the photographic report containing details for experiment No. 13</td>
</tr>
<tr>
<td>15</td>
<td>Visit the road of any one type (flexible or rigid) to know the drainage condition.</td>
</tr>
<tr>
<td>16</td>
<td>Prepare the photographic report suggesting possible repairs and maintenance for experiment No. 15.</td>
</tr>
<tr>
<td>17</td>
<td>Visit to railway track for visual inspection of fixtures, fasteners and yards.</td>
</tr>
<tr>
<td>18</td>
<td>Prepare the photographic report containing details for experiment No. 17.</td>
</tr>
</tbody>
</table>

Suggested learning resources:

5. Birdi, Ahuja, Road, Railways, Bridge and Tunnel Engg., Standard Book House, Delhi.

Course outcomes:

After completing this course, student will be able to:

- Identify the types of roads as per IRC recommendations.
- Implement the geometrical design features of different highways.
- Perform different tests on road materials.
- Identify the components of railway tracks.
- Identify the defects in railway tracks.
PROGRAM ELECTIVE I

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CEPE202</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Precast and Prestressed Concrete</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3 (L: 3, T: 0, P: 0)</td>
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<tr>
<td>Prerequisites</td>
<td>NIL</td>
</tr>
<tr>
<td>Course Category</td>
<td>PE</td>
</tr>
</tbody>
</table>

Course Objectives:
Following are the objectives of this course:

- To introduce various types of precast and prefabricated concrete elements.
- To know advantages and disadvantages of precast and prefabricated concrete elements.
- To understand prestressing methods, systems for Reinforced Concrete members.
- To learn issues involved in design of prestressing system and loss of prestressing.

Course Content:

Unit – I Precast concrete Elements

- Advantages and disadvantages of precast concrete members
- Non-structural Precast elements - Paver blocks, Fencing Poles, Transmission Poles, Manhole Covers, Hollow and Solid Blocks, kerb stones as per relevant BIS specifications
- Structural Precast elements – tunnel linings, Canal lining, Box culvert, bridge panels, foundation, sheet piles
- Testing of Precast components as per BIS standards

Unit– II Prefabricated building

- Precast Structural Building components such as slab panels, beams, columns, footings, walls, lintels and chajjas, staircase elements,
- Prefabricated building using precast load bearing and non load bearing wall panels, floor systems - Material characteristics, Plans & Standard specifications
- Modular co-ordination, modular grid, and finishes
- Prefab systems and structural schemes and their classification including design considerations
- Joints – requirements of structural joints and their design considerations
- Manufacturing, storage, curing, transportation and erection of above elements, equipment needed

Unit– III Introduction to Prestressed Concrete

- Principles of pre-stressed concrete and basic terminology.
- Applications, advantages and disadvantages of prestressed concrete
- Materials used and their properties, Necessity of high-grade materials
- Types of Pre-stressing steel -Wire, Cable, tendon, Merits-demerits and applications
Unit– IV Methods and systems of prestressing

- Methods of prestressing – Internal and External pre-stressing, Pre and Post tensioning - applications
- Systems for pre tensioning – process, applications, merits and demerits - Hoyer system
- Systems for post-tensioning - process, applications, merits and demerits - Freyssinet system, Magnel Blaton system, Gifford Udall system.
- Prestressing force in Cable, Loss of prestress during the tensioning process - loss due to friction, length effect, wobbling effect and curvature effect, (Simple Numerical problems to determine loss of pre-stress), Loss of pre-stress at the anchoring stage.
- BIS recommendations for percentage loss in case of Pre and Post tensioning.

Unit– V Analysis and design of Prestressed rectangular beam section

- Basic assumptions in analysis of pre-stressed concrete beams.
- Cable Profile in simply supported rectangular beam section – concentric, eccentric straight and parabolic
- Effect of cable profile on maximum stresses at mid span and at support.
- Numerical problems on determination of maximum stresses at mid spans with linear (concentric and eccentric) cable profiles only.
- Simple steps involved in Design of simply supported rectangular beam section (No numerical problems)

Suggested learning resources

2. Shrikant B. Vanakudre, Prestressed Concrete, Khanna Publishing House, New Delhi
4. Indian Concrete Institute., Handbook on Precast Concrete buildings.
6. Lin, TY, Design of Pre-Stressed Concrete Structures, John Wiley and Sons, New York Nagaranjan, Pravin., Pre-stressed Concrete Structures, Pearson Education India
7. BIS, New Delhi. IS 12592 Precast Concrete Manhole Cover and Frame, BIS, New Delhi
8. BIS, New Delhi. IS 15658 Precast concrete blocks for paving - Code of Practice, BIS, New Delhi
9. BIS, New Delhi. IS 15916 Building Design and Erection Using Prefabricated Concrete - Code of Practice, BIS, New Delhi
10. BIS, New Delhi. IS 15917 Building Design and Erection Using Mixed/Composite Construction - Code of Practice, BIS, New Delhi
11. BIS, New Delhi. IS 458 Precast Concrete Pipes (with and without reinforcement) — Specification, BIS, New Delhi

Course outcomes:
After completing this course, student will be able to:
• Select the relevant precast concrete element for a given type of construction.
• Use relevant components for prefabricated structures.
• Justify the relevance of prestressed element in a given situation.
• Select relevant methods / systems for given construction work.
• Propose suitable cable profile for the given prestressed concrete members.

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<table>
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<tr>
<th>Course Code</th>
<th>CEPE204</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Construction Management</td>
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<tr>
<td>Number of Credits</td>
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<td>Prerequisites</td>
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</table>

**Course Objectives:**

Following are the objectives of this course:

- To understand the contract management and associated labour laws.
- To prepare and understand the principles involved in site layout.
- To know the procedure for scheduling of various activates in construction project.
- To understand the labour laws, procedure for arbitration, settlements.
- To know different safety measures in construction projects.

**Course Content**

**Unit – I Construction industry and management**

- Organization-objectives, principles of organization, types of organization: government/public and private construction industry, Role of various personnel in construction organization
- Agencies associated with construction work- owner, promoter, builder, designer, architects.
- Role of consultant for various activities: Preparation of Detailed Project Report (DPR), monitoring of progress and quality, settlement of disputes.

**Unit – II Site Layout**

- Principles governing site layout.
- Factors affecting site layout.
- Preparation of site layout.
- Land acquisition procedures and providing compensation.

**Unit- III Planning and scheduling**

- Identifying broad activities in construction work & allotting time to it, Methods of Scheduling, Development of bar charts, Merits & limitations of bar chart.
- Elements of Network: Event, activity, dummy activities, Precautions in drawing Network, Numbering the events.
• CPM networks, activity time estimate, Event Times by forward & backward pass calculation, start and finish time of activity, project duration. Floats: Types of Floats-Free, independent and total float, critical activities and critical path,
• Purpose of crashing a network, Normal Time and Cost, Crash Time and Cost, Cost slope, Optimization of cost and duration.
• Material Management- Ordering cost, inventory carrying cost, Economic Order Quantity
• Store management, various records related to store management, inventory control by ABC technique, Introduction to material procurement through portals (e.g. www.inampro.nic.in)

Unit IV Construction Contracts and Specifications
• Types of Construction contracts
• Contract documents, specifications, general special conditions
• Contract Management, procedures involved in arbitration and settlement (Introduction only)

Unit– V Safety in Construction
• Safety in Construction Industry—Causes of Accidents, Remedial and Preventive Measures.
• Labour Laws and Acts pertaining to Civil construction activities (Introduction only)

Suggested learning resources
5. Khanna, O.P., Industrial Engineering and management, Dhanpat Rai New Delhi
6. Punmia, B.C. and Khandelwal, K.K., Project Planning and Controlling with PERT And CPM, Laxmi Publications (P)Ltd.

Course outcomes:
After competing this course, student will be able to:
• Understand the contract management and associated labour laws.
• Prepare and understand the nuances of executing the site layout.
• Prepare networks and bar charts for the given construction project.
• Understand the intricacies of disputes, related arbitration and settlement laws.
• Apply safety measures at construction projects.
Course Code: CEPE206
Course Title: Rural Construction Technology
Number of Credits: 3 (L: 3, T: 0, P: 0)
Prerequisites: NIL
Course Category: PE

Course Objectives:
Following are the objectives of this course:
- To learn development and planning of low cost housing infrastructure.
- To know about different government schemes for rural development.
- To understand techniques for rural road construction as per IRC stipulations.
- To learn rural irrigation techniques and watershed management.

Course Contents:

Unit I - Rural Development and Planning
- Scope; development plans; various approaches to rural development planning.
- Significance of rural development.
- Rural development programme/projects.

Unit II - Rural Housing
- Low cost construction material for housing
- Composite material- ferro-cement & fly ash, autoclaved calcium silicate bricks and soil-stabilized un-burnt brick; Plinth protection of mud walls.
- Water-proof and fire-retardant roof treatment for thatch roofs. Pre-cast stone masonry, rat-trap bond for walls; Panels for roof, ferro-cement flooring/roofing units.
- Biomass - types of fuels such as firewood, agricultural residues, dung cakes.
- Renewable energy and integrated rural energy program - Objectives, Key elements, Implementation, Financial provisions, sources of renewable energy.
- Working of gobar gas and bio gas plants.

Unit III Water Supply and Sanitation for Rural Areas
- Sources of water: BIS & WHO water standards.
- Quality, Storage and distribution for rural water supply works.
- Hand pumps-types, installation, operation, and maintenance of hand pumps.
- Conservation of water - rainwater harvesting, drainage in rural areas.
- Construction of low cost latrines: Two pit pour flush water seal, septic tank etc.
- Low cost community and individual Garbage disposal systems, Ferro-cement storage tanks.

Unit IV - Low Cost Rural Roads
- Broad categories of Pavement Layers, types of Granular Sub-Bases and Bases.
- Guidelines for Surfacing of Rural Road as per relevant IRC codes.
- Pradhan Mantri Gram Sadak Yojna (PMGSY)- Highlights of Scheme.
Unit V - Low Cost Irrigation

- Design consideration and construction of tube-well, drip & sprinkler irrigation systems.
- Watershed and catchment area development – problems and features of watershed management.
- Watershed management structures - K. T. weir, Gabian Structure, Cement Plug, Contour Bunding, Farm pond, Bandhara system.

Suggested learning resources:

2. CBRI, Roorkee, Advances in Building Materials and Construction.
7. Document Published by Ministry of Rural development, Govt. of India, Ministry of Rural development.

Course outcomes:

After completing this course, student will be able to:

- Plan low cost housing using rural materials.
- Make use of relevant government schemes for construction of roads and housing.
- Use guidelines for rural road construction.
- Implement different irrigation systems for rural areas.
- Identify the need of watershed management in rural areas.

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SEMESTER V

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CEPC301</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Design of Steel and RCC Structures</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3  (L: 3, T: 0, P: 0)</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>NIL</td>
</tr>
<tr>
<td>Course Category</td>
<td>PC</td>
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</tbody>
</table>

**Course Objectives:**

Following are the objectives of this course:

- To learn the concept of limit state design for tension and compression steel members.
- To learn the concept of limit state design of steel beams.
- To understand design of RCC elements.
- To know the design of short and long RCC columns.

**Course Content:**

**Unit – I Design of Steel Tension and Compression Members (Limit State Method)**

- Types of sections used for Tension members.
- Strength of tension member by- yielding of section, rupture of net cross-section and block shear.
- Design of axially loaded single angle and double angle tension members with bolted and welded connections.
- Types of sections used as compression member, Calculation of effective length, Radius of gyration and slenderness ratio, Permissible values of slenderness ratio as per IS 800, Design compressive stress.
- Introduction to built up sections, lacing and battening (Meaning and purpose), Diagrams of single and double lacing and battening system. (No numerical problems).
- Design of axially loaded single and double angle struts connected by bolted and welded connections with gusset plate.

**Unit – II Design of Steel beams (Limit State Method)**

- Standard beam sections, Bending stress calculations.
- Design of simple I and channel section.
- Check for shear as per IS 800.

**Unit – III Design of Reinforced Concrete Beams by Limit State Method**

- Concept of Limit state, Stress block diagram, Introduction to singly and doubly reinforced sections, IS 456
- Design of singly reinforced beam, concept of under reinforced, over reinforced and balanced section, Simple numerical problem on ultimate moment of resistance and design of beam section
- Design of doubly reinforced sections, stress and strain diagrams, depth of neutral axis, simple numerical problems on ultimate moment of resistance of reinforced beam, Calculation of $A_{st}$ and $A_{sc}$.

**Unit – IV Shear, Bond and Development length in Design of RCC member**

- Nominal shear stress in RCC section, Design shear strength of concrete, Design of shear reinforcement, Minimum Shear Reinforcement, Provisions of IS 456, forms of shear reinforcement
• Types of bond, Bond stress, check for bond stress, Determination of Development length in tension and compression members and check as per codal provisions, Anchorage value of 90° hook, Lapping of bars.
• Simple numerals on: Shear reinforcement, Adequacy of section for shear.
• Introduction to serviceability limit state check

Unit– V Design of axially loaded RCC Column
• Definition and classification of column, Limit state of compression members, Effective length of column.
• Provisions of IS 456 for minimum steel, cover; maximum steel, spacing of ties etc.
• Design of axially loaded short column - Square, Rectangular, and Circular only.

Suggested learning resources:
• Dayarathnam P., Design of Steel Structures, S. Chand and Company, Delhi.
• Subramanian N., Design of Steel Structures, Oxford University Press.
• Sairam, K.S., Design of Steel Structures, Pearson Publication, Chennai, Delhi.
• Krishna Raju, and N. Pranesh, R.N., Reinforced Concrete Design Principles and Practice, New Age International, Mumbai.

Course outcomes:
After completing this course, student will be able to perform:
• Design of steel tension and compression member.
• Design of steel I and Channel sections.
• Design of singly and doubly reinforced RCC beam.
• Design of RCC beam for shear and development length.
• Design of short and long RCC columns.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CEPC303</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Estimating and Costing</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>2 (L: 2, T: 0, P: 0)</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>NIL</td>
</tr>
<tr>
<td>Course Category</td>
<td>PC</td>
</tr>
</tbody>
</table>

Course Objectives:
Following are the objectives of this course:
• To learn the procedure for estimating and costing of Civil Engineering works.
• To perform rate analysis for different items associated with construction projects.
• To use software for detailed estimate related to civil infrastructural projects.
Course Content

Unit – I Fundamentals of Estimating and Costing

- Types of estimates – Approximate and Detailed estimate.
- Types and Uses of Estimates: Revised estimate, Supplementary estimate, Repair and maintenance estimate, renovation estimate.
- Roles and responsibility of Estimator.
- Checklist of items in load bearing and framed structure.
- Modes of measurement and desired accuracy in measurements for different items of work as per IS:1200.
- Rules for deduction in different category of work as per IS:1200.
- Description / specification of items of building work as per PWD /DSR.

Unit – II Approximate Estimates

- Approximate estimate- Definition, Purpose.
- Methods of approximate estimate - Service unit method, Plinth area rate method, Cubical content method, Typical bay method, Approximate quantity method (with simple numericals)
- Approximate estimate for roads, Railways, bridges/culvert, irrigation projects and water supply projects.

Unit – III Detailed Estimate

- Detailed Estimate- Definition and Purpose, Data required for detailed estimate - Civil cost, GST, Contingencies, Supervision charges, Agency charges, Procedure for preparation of detailed estimate- Taking out quantities and Abstracting.
- Methods of Detailed Estimate- Unit quantity method and total quantity method (with simple numericals)
- Long wall and Short wall method, Centre line method.
- Bar bending schedule for footing, column, beam, Lintel, chajja and slab elements
- Provisions in detailed estimate: contingencies, work charged establishment, percentage charges, water supply and sanitary Charges and electrification charges etc.
- Prime cost, Provisional sum, Provisional quantities, Bill of quantities, Spot items or Site items.

Unit – IV Estimate for Civil Engineering Works

- Earthwork - Quantities for roads, Embankment and canal by – Mid sectional area method, mean sectional area method, Prismoideal and trapezoidal formula method.
- Detailed estimate for septic tank, Community well.
- Use of computer /softwares / programmes for detailed estimate Preparation of Civil Engineering Works.

Unit – V Rate Analysis

- Rate Analysis: Definition, purpose and importance.
- Lead (Standard and Extra), lift, overhead charges, water charges and contractors’ profit,
- Procedure for rate analysis.
- Task work: Definition, types. Task work of different skilled labour for different items.
- Categories of labours, their daily wages, types and number of labours for different items of work.
- Transportation charges of materials - Lead and Lift, Hire charges of machineries and equipments.
- Preparing rate analysis of different items of work pertaining to buildings and roads.

**Suggested learning resources**

7. PWD Schedule of Rates.
8. Ministry of Road Transport and Highways (MORT&H) Specifications and Analysis of Schedule of Rates.

**Course outcomes:**

After completing this course, a student will be able to:

- Select modes of measurements for different items of works.
- Prepare approximate estimate of a civil engineering works.
- Prepare detailed estimate of a civil engineering works.
- Use relevant software for estimating the quantities and cost of items of works.
- Justify rate for given items of work using rate analysis techniques.

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<table>
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<tr>
<th>Course Code</th>
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<td>Course Title</td>
<td>Design of Steel and RCC Structures Lab</td>
</tr>
<tr>
<td>Number of Credits</td>
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<tr>
<td>Prerequisites</td>
<td>NIL</td>
</tr>
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**Course Objectives:**

Following are the objectives of this course:

- To learn the concept of limit state design of tension and compression steel members.
- To understand design of steel beams.
- To learn the concept of limit state design of RCC beams.
- To know the limit state design of RCC columns.

**List of Practical to be performed:**

1. Draw any five commonly used rolled steel sections and five built up sections.
2. Summarize the provisions of IS 800 required for the design of tension member in report form.

3. Compile relevant clauses from IS 800 required for the design of a compression member and submit it in report form.

4. Draw sketches for single & double lacing of given built up columns.

5. Draw sketches for battening of given built up columns.

6. Prepare a report on the IS 800 provisions pertaining to design of lacing & battening along with its significance.

7. Draw cross section, strain diagram & stress diagram for singly reinforced section.

8. Draw cross section, strain diagram & stress diagram for doubly reinforced section.

9. Design simply supported I section steel beam for udl.

10. Design beams section for shear as per IS 800 provisions.

11. Draw sketches of different types of column footings.

12. Interpret the actual RCC Structural Drawings used on site with reference to reinforcement details of various structural elements.

13. Prepare a checklist for reinforcement provided from actual drawings used on site for various structural elements.

14. Prepare a detailed report of site visit for reinforcement detailing of structural elements like beams, columns, staircase & footing.

15. Prepare a detailed report of site visit for study of rolled steel tension & compression members used in various structures.

Suggested learning resources:

2. Dayarathnam, P., Design of Steel Structures, S. Chand and Company, Delhi.
3. Subramanian N., Design of Steel Structures, Oxford University Press.

Course outcomes:
After completing this course, student will be able to perform:

- Design of steel tension and compression member.
- Design of steel beams including check for shear.
- Design of singly and doubly reinforced RCC beam.
- Design of shear reinforcement in RC beams.
- Design of RCC column as per IS 456.
Course Code : CEPC307
Course Title : Estimation and Costing Lab.
Number of Credits : 1 (L: 0, T: 0, P: 2)
Prerequisites : NIL
Course Category : PC

Course Objectives:
Following are the objectives of this course:

- To learn the procedure for estimating and costing of Civil Engineering works.
- To perform rate analysis for different items associated with construction projects.
- To use software for detailed estimate related to civil infrastructural projects.

List of Practical to be performed:

1. Prepare the list of items to be executed with units for detailed estimate of a given structure from the given drawing.
2. Prepare a report on market rates for given material, labour wages, hire charges of tools & equipments required to construct the given structure as mentioned in at Serial number 1 above.
3. Study of items with specification given in the DSR (for any ten item)
4. Recording in Measurement Book (MB) for any four items
5. Prepare bill of quantities of given item from actual measurements. (any four items).
6. Prepare approximate estimate for the given civil engineering works.
7. Calculate the quantity of items of work from the given set of drawings using standard measurement sheet for load bearing residential structure using description of item from DSR (1BHK Building with staircase).
8. Prepare detailed estimate from the given set of drawings using “standard measurement and abstract format” for RCC framed structure using description of item from DSR along with face sheet and prepare quarry chart, lead statement (G+1 Building).
9. Calculate the reinforcement quantities from the given set of drawings for a room size of 3 m X 4 m with bar bending schedule (footing, column, beam, lintel with chajja, slab)
10. Prepare rate analysis for the given five item of works.
11. Prepare detailed estimate of road of one kilometre length from the given drawing.
12. Prepare detailed estimate of small Septic tank from the given set of drawings.
13. Prepare detailed estimate of well from the given set of drawing.
14. Use the relevant software to prepare detailed estimate of a Road.
15. Use the relevant software to prepare detailed estimate of a residential building.

Suggested learning resources:

7. PWD Schedule of Rates.
8. Ministry of Road Transport and Highways (MORT&H) Specifications and Analysis of Schedule of Rates.

**Course outcomes:**
After completing this course, student will be able to:

- Select modes of measurements for different items of works.
- Prepare approximate estimate of a civil engineering works.
- Prepare detailed estimate of a civil engineering works.
- Use relevant software for estimating the quantities and cost of items of works.
- Justify rate for given items of work using rate analysis techniques.

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<td>Course Title</td>
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<tr>
<td>Number of Credits</td>
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<td>Prerequisites</td>
<td>NIL</td>
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<td>Course Category</td>
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</table>

**Course Objectives:**
Following are the objectives of this course:

- To understand the issues involved in traffic flow.
- To know and understand the tools for traffic studies.
- To delineate various traffic control measures.
- To understand measures for preventing accidents.

**Course Content:**

**Unit – I Fundamentals of Traffic Engineering.**
- Traffic engineering- Definition, objects, scope
- Relationship between speed, volume and density of traffic
- Road user’s characteristics-physical, mental, emotional factors.
- Vehicular characteristics-width, length, height, weight, speed, efficiency of breaks.
- Road characteristics - gradient, curve of a road, design speed, friction between road and tyre surface.
- Reaction time - factors affecting reaction time. PIEV Theory.

**Unit – II Traffic Studies**
- Traffic volume count data- representation and analysis of data.
- Necessity of Origin and Destination study and its methods.
- Speed studies - Spot speed studies, and its presentation.
- Need and method of parking study.

**Unit – III Road Signs and Traffic Markings**
- Traffic control devices –definition, necessity, types.
- Road signs - definition, objects of road signs.
- Classification as per IRC: 67-Mandatory or Regulatory, Cautionary or warning, informatory signs, Location of cautionary or warning sign in urban and non-urban areas, Points to be considered while designing and erecting road signs.
- Traffic markings- definition, classification, carriage way, kerb, object marking and reflector markers.

Unit– IV Traffic Signals and Traffic Islands
- Traffic signals- Definition, Types, Traffic control signals, pedestrian signals.
- Types of traffic control signals - Fixed time, manually operated, traffic actuated signals and location of signals.
- Compute signal time by fix time cycle, Webster’s and IRC method and sketch timing diagram for each phase.
- Traffic islands –Definition, advantages and disadvantages of providing islands.
- Types of traffic islands - rotary or central, channelizing or Refuge Island.
- Road intersections or junctions - Definition, Types of road intersection.
- Intersection at grade- Types, basic requirements of good intersection at grade.
- Grade separated intersection- advantages and disadvantages, types - flyovers-partial and full Cloverleaf pattern, Diamond intersection, Trumpet type, underpass.

Unit– V Road Accident Studies and Arboriculture
- Road Accidents-Definition, types and causes for collision and non-collision accidents.
- Measures to prevent road accidents.
- Collision and condition diagram.
- Street lighting –definition, necessity, types-luminaire, foot candle, lumen, factors affecting their utilization and maintenance.
- Arboriculture- definition, objectives, factors affecting selection of type of trees.
- Maintenance of trees-protection and care of road side trees.

Suggested learning resources:
2. Kadiyali L.R., Transportation Engineering, Khanna Book Publishing Co., Delhi
5. Kumar R S, Introduction to Traffic Engineering, University Press (India), Pvt. Ltd.

Course outcomes:
After competing this course, student will be able to:
- Analyze road traffic characteristics.
- Undertake various types of road traffic studies.
- Use relevant road traffic signs, signal and markings.
- Identify the intersection depending on the traffic flow.
- Suggest preventive measures to avoid accidents by analyzing the traffic conditions at site.

******
Course Objectives:
Following are the objectives of this course:
- To know various sources of solid.
- To learn techniques of collection and transportation of solid waste.
- To know various methods of disposal of solid waste.
- To understand and identify different biomedical and E-waste and their subsequent disposal techniques.

Course Content:

Unit – I Introduction
- Definition of solid waste, different solid waste – domestic Waste, commercial waste, industrial waste, market waste, agricultural waste, biomedical waste, E-waste, hazardous waste, institutional waste, etc.
- Sources of solid waste, Classification of solid waste – hazardous and non-hazardous waste.
- Physical and chemical characteristics of municipal solid waste.

Unit– II Storage, Collection and Transportation of Municipal Solid Waste
- Collection, segregation, storage and transportation of solid waste.
- Tools and Equipment: Litter Bin, Broom, Shovels, Handcarts, Mechanical road sweepers, Community bin - like movable and stationary bin.
- Transportation vehicles with their working capacity - Animal carts, Auto vehicles, Tractors or Trailers, Trucks, Dumpers, Compactor vehicles. Transfer station - meaning, necessity, location.
- Role of rag pickers and their utility for society.

Unit– III Composting of Solid Waste
- Concept of composting of waste, Principles of composting process. Factors affecting the composting process.

Unit IV Techniques for Disposal of Solid Waste
- Solid waste management techniques – solid waste management hierarchy, waste prevention and waste reduction techniques
- Land filling technique, Factors to be considered for site selection, Land filling methods: Area method, Trench method and Ramp method, Leachate and its control, Biogas from landfill, Advantages and disadvantages of landfill method, Recycling of municipal solid waste
- Incineration of waste: Introduction of incineration process, Types of incinerators - Flash, Multiple chamber Incinerators, Products of incineration process with their use, Pyrolysis of waste – Definition, Methods
Unit – V Biomedical and E-waste management

- Definition of Biomedical Waste.
- Sources and generation of Biomedical Waste and its classification
- Biomedical waste Management technologies.
- Definition, varieties and ill effects of E- waste,
- Recycling and disposal of E- waste.

Suggested learning resources:
4. Sasikumar, K., Solid Waste Management, PHI learning, Delhi.
5. Hosetti, B.B., Prospect and Perspectives of Solid Waste Management, New Age International Publisher.

Course outcomes:
After competing this course, student will be able to:

- Identify the sources of solid waste.
- Select the relevant method of collection and transportation of solid waste.
- Suggest an action plan for composting of solid waste.
- Devise suitable disposal technique for solid waste.
- Use the relevant method for disposal of Bio-medical and E-waste.

Course Objectives:
Following are the objectives of this course:

- To gain knowledge on different materials in advanced construction
- To know different methods in concreting.
- To know the relevance of advanced construction methods for particular site condition.
- To identify the requisite hoisting and conveying machinery for the given situation.

Course Content:
Unit – I Advanced Construction Materials

- Fibres: Use and properties of steel, polypropylene, carbon and glass fibres.
- Plastics: Use and properties of PVC, RPVC, HDPE, FRP, GRP.
- Miscellaneous Materials: Properties and uses of acoustics materials, wall claddings, plaster boards, micro-silica, waterproofing materials, adhesives.
• Use of waste products and industrial by products in bricks, blocks, concrete and mortar.

**Unit– II Advanced Concreting Methods and Equipments**
• Vibrators for concrete consolidation: Internal, needle, surface, platform and form vibrators.
• Special concrete: procedure and uses of special concretes: Roller compacted concrete, Self-compacting concrete (SCC), Steel fibre reinforced concrete, Foam concrete, shotcreting.

**Unit– III Advanced Technology in Constructions**
• Construction of bridges and flyovers: Equipments and machineries required for foundation and super structure.
• Construction of multi-storeyed Building: Equipments and machinery required for construction of multi-storeyed building such as use of lifts, belt conveyers, pumping of concrete.
• Prefabricated construction: Methods of prefabrication, Plant fabrication and site fabrication, All prefabricated building elements such as wall panels, slab panels, beams, columns, door and window frames etc. Equipments and machineries used for placing and Jointing of prefabricated elements.
• Strengthening of embankments by soil reinforcing techniques using geo-synthetics

**Unit– IV Hoisting and Conveying Equipments**
• Conveying Equipments: Working of belt conveyers, types of belts and conveying mechanism. Capacity and use of dumpers, tractors and trucks.

**Unit– V Miscellaneous Machineries and Equipments**
• Excavation Equipments: Use, working and output of following machinery – bull dozers, scrapers, graders, Clam Shell, trenching equipment, Tunnel boring machine, Wheel mounted bel loaders, power shovels, JCB, and drag lines.
• Compacting Equipments: Output of different types of rollers such as plain rollers, ship footed rollers, vibratory, pneumatic rollers rammers.
• Miscellaneous Equipments: Working and selection of equipments: Pile driving equipments, Pile hammers, Hot mix bitumen plant, bitumen paver, grouting equipment, guniting equipments, floor polishing and cutting machine selection of drilling pattern for blasting, Bentonite/mud slurry in drilling, Explosives for blasting, Dynamite, process of using explosives.

**Suggested learning resources:**

Course outcomes:
After completing this course, student will be able to:

• Use relevant materials in advanced construction of structures.
• Use relevant method of concreting and equipment according to type of construction.
• Apply advanced construction methods for given site condition.
• Select suitable hoisting and conveying equipment for a given situation.
• Identify advanced equipment required for a particular site condition

Course Code : CEPE307
Course Title : Pavement Design and Maintenance
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : PE

Course Objectives:
Following are the objectives of this course:

• To know types of pavements and their uses.
• To learn issues in design of flexible and rigid pavements.
• To understand methods of pavement evaluation.
• To learn pavement maintenance methods.

Course Content:
Unit – I Basics of pavement Design
• Types of pavement - Flexible, Rigid and Semi Rigid
• Comparison of Rigid and flexible pavement according to Design precision, life maintenance, initial cost, stages of construction, availability of materials, surface characteristic, penetration of water in the pavement, utility location, glare and night visibility.
• Functions and characteristics of pavement.
• Factors affecting selection of type of pavement.

Unit– II Fundamentals of pavement design
• Factors affecting pavement design-design wheel load, Traffic factors, Environmental factors, Road geometry and material, Characteristics of soil and Drainage situation.
Unit– III Design overview of Flexible and Concrete pavement

- Methods of flexible pavement design-Theoretical method, Empirical method with and without soil strength test.
- IRC37 guidelines for design of flexible pavement (overview only)
- Factors affecting design of concrete pavement.
- IRC58 guidelines for design of concrete pavement (overview only)
- Joints-Need, Types, requirements, spacing of joints

Unit– IV Pavement evaluation

- Definition and purpose of pavement evaluation
- Methods of Pavement evaluation –Visual rating, Pavement serviceability index, Roughness measurements, Benkelman Beam deflection method

Unit V - Pavement Maintenance

- Types of pavement maintenance - routine, periodic, and special. Need for inspection and maintenance schedule. Causes of pavement failure and remedial measures. Typical flexible and rigid pavement failures
- Types of damages to rigid pavement - cracking, spalling, slab rocking, settlement, joint sealant failure. Methods of repair - repair of spalled joints, full depth reconstruction, replacement of dowel bars.

Suggested learning resources


Course outcomes:

After completing this course, student will be able to:

- Identify the components of the given type of pavement.
- Suggest the type of pavement for the given situation.
- Design the flexible pavement using the provisions of IRC
- Design the concrete pavement using the provisions of IRC
- Decide type of maintenance required under different damaged conditions

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Course Code : CEPE309
Course Title : Green Building and Energy Conservation
Number of Credits : 3  (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : PE

Course Objectives:
Following are the objectives of this course:

- To know various aspects of green buildings
- To use different steps involved in measuring environmental impact assessment.
- To relate the construction of green building with prevailing energy conservation policy and regulations.
- To know and identify different green building construction materials.
- To learn different rating systems and their criteria.

Course Content:

Unit I : Introduction to Green Building and Design Features

- Site selection strategies, Landscaping, building form, orientation, building envelope and fenestration, material and construction techniques, roofs, walls, fenestration and shaded finishes, advanced passive heating and cooling techniques, waste reduction during construction

Unit–II Energy Audit and Environmental Impact Assessment (EIA)

- Energy Audit: Meaning, Necessity, Procedures, Types, Energy Management Programs

Unit– III Energy and Energy conservation

- Energy conservation: Introduction, Specific objectives, present scenario, Need of energy conservation, LEED India Rating System and Energy Efficiency.

Unit– IV Green Building

- Introduction: Definition of Green building, Benefits of Green building,
- Principles: Principles and planning of Green building
- Features: Salient features of Green Building, Environmental design (ED) strategies for building construction.
- Process: Improvement in environmental quality in civil structure
• Materials: Green building materials and products- Bamboo, Rice husk ash concrete, plastic bricks, Bagasse particle board, Insulated concrete forms. Reuse of waste material- Plastic, rubber, Newspaper wood, Nontoxic paint, Green roofing

Unit V Rating System
• Introduction to (LEED) criteria,
• Indian Green Building council (IGBC) Green rating,
• Green Rating for Integrated Habitat Assessment. (GRIHA) criteria
• Heating Ventilation Air Conditioning (HVAC) unit in green Building
• Functions of Government organization working for Energy conservation and Audit(ECA)-
• National Productivity council(NPC)
• Ministry of New and Renewable Energy (MNRE)
• Bureau of Energy efficiency (BEE)

Suggested learning resources:
3. O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi

Course outcomes:
After completing this course, student will be able to:
• Identify various requirements for green building.
• Use different steps in environmental impact assessment.
• Relate the construction of green building with prevailing energy conservation policy and regulations.
• Supervise the construction of green building construction using green materials.
• Focus on criteria related to particular rating system for assessment of particular Green building.

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<tr>
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Course Objectives:

Following are the objectives of this course:

- To know the procedure for classifying various types of building services.
- To know the fire safety requirements for multi-storeyed building.
- To devise suitable plumbing system for given type of building.
- To understand the procedure for rain water harvesting and solar water heater.
- To know the system for designing lighting, ventilation and acoustics for any building.

Course Content:

Unit – I Overview of Building Services

- Introduction to building services, Classification of buildings as per National Building code, Necessity of building services, Functional requirements of building, Different types of building services i.e. HVAC (Heat, Ventilation and Air Conditioning), Escalators and lifts, fire safety, protection and control, plumbing services, rain water harvesting, solar water heating system, lighting, acoustics, sound insulation and electric installation etc.
- Role and responsibility of Building Service Engineer, Introduction to BMS (Building Management Services), Role of BMS, concept of smart building.

Unit – II Modes of vertical communication

- Objectives and modes of vertical communication in building.
- Lifts: Different types of lifts and its uses, Component parts of Lift- Lift Well, Travel, Pit, Hoist Way, Machine, Buffer, Door Locks, Suspended Rope, Lift Car, Landing Door, Call Indicators, Call Push etc., Design provisions for basic size calculation of space enclosure to accommodate lift services, Safety measures.
- Escalators: Different Types of Escalators and its Uses, Components of escalators, Design provisions for basic size calculation of space enclosure to accommodate escalator services, Safety measures.
- Ramp: Necessity, design consideration, gradient calculation, layout and Special features required for physically handicapped and elderly.

Unit – III Fire Safety

- Fire protection requirements for multi-storeyed building, causes of fire in building, Fire detecting and various extinguishing systems, Working principles of various fire protection systems.
- Safety against fire in residential and public buildings (multi-storeyed building), National Building Code provision for fire safety, Fire resisting materials and their properties, Fire resistant construction, procedures for carrying out fire safety inspections of existing buildings, Provisions for evacuation.

Unit – IV Plumbing Services

- Importance of plumbing, AHJ (Authority Having Jurisdiction) approval, Plumbing Terminology and fixtures: Terms used in plumbing, Different types of plumbing fixtures, shapes/sizes, capacities, situation and usage, Traps, Interceptors.
- System of plumbing for building water supply: storage of water, hot and cold water supply system.
- System of plumbing for building drainage: Types of drainage system such as two pipe system, one pipe system, types of Vents and purpose of venting, Concept of grey water and reclaimed water.
• Different pipe materials, and jointing methods, fittings, hanger, supports and valves used in plumbing and their suitability.

Unit– V Lighting, Ventilation and Acoustics

• Concept of SWH (Solar water heating), component parts of SWH, various system of SWH (heat transfer, propulsion, passive direct system, active direct system, Do-it-yourself), installation and maintenance.
• Concept of lighting, types of lighting (natural and artificial), factors influencing the brightness of room, factors affecting selection of artificial lighting, installation of light (direct, half-direct, indirect, half-indirect and direct-indirect), types of light control (manual switch, remote switch, timer switch and photo-electric cell switch), types of lamps (incandescent, tungsten halogen and electric discharge), Lamp selection as per room sizes.
• Concept of ventilation, necessity and Types of ventilation.
• Building Acoustic, Objectives, acoustic Control in a building, acoustic material (porous absorber and cavity resonator)

Suggested learning resources:

1. Patil, S. M., Building Services, Seema Publication, Mumbai.
4. Deolalikar, S. G., Plumbing Design and Practice, McGraw-Hill,
8. BIS., National Building Code Part1, 4, 8, 9., Bureau of Indian Standard, New Delhi
10. BIS., 2008 Uniform plumbing code – India (UPC-I ), Bureau of Indian Standard

Course outcomes:

After completing this course, student will be able to:

• Classify various types of building services as per functional requirements.
• Propose the fire safety requirements for multi-storeyed building.
• Devise suitable water supply and sanitation system for given type of building.
• Evaluate the potential of rain water harvesting and solar water heater system for the given type of building.
• Justify the necessity of designing the system of lighting, ventilation and acoustics for the given type of building.

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SEMESTER VI

Course Code : CEPC302
Course Title : Public Health Engineering
Number of Credits : 2   (L: 2, T: 0, P: 0)
Prerequisites : NIL
Course Category : PC

Course Objectives:
Following are the objectives of this course:

- To learn the principles for identification of sources of surface and subsurface water
- To learn calculation of population and requirement of drinking water
- To understand the plotting of water supply scheme highlighting different features
- To know evaluation of characteristics and treatment of sewage.

Course Content

Unit – I Sources, Demand and Quality of water
- Water supply schemes - Objectives, components,
- Sources of water: Surface and Subsurface sources of water, Intake Structures, Definition and types, Factors governing the location of an intake structure, Types of intakes.
- Demand of water: Factors affecting rate of demand, Variations of water demands, Forecasting of population, Methods of forecasting of population, (Simple problems on forecasting of population), Design period, Estimating of quantity of water supply required for city or town.
- Quality of water: Need for analysis of water, Characteristics of water- Physical, Chemical and Biological, Testing of water for Total solids, hardness, chlorides, dissolved Oxygen, pH, Fluoride, Nitrogen and its compounds, Bacteriological tests, E coli, B coli index, MPN, Sampling of water, Water quality standards as per IS 10500.

UNIT II Purification of water
- Purification of Water: Objectives of water treatment, Aeration- objects and methods of aeration, Plain sedimentation, Sedimentation with coagulation, principles of coagulation, types of coagulants, Jar Test, process of coagulation, types of sedimentation tanks, Clariflocculator.
- Miscellaneous water Treatments: Introduction to water softening, Defluoridation techniques.

UNIT III Conveyance and Distribution of water
- Conveyance: Types of Pipes used for conveyance of water, choice of pipe material, Types of joints & Types of valves- their use, location and function on a pipeline.
- Distribution of water: Methods of distribution of water- Gravity, pumping, and combined system, Service reservoirs - functions and types, Layouts of distribution of Water-Dead end system, grid iron system, circular system, radial system; their suitability, advantages and disadvantages.

UNIT IV Domestic sewage and System of Sewerages
- Building Sanitation: Necessity of sanitation, Necessity to treat domestic sewage, Definitions - Sewage, sullage, types of sewage. Definition of the terms related to Building Sanitation-

- Systems of Sewerage and Sewer Appurtenances: Types of Sewers, Systems of sewerage, self-cleansing velocity and non-scouring velocity, Laying, Testing and maintenance of sewers, Manholes and Drop Manhole-component parts, location, spacing, construction details, Sewer Inlets, Street Inlets.

UNIT V Characteristics and treatment of Sewage


Suggested learning resources

4. Gupta, O.P., Elements of Environmental Pollution Control, Khanna Publishing House, Delhi
5. Rao, C.S., Environmental Pollution Control Engineering, New Age International

Course outcomes:
After competing this course, student will be able to:

- Know the procedure to identify the sources of surface and subsurface water
- Estimate the quantity of drinking water required for a population
- Draw labelled layout for water supply scheme.
- Device suitable water treatment technique.
- Evaluate the characteristics and suggest treatment of sewage.

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<td>Course Title</td>
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Course Objectives:
Following are the objectives of this course:

- To learn the tests for measuring quality of drinking water.
- To learn determination of BOD and COD requirement in sewage.
- To understand the plotting of water supply scheme highlighting different features.
List of Practical to be performed:

1. Determine pH value of given sample of water.
2. Determine the turbidity of the given sample of water.
3. Determine residual chlorine in a given sample of water.
4. Determine suspended, dissolved solids and total solids of given sample of water.
5. Determine the dissolved oxygen in a sample of water.
6. Undertake a field visit to water treatment plant and prepare a report.
7. Determine the optimum dose of coagulant in a given raw water sample by jar test.
8. Draw sketches of various valves used in water supply pipe line.
9. Draw a sketch of one pipe and two pipe system of plumbing.
11. Determine pH value of given sample of sewage.
12. Determine suspended solids dissolved and total solids for sample of sewage.
13. Determine the dissolved oxygen in the given sample of sewage.
15. Prepare a report of a field visit to sewage treatment plant.

Suggested learning resources:

4. Gupta, O.P., Elements of Environmental Pollution Control, Khanna Publishing House, Delhi
5. Rao, C.S., Environmental Pollution Control Engineering, New Age International

Course outcomes:

After completing this course, student will be able to:

- Perform various tests to assess quality of water.
- Estimate dissolved solids as per BIS codes.
- Measure BOD and COD of sewage sample.
- Draw line diagram of water pipeline system for a locality.

Course Code : CEPE302
Course Title : Repairs and Maintenance of Structures
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : PE

Course Objectives:

Following are the objectives of this course:

- To learn about types of maintenance techniques
- To understand causes of various types of damages.
To know about relevant materials for repair.
To learn methods of retrofitting for different structures.

Course Content:

Unit – I Basics of maintenance
• Types of Maintenances - repair, retrofitting, re-strengthening, rehabilitation and restoration.
• Necessity, objectives and importance of maintenance.
• Approach of effective management for maintenance.
• Periodical maintenance: check list, maintenance manual containing building plan, reinforcement details, material sources, maintenance frequency, corrective maintenance procedures and sources. Pre- and post- monsoon maintenance.

Unit – II Causes and detection of damages
• Causes of damages due to distress, earthquake, wind, flood, dampness, corrosion, fire, deterioration, termites, pollution and foundation settlement.
• Various aspects of visual observations for detection of damages.
• Load test and non-destructive tests (brief description). NDT tests on damaged structure such as rebound hammer, ultrasonic pulse velocity, rebar locator, crack detection microscope, digital crack measuring gauge.
• Chemical test - Chloride test, sulphate attack, carbonation test, pH measurement, resistivity method, Half-cell potential meter (Introduction and demonstration only).

Unit – III Materials for maintenance and repairs
• Types of repair material, material selection.
• Essential parameters for maintenance and repair materials such - bond with substrate, durability.
• Waterproofing materials based on polymer modified cement slurry, UV resistant acrylic polymer, ferro-cement.
• Repairing materials for masonry: plastic/aluminum nipples, non-shrink cement, polyester putty or 1:3 cement sand mortar, galvanized steel wire fabrics and clamping rods, wire nails, ferro-cement plates.
• Repairing materials for RCC: epoxy resins, epoxy mortar, cement mortar impregnated with polypropylene, silicon, polymer concrete composites, sealants, fiber reinforcement concrete, emulsions and paints.

Unit – IV Maintenance and repair methods for masonry Construction
• Causes of cracks in walls - bulging of wall, shrinkage, bonding, shear, tensile, vegetation.
• Probable crack location: junction of main and cross wall, junction of slab and wall, cracks in masonry joints.
• Repair methods based on crack type - For minor & medium cracks (width 0.5 mm to 5mm): grouting and for major cracks (width more than 5mm): fixing mesh across cracks, RCC band, installing ferro-cement plates at corners, dowel bars, propping of load bearing.
• Remedial measures for dampness & efflorescence in wall.

Unit – V Maintenance and repair methods for RCC Construction
• Repair stages such as concrete removal and surface preparation, fixing suitable formwork, bonding/passive coat and repair application, various methods of surface preparation.
• Repair options such as grouting, patch repairs, carbonated concrete, cleaning the corroded steel, concrete overlays, latex concrete, epoxy bonded mortar and concrete, polymer concrete, corrosion protection such as jacketing.

• Building cracks and its prevention, common methods for dormant crack repairs such as Epoxy injection, grooving and sealing, stitching, grouting and guniting/shotcreting.

• Strengthening methods for live cracks such as addition of reinforcements, jacketing, brackets, collars, supplementary members i.e. shoring, underpinning and propping of framed structure.

Suggested learning resources:
2. Guha, P. K., Maintenance and Repairs of Buildings, New Central Book Agencies
3. Hutchin Son, B. D., Maintenance and Repairs of Buildings, Newnes-Butterworth
4. Relevant BIS codes

Course outcomes:
After completing this course, student will be able to:
• Decide which type of maintenance is needed for a given damaged structure
• Assess causes of damages various types of structures.
• Select the relevant material for repair of the given structure.
• Apply relevant method of retrofitting for re-strengthening of structures.
• Suggest relevant technique to restore the damages of the given structural elements.

Course Code : CEPE304
Course Title : Advanced Design of Structures
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : PE

Course Objectives:
Following are the objectives of this course:
• To understand the concepts involved in the design of riveted and welded connections.
• To know the provisions of BIS code for design of built up sections.
• To analyze T and L shaped beam sections.
• To understand the concept for design of one way and two way slabs.
• To identify short and long columns and their design provisions.

Course Content:
Unit – I Design of connections in steel structures
• Types of rivets, Riveted connections, Strength of riveted joints, Design of riveted joints for axially loaded members.
• Types of weld, welded connections, Permissible stresses in weld, Strength of weld. Advantages and disadvantages of weld, Design of fillet weld and butt weld for axial load.
• Design of column bases for axially loaded columns only.
Unit– II Steel Beams
- Different steel sections, Simple and built up sections, Permissible bending stresses,
- Design of built up sections (symmetrical I section with cover plates only), check for shear and deflection
- Introduction to plate girder: Components and functions (no numericals)

Unit– III Design of RC flanged beam
- General features of T and L beams, Advantages, Effective width as per BIS 456
- Design of singly reinforcement T beam, Stress and Strain diagram, Depth of neutral axis, Moment of resistance, T and L beams with neutral axis in flange only.
- Simple numericals on location of neutral axis, Effective width of flange.

Unit– IV Design of slab
- Design of simply supported one-way slab for flexure, shear and deflection and checks, as per the provisions of BIS 456
- Design of one-way cantilever slab, Chajjas, Flexure including checks for Development length and Shear stress.
- Design of two-way simply supported slab,
- Introduction to design of dog-legged staircases.

Unit– V Design of RCC Column and Footing design: Uni-axial bending
- IS 456 provisions, Column with uni-axial moment, Effective length calculations, Minimum eccentricity
- Design of footing for axially loaded column only.

Suggested learning resources:
2. Dayarathnam, P., Design of Steel Structures, S. Chand and Company, New Delhi.
3. Subramanian N., Design of Steel Structures, Oxford University Press.

Course outcomes:
After competing this course, student will be able to perform:
- Design of riveted and welded connections.
- Design of built up sections.
- Design of T and L shaped beam sections.
- Design of one way and two way slabs.
- Design of RCC column and isolated footings.

******
Course Code : CEPE306
Course Title : Tendering and Accounts
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : PC

Course Objectives:
Following are the objectives of this course:

- To understand terminologies in contract and tender document and their significance.
- To know different types of contracts and their uses.
- To learn preparation of typical Tender documents for civil engineering work.
- To get acquainted with rent fixation and valuation of civil structures.

Course Content:

Unit – I Procedure to execute the work
Administrative approval, Technical sanction, budget provision, expenditure sanction.
Methods for carrying out works- contract method, departmental method -rate list method, piece work method, day’s work method, employing labours on daily wages basis.

Unit – II Contracts
- Types of engineering contract with advantages, disadvantages and their suitability - Lump sum contract, item rate contract, percentage rate contract, cost plus percentage, cost plus fixed fee, cost plus variable percentage and cost plus variable fee contract, labour contract, demolition contract, target contract, negotiated contract, Engineering Procurement Construction Contract (EPC), Annuity Contract.
- Introduction of FIDIC Conditions of contract.
- Classification of contractor on basis of financial limits, Requirement of documents for registration of contractor.
- Build Operate Transfer (BOT) Project, BOT Toll contract, BOT (Annuity) contract, Design, Build, Finance, Operate and Transfer (DBFOT) contract, Hybrid Annuity contract, Operate Maintain and Transfer (OMT) contract, Operation & Maintenance contract (Introduction only).

Unit– III Tender and Tender Documents
- Definition of tender, necessity of tender, types of tender- Local, Global, Limited.
- Notice to invite tender (NIT)- Points to be included while drafting tender notice, Drafting of tender notice.
- Procedure of submitting filled tender Documents (Two envelope system), procedure of opening tender, comparative statement, scrutiny of tenders, award of contract, letter of award.
- Meaning of terms - Earnest Money Deposit (EMD), Performance Security Deposit, Validity period, corrigendum to tender notice and its necessity, Unbalanced bid.
- Tender documents – Index, tender notice, general instructions, special instructions, Schedule A, Schedule B, Schedule C etc.
• Terms related to tender documents – contract conditions- time limit, time extension, penalty, defective material and workmanship, termination of contract, suspension of work, subletting of contract, extra items, price variation clause (escalation), defect liability Period, liquidated Damages.

• Arbitration- Meaning, Qualification of an arbitrator, Appointment, Dispute and Settlement of disputes, Arbitration and Conciliation Act, Arbitration award.

Unit– IV Accounts
• Mode of Payment to the contractor and its necessity -Interim Payment, Advance Payment Secured Advance, Petty advance, Mobilization advance, Running account bill, Final bill, Retention money, E - payment.

Unit– V Introduction to Valuation
• Definition and purpose of Valuation, role of valuer. Definition - Cost, Price and Value, Characteristics of Value, Factors Affecting Value.
• Types of Value - Book Value, Scrap Value, Salvage Value, Speculative Value, Distress Value, Market Value, monopoly Value, Sentimental Value. Factors affecting value.
• Fixation of rent, Lease – types of lease, lease hold property and free hold property. Mortgage – Mortgage deed, precautions to be taken while making mortgage.

Suggested learning resources:
5. Patil, B. S., Civil Engineering Contracts and Estimates, Orient Longman, Mumbai

Course outcomes:
After completing this course, student will be able to:
• Understand various types of contract and when they are used
• Suggest the relevant type of contract for the given civil engineering work.
• Prepare the typical Tender document for the given civil engineering work.
• Decide type of payment for the executed work.
• Justify the rent fixation and valuation of given civil structure.

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CHAPTER 4

Electrical Engineering Curriculum Structure
(III to VI Semesters)
### 4.1 List of Programme Core Courses [PC]

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<th>Course Code</th>
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**Note:** ^one credit is carried forward from the Vth semester major project evaluation.
Course Code: EEPC201
Course Title: INTRODUCTION TO ELECTRIC GENERATION SYSTEMS
Number of Credits: 3 (L: 3, T: 0, P: 0)
Prerequisites: NIL
Course Category: PC

Course Objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain the efficient operation of various electric power generating plants.

Course Contents:

Unit – I Thermal Power Plants: Coal, Gas/ Diesel and Nuclear-based

- Layout and working of a typical thermal power plant with steam turbines and electric generators.
- Properties of conventional fuels used in the energy conversion equipment used in thermal power plants: Coal, Gas/ diesel, Nuclear fuels –fusion and fission action
- Safe Practices and working of various thermal power plants: coal-based, gas-based, diesel-based, nuclear-based.
- Functions of the following types of thermal power plants and their major auxiliaries:
  - Coal fired boilers: fire tube and water tube.
  - Gas/diesel based combustion engines
  - Types of nuclear reactors: Disposal of nuclear waste and nuclear shielding.
- Thermal power plants in Maharashtra.

Unit – II Large and Micro-Hydro Power Plants

- Energy conversion process of hydro power plant.
- Classification of hydro power plant: High, medium and low head.
- Construction and working of hydro turbines used in different types of hydro power plant:
  a. High head – Pelton turbine
  b. Medium head – Francis turbine
  c. Low head – Kaplan turbine.
- Safe Practices for hydro power plants.
- Different types of micro- hydro turbines for different heads: Pelton, Francis and Kaplan turbines
- Locations of these different types of large and micro-hydro power plants in Maharashtra
- Potential locations of micro-hydro power plants in Maharashtra.

Unit – III Solar and Biomass based Power Plants

Solar Power Technology

Biomass-based Power Plants
   a. Layout of a Bio-chemical based (e.g. biogas) power plant:
   b. Layout of a Thermo-chemical based (e.g. Municipal waste) power plant
   c. Layout of an Agro-chemical based (e.g. bio-diesel) power plant
      Features of the solid, liquid and gas biomasses as fuel for biomass power plant.

Unit– IV    Wind Power Plants
   Wind Map of India: Wind power density in watts per square meter
   Layout of Horizontal axis large wind power plant:
      Geared wind power plant.
      Direct-drive wind power plant.
   Salient Features of electric generators used in large wind power plants:
      Constant Speed Electric Generators: Squirrel Cage Induction Generators (SCIG), Wound Rotor Induction Generator (WRIG)
      Variable Speed Electric Generators: Doubly-fed induction generator (DFIG), wound rotor synchronous generator (WRSG), permanent magnet synchronous generator (PMSG)

Unit– V   Economics of Power Generation and Interconnected Power System
   Related terms: connected load, firm power, cold reserve, hot reserve, spinning reserve. Base load and peak load plants; Load curve, load duration curve, integrated duration curve
   Cost of generation: Average demand, maximum demand, demand factor, plant capacity factor, plant use factor, diversity factor, load factor and plant load factor.
   Choice of size and number of generator units, combined operation of power station.
   Causes and Impact and reasons of Grid system fault: State grid, national grid, brownout and black out; sample blackouts at national and international level

References:
3. Gupta, B.R., Generation of Electrical Energy, S. Chand & Co. New Delhi,
Course Outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Maintain the optimised working of the thermal power plant.
b) Maintain the optimised working of large and micro hydro power plants.
c) Maintain the optimised working of solar and biomass-based power plants.
d) Maintain the optimised working of wind power plants.
e) Select the adequate mix of power generation based on economic operation.

Course Objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain the efficient operation of various electric power generating plants.

Practicals:
1. Identify the routine maintenance parts of the coal fired thermal power plant after watching a video programme
2. Identify the routine maintenance parts of the gas fired thermal power plant after watching a video programme
3. Assemble and dismantle a small diesel generator power plant.
4. Identify the routine maintenance parts of the nuclear fired thermal power plant after watching a video programme.
5. Identify the routine maintenance parts of the large hydro power plant after watching a video programme.
6. Identify the routine maintenance parts of the micro hydro power plant after watching a video programme.
7. Assemble a micro hydro power plant and then dismantle it.
8. Assemble the parabolic trough or parabolic dish Concentrated Solar Power (CSP) plant.
9. Dismantle the parabolic trough or parabolic dish CSP plant.
10. Assemble the solar PV plant to produce electric power and then dismantle it.
11. Assemble a small biogas plant to generate electric power.
12. Dismantle the biogas plant.
13. Identify the routine maintenance parts of the large wind power plant after watching a video programme.
14. Assemble a horizontal axis small wind turbine to produce electric power.
15. Dismantle a horizontal axis small wind turbine.
16. Assemble a vertical axis small wind turbine to produce electric power and then dismantle it.
17. Identify the routine maintenance parts of the horizontal axis small wind turbine after watching a video programme.
18. Identify the routine maintenance parts of the vertical axis small wind turbine after watching a video programme.

Course Outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:
   a) Maintain the optimised working of the thermal power plant.
   b) Maintain the optimised working of large and micro hydro power plants.
   c) Maintain the optimised working of solar and biomass-based power plants.
   d) Maintain the optimised working of wind power plants.
   e) Select the adequate mix of power generation based on economic operation.

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<tr>
<td>Course Title</td>
<td>: ELECTRIC CIRCUITS</td>
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<tr>
<td>Number of Credits</td>
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Course Objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:
   • Maintain electrical systems applying AC and DC circuit fundamentals.

Course Contents:

Unit – I Single Phase A.C Series Circuits
   Generation of alternating voltage, Phasor representation of sinusoidal quantities
   R, L, C circuit elements its voltage and current response
   R-L, R-C, R-L-C combination of A.C series circuit, impedance, reactance, impedance
triangle, Power factor, active power, reactive power, apparent power, power
triangle and vector diagram
Resonance, Bandwidth, Quality factor and voltage magnification in series R-L, R-C, R-
L-C circuit

Unit – II Single Phase A.C Parallel Circuits
R-L, R-C and R-L-C parallel combination of A.C. circuits. Impedance, reactance, phasor diagram,
impedance triangle
R-L, R-C, R-L-C parallel A.C. circuits power factor, active power, apparent power, reactive power,
power triangle
Resonance in parallel R-L, R-C, R-L-C circuit, Bandwidth, Quality factor and voltage magnification

Unit– III Three Phase Circuits
Phasor and complex representation of three phase supply
Phase sequence and polarity
Types of three-phase connections, Phase and line quantities in three phase star and
delta system
Balanced and unbalanced load, neutral shift in unbalanced load
Three phase power, active, reactive and apparent power in star and delta system.

Unit– IV Network Reduction and Principles of Circuit Analysis
Source transformation
Star/delta and delta/star transformation
Mesh Analysis
Node Analysis

Unit– V Network Theorems
Superposition theorem.
Thevenin's theorem.
Norton's theorem
Maximum power transfer theorem
Reciprocity theorem
Duality in electric circuits

References:
4. Theraja, B. L.: Theraja, A. K; A Text Book of Electrical Technology Vol-I, S. Chand & Co. Ram-
nagar, New Delhi, ISBN : 9788121924405

Course Outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Troubleshoot problems related to single phase A.C series circuits.
b) Troubleshoot problems related to single phase A.C parallel circuits.
c) Troubleshoot problems related to three phase circuits.
d) Use principles of circuit analysis to troubleshoot electric circuits.
e) Apply network theorems to troubleshoot electric circuits.

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<td>Course Title</td>
<td>ELECTRIC CIRCUITS LABORATORY</td>
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Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain electrical systems applying AC and DC circuit fundamentals.

Practicals:
1. Use dual trace oscilloscope to determine A.C voltage and current response in given R, L, C circuit.
2. Use voltmeter, ammeter, wattmeter to determine active, reactive and apparent power consumed in given R-L series circuit. Draw phasor diagram.
3. Use voltmeter, ammeter to determine active, reactive and apparent power consumed in given R-C series circuit. Draw phasor diagram.
4. Use voltmeter, ammeter, wattmeter to determine active, reactive and apparent power consumed in given R-L-C series circuit. Draw phasor diagram.
5. Use variable frequency supply to create resonance in given series R-L-C circuit or by using variable inductor or variable capacitor.
6. Use voltmeter, ammeter, wattmeter to determine current, p.f., active, reactive and apparent power in R-C parallel A.C. circuit.

7. Use voltmeter, ammeter, wattmeter, p.f meter to determine current, p.f., active, reactive and apparent power for given R-L-C parallel circuit with series connection of resistor and inductor in parallel with capacitor.

8. Use variable frequency supply create resonance in given parallel R-L-C circuit or by using variable inductor or capacitor.

9. Use voltmeter, ammeter, wattmeter, p.f meter to determine line and phase quantities of voltage and current for balanced three phase star and delta connected load and calculate active, reactive, and apparent power. Draw phasor diagram.

10. Use voltmeter, ammeter, wattmeter, p.f meter to determine line and phase quantities of voltage and current for unbalanced three phase star and delta connected load and calculate active, reactive, and apparent power. Draw phasor diagram.

11. Use voltmeter, ammeter to determine current through the given branch of an electric network by applying mesh analysis.

12. Use voltmeter, ammeter to determine current through the given branch of an electric network by applying node analysis.

13. Use voltmeter, ammeter to determine current through the given branch and voltage across the given element of circuit by applying superposition theorem.

14. Use voltmeter, ammeter to determine equivalent circuit parameter in a given circuit by applying Thevenin’s theorem

15. Use voltmeter, ammeter to determine equivalent circuit parameter in a given circuit by applying Norton’s theorem

16. Use voltmeter, ammeter to determine load resistance for maximum power transfer for a given circuit by applying maximum power transfer theorem.

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Troubleshoot problems related to single phase A.C series circuits.

b) Troubleshoot problems related to single phase A.C parallel circuits.

c) Troubleshoot problems related to three phase circuits.

d) Use principles of circuit analysis to troubleshoot electric circuits.

e) Apply network theorems to troubleshoot electric circuits.

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<td>ELECTRICAL AND ELECTRONIC MEASUREMENTS</td>
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Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

• Use relevant measuring instrument in different electrical applications.
Course contents:

**Unit – I Fundamentals of Measurements**
- Measurement: Significance, units, fundamental quantities and standards
- Classification of Instrument Systems:
  - Null and deflection type instruments
  - Absolute and secondary instruments
  - Analog and digital instruments
- Static and dynamic characteristics, types of errors
- Calibration: need and procedure
- Classification of measuring instruments: indicating, recording and integrating instruments.
- Essential requirements of an indicating instruments

**Unit – II Measurement of voltage and current**
- DC Ammeter: Basic, Multi range, Universal shunt,
- DC Voltmeter: Basic, Multi-range, concept of loading effect and sensitivity
- AC voltmeter: Rectifier type (half wave and full wave)
- CT and PT: construction, working and applications.
- Clamp-on meter:

**Unit– III Measurement of Electric Power**
- Analog meters: Permanent magnet moving coil (PMMC) and Permanent magnet moving iron (PMMI) meter, their construction, working, salient features, merits and demerits
- Dynamometer type wattmeter: Construction and working
- Range: Multiplying factor and extension of range using CT and PT
- Errors and compensations.
- Active and reactive power measurement: One, two and three wattmeter method.
- Effect of Power factor on wattmeter reading in two wattmeter method.
- Maximum Demand indicator

**Unit– IV Measurement of Electric Energy**
- Single and three phase electronic energy meter: Constructional features and working principle.
- Errors and their compensations.
- Calibration of single phase electronic energy meter using direct loading.

**Unit– V Circuit Parameter Measurement, CRO and Other Meters**
- Measurement of resistance:
  - Low resistance: Kelvin’s double bridge,
  - Medium Resistance: Voltmeter and ammeter method
High resistance: Megger and Ohm meter: Series and shunt
Measurement of inductance using Anderson bridge (no derivation and phasor diagram)
Measurement of capacitance using Schering bridge (no derivation and phasor diagram)
Single beam/single trace CRO, Digital storage Oscilloscope: Basic block diagram, working, Cathode ray tube, electrostatic deflection, vertical amplifier, time base generator, horizontal amplifier, measurement of voltage/ amplitude/ time period/ frequency/ phase angle delay line, specifications.
Other meters: Earth tester, Digital Multimeter; L-C-R meter, Frequency meter (ferromagnetic and Weston type), Phase sequence indicator, power factor meter (single phase and three phase dynamometer type), Synchro scope, Tri-vector meter
Signal generator: need, working and basic block diagram.
Function generator: need, working and basic block diagram, function of symmetry.

References:
5. Sawhney A.K., Electrical and Electronics Measurements and Instrumentation, Dhanpai Rai and Sons,New Delhi, ISBN : 9780000279744

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Check the working of the electrical measuring instrument.
b) Use different types of measuring instruments for measuring voltage and current.
c) Use different types of measuring instruments for measuring electric power
d) Use different types of measuring instruments for measuring electric energy.
c) Use different types of electrical instruments for measuring various ranges of electrical parameters.

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Course Code : EEPC211
Course Title : ELECTRICAL AND ELECTRONIC MEASUREMENTS LABORATORY
Number of Credits : 1 (L: 0, T: 0, P: 2)
Prerequisites : NIL
Course Category : PC

Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Use relevant measuring instrument in different electrical applications.

Practicals:

1. Identify measuring instruments on the basis of symbols on dial, type, accuracy, class position and scale.
2. Identify the components of PMMC and MI instruments.
3. Troubleshoot PMMC and MI instruments.
4. Measure AC and DC quantities in a working circuit.
5. Extend range of ammeter and voltmeter by using (i) shunt and multiplier (ii) CT and PT.
6. Use Clamp-on meter for measurement of AC/DC current, AC/DC voltage.
7. Use electro-dynamic watt-meter for measurement of power in a single phase circuit.
8. Troubleshoot electrodynamic watt-meter for measurement of power in a single phase circuit.
9. Use single wattmeter for measurement of active and reactive power of three phase balanced load.
10. Use two watt-meters for measuring active power of three-phase balanced load.
11. Calibrate single phase electronic energy meter by direct loading.
12. Troubleshoot single phase electronic energy meter.
13. Use digital multi-meter for measurement of AC/DC current, AC/DC voltage.
14. Use Kelvin’s double bridge for measurement of low resistance.
15. Use voltmeter and ammeter method for measurement of medium resistance.
16. Use Megger for insulation resistance measurements.
17. Use earth tester for measurement of earth resistance.
18. Use CRO for the Measurement of supply frequency in single-phase circuit.
19. Use Tri-vector meter for measuring kW, kVAR and kVA of a power line.

COURSE OUTCOMES:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Check the working of the electrical measuring instrument.
b) Use different types of measuring instruments for measuring voltage and current.
c) Use different types of measuring instruments for measuring electric power.
d) Use different types of measuring instruments for measuring electric energy.

e) Use different types of electrical instruments for measuring electrical parameters of various ranges.

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<th>Course Code</th>
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<tr>
<td>Course Title</td>
<td>ELECTRIC MOTORS AND TRANSFORMERS</td>
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<td>Number of Credits</td>
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**Course objectives:**

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain electric motors and transformers.

**Course contents**

**Unit – I DC Generators**

DC generator: construction, parts, materials and their functions.

Principle of operation of DC generator: Fleming’s right hand rule, schematic diagrams, e.m.f. equation of generator, armature reaction, commutation and.

Applications of DC generators. Classification of measuring instruments: indicating, recording and integrating instruments.

**Unit – II D.C. Motors**

DC motor: Types of DC motors. Fleming’s left hand rule, Principle of operation of, Back e.m.f. and its significance, Voltage equation of DC motor.

Torque and Speed; Armature torque, Shaft torque, BHP, Brake test, losses, efficiency.

DC motor starters: Necessity, two point and three point starters.

Speed control of DC shunt and series motor: Flux and Armature control.

Brushless DC Motor: Construction and working.

**Unit – III Single Phase Transformers**

Types of transformers: Shell type and core type; Construction: Parts and functions, materials used for different parts: CRGO, CRNGO, HRGO, amorphous cores,

Transformer: Principle of operation, EMF equation of transformer: Derivation, Voltage transformation ratio,

Significance of transformer ratings

Transformer No-load and on-load phasor diagram, Leakage reactance,

Equivalent circuit of transformer: Equivalent resistance and reactance.

Voltage regulation and Efficiency: Direct loading, OC/SC method, All day efficiency.

**Unit – IV Three Phase Transformers**

Bank of three single phase transformers, Single unit of three phase transformer Distribution
and Power transformers.
Construction, cooling, Three phase transformers connections as per IS:2026 (part IV)-1977, Three phase to two phase conversion (Scott Connection),
Selection of transformer as per IS: 10028 (Part I)-1985, Criteria for selection of distribution transformer, and power transformer, Amorphous Core type
Distribution Transformer; Specifications of three-phase distribution transformers as per IS:1180 (part I)-1989
Need of parallel operation of three phase transformer, Conditions for parallel operation.
Polarity tests on mutually inductive coils and single phase transformers;
Polarity test, Phasing out test on Three-phase transformer.

**Unit– V Special Purpose Transformers**

Single phase and three phase auto transformers: Construction, working and applications.
Instrument Transformers: Construction, working and applications of Current transformer and Potential transformer.
Isolation transformer: Constructional Features and applications.
Single phase welding transformer: constructional features and applications.
Pulse transformer: constructional features and applications.
‘K’ factor of transformers: overheating due to non-linear loads and harmonics.

**References:**

8. Murugesh Kumar, K., DC Machines and Transformers, ISBN: 9788125916055

**Course outcomes:**
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Maintain different types of DC generators.
b) Maintain different types of DC motors.
c) Maintain single phase transformer.
d) Maintain three phase transformers.
e) Maintain different types of special purpose transformers used in different applications.

Course Code : EEPC215  
Course Title : ELECTRIC MOTORS AND TRANSFORMERS LABORATORY  
Number of Credits : 1 (L: 0, T: 0, P: 2)  
Prerequisites : NIL  
Course Category : PC

Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:
- Use electric motors and transformers.

Practicals:
1. Dismantle a DC machine.
2. Reverse the direction of rotation of the DC shunt motor.
3. Perform brake test on DC shunt motor.
4. Control the speed of DC shunt motor by different methods.
5. Control the speed of DC series motor by different methods.
6. Perform the brake test on DC series motor.
7. Check the functioning of single phase transformer.
8. Determine regulation and efficiency of single phase transformer by direct loading.
10. Perform parallel operation of two single phase transformers to determine the load current sharing.
11. Perform parallel operation of two single phase transformers and determine the apparent and real power load sharing.
12. Perform polarity test on a single phase transformer whose polarity markings are masked.
13. Perform phasing out test on a three phase transformer whose phase markings are masked.
14. Connect the auto-transformer in step-up and step-down modes noting the input/output readings.
15. Check the functioning of the CT, PT and isolation transformer.
16. Test the pulse transformer.
Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Maintain different types of DC generators.
b) Maintain different types of DC motors.
c) Maintain single phase transformer.
d) Maintain three phase transformers.
e) Maintain different types of special purpose transformers used in different applications.

Course Code : EEPC217
Course Title : Renewable Energy Power Plants
Number of Credits : 3  (L: 3, T: 0, P: 0)
Prerequisites (Course code) : NIL
Course Category : PC

Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain the efficient operation of various types of renewable energy power plants.

Course contents:

Unit – I Solar PV and Concentrated Solar Power Plants
Solar Map of India: Global solar power radiation, Solar PV
Concentrated Solar Power (CSP) plants, construction and working of: Power Tower, Parabolic Trough, Parabolic Dish, Fresnel Reflectors
Solar Photovoltaic (PV) power plant: components layout, construction, working.
Rooftop solar PV power system

Unit – II Large Wind Power Plants
Wind Map of India: Wind power density in watts per square meter
Lift and drag principle; long path theory.
Geared type wind power plants: components, layout and working.
Direct drive type wind power plants: components, layout and working.
Constant Speed Electric Generators: Squirrel Cage Induction Generators (SCIG), Wound Rotor Induction Generator (WRIG); Variable Speed Electric Generators: Doubly-fed induction generator (DFIG), wound rotor synchronous generator (WRSG), permanent magnet synchronous generator (PMSG).
Unit– III  Small Wind Turbines

- Horizontal axis small wind turbine: direct drive type, components and working
- Horizontal axis small wind turbine: geared type, components and working
- Vertical axis small wind turbine: direct drive and geared, components and working
- Types of towers and installation of small wind turbines on roof tops and open fields.
- Electric generators used in small wind power plants

Unit– IV  Micro-hydro Power Plants

- Energy conversion process of hydro power plant.
- Classification of hydro power plant: High, medium and low head.
- Layouts of micro-hydro power plants
- Construction and working of hydro turbines used in different types of hydro power plant:
  - High head – Pelton turbine
  - Medium head – Francis turbine
  - Low head – Kaplan turbine.
- Safe Practices for micro hydro power plants.

Unit– V  Biomass-based Power Plants

- Properties of solid fuel for biomass power plants: bagasse, wood chips, rice husk, municipal waste
- Properties of liquid and gaseous fuel for biomass power plants: Jatropha, bio-diesel, gobar gas
- Layout of a Bio-chemical based (e.g. biogas) power plant:
- Layout of a Thermo-chemical based (e.g. Municipal waste) power plant
- Layout of an Agro-chemical based (e.g. bio-diesel) power plant

References:

Course outcomes:
the theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Maintain the optimised working of solar PV and CS power plants.
b) Maintain the optimised working of large wind power plants
c) Maintain the optimised working of small wind turbines.
d) Maintain the optimised working of micro hydro power plants.
e) Maintain the optimised working of biomass-based power plants.

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Course Code : EEPC219
Course Title : Renewable Energy Power Plants Laboratory
Number of Credits : 1 (L: 0, T: 0, P: 2)
Prerequisites : NIL
Course Category : PC

Course objectives:
the aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain the efficient operation of various renewable energy power plants.

Practicals:
1. Dismantle the parabolic trough CSP plant.
2. Assemble the parabolic trough Concentrated Solar Power (CSP) plant.
3. Assemble the parabolic dish CSP plant.
4. Dismantle the parabolic dish CSP plant.
5. Assemble the solar PV plant to produce electric power.
6. Dismantle the solar PV plant.
7. Identify the routine maintenance parts of the large wind power plant after watching a video programme.
8. Assemble a horizontal axis small wind turbine to produce electric power
10. Assemble a vertical axis small wind turbine to produce electric power
11. Dismantle a vertical axis small wind turbine.
12. Identify the routine maintenance parts of the micro hydro power plant after watching a video programme.
13. Assemble a micro hydro power plant.
14. Dismantle a micro hydro power plant.
15. Assemble a small biogas plant to generate electric power
16. Dismantle the biogas plant.
Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Maintain the optimised working of solar PV and CS power plants.

b) Maintain the optimised working of large wind power plants.

c) Maintain the optimised working of small wind turbines.

d) Maintain the optimised working of micro hydro power plants.

e) Maintain the optimised working of biomass-based power plants.

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Course Code : EEPC202
Course Title : Fundamentals of Power Electronics
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : PC

Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain the proper functioning of power electronic devices.

Course contents:

Unit – I Power Electronic Devices
Power electronic devices
Power transistor: construction, working principle, V-I characteristics and uses.
IGBT: Construction, working principle, V-I characteristics and uses.
Concept of single electron transistor (SET) - aspects of Nano- technology.

Unit – II Thyristor Family Devices
SCR: construction, two transistor analogy, types, working and characteristics.
SCR mounting and cooling.
Types of Thyristors: SCR, LASCR, SCS, GTO, UJT, PUT, DIAC and TRIAC
Thyristor family devices: symbol, construction, operating principle and V-I characteristics.
Protection circuits: over-voltage, over-current, Snubber, Crowbar.

Unit – III Turn-on and Turn-off Methods of Thyristors
SCR Turn-On methods: High Voltage thermal triggering, Illumination triggering, dv/dt triggering, Gate triggering.
Gate trigger circuits – Resistance and Resistance-Capitance circuits.
SCR triggering using UJT, PUT: Relaxation Oscillator and Synchronized UJT circuit.
Pulse transformer and opto-coupler based triggering.
SCR Turn-Off methods: Class A- Series resonant commutation circuit, Class B-Shunt
Resonant commutation circuit, Class C-Complimentary Symmetry commutation circuit, Class D –Auxiliary commutation, Class E- External pulse commutation, Class F- Line or natural commutation.

Unit – IV Phase Controlled Rectifiers
Phase control: firing angle, conduction angle.
Single phase half controlled, full controlled and midpoint controlled rectifier with R, RL load: Circuit diagram, working, input-output waveforms, equations for DC output and effect of freewheeling diode.
Different configurations of bridge controlled rectifiers: Full bridge, half bridge with common anode, common cathode, SCRs in one arm and diodes in another arm.

Unit– V Industrial Control Circuits
Applications: Burglar’s alarm system, Battery charger using SCR, Emergency light system, Temperature controller using SCR and; Illumination control / fan speed control TRIAC.
SMPS.
UPS: Offline and Online
SCR based AC and DC circuit breakers.

References:

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Select power electronic devices for specific applications.
b) Maintain the performance of Thyristors.
c) Troubleshoot turn-on and turn-off circuits of Thyristors.
d) Maintain phase controlled rectifiers.
e) Maintain industrial control circuits.

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<tr>
<td>Number of Credits</td>
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<td>Prerequisites</td>
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<tr>
<td>Course Category</td>
<td>: PC</td>
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Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain the proper functioning of power electronic devices.

Practicals:
1. Test the proper functioning of power transistor.
2. Test the proper functioning of IGBT.
3. Test the proper functioning of DIAC to determine the break over voltage.
4. Determine the latching current and holding current using V-I characteristics of SCR.
5. Test the variation of R, C in R and RC triggering circuits on firing angle of SCR.
6. Test the effect of variation of R, C in UJT triggering technique.
7. Perform the operation of Class – A, B, C, turn off circuits.
8. Perform the operation of Class –D, E, F turn off circuits.
9. Use CRO to observe the output waveform of half wave controlled rectifier with resistive load and determine the load voltage.
10. Draw the output waveform of Full wave controlled rectifier with R load, RL load, free wheeling diode and determine the load voltage.
11. Determine the firing angle using DIAC and TRIAC phase controlled circuit on output power under different loads such as lamp, motor or heater
12. Simulate above firing angle control on SCILAB software
13. Test the performance of given SMPS, UPS.
14. Troubleshoot the Burglar’s alarm, Emergency light system, Speed control system, Temperature control system.

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Select power electronic devices for specific applications.

b) Maintain the performance of Thyristors.

c) Troubleshoot turn-on and turn-off circuits of Thyristors.

d) Maintain phase controlled rectifiers.

e) Maintain industrial control circuits.

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<tr>
<th>Course Code</th>
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<tr>
<td>Course Title</td>
<td>ELECTRIC POWER TRANSMISSION AND DISTRIBUTION</td>
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<tr>
<td>Number of Credits</td>
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Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain the proper functioning of the electrical transmission and distribution systems.

Course contents:

Unit – I Basics of Transmission and Distribution

Single line diagrams with components of the electric supply transmission and distribution systems.

Classification of transmission lines: Primary and secondary transmission; standard voltage level used in India.

Classification of transmission lines: based on type of voltage, voltage level, length and others

Characteristics of high voltage for power transmission.

Method of construction of electric supply transmission system – 110 kV, 220 kV, 400 kV.

Method of construction of electric supply distribution systems – 220 V, 400V, 11 kV, 33 kV

Unit – II Transmission Line Parameters and Performance

Line Parameters: Concepts of R, L and C of line parameters and types of lines.

Performance of short line: Efficiency, regulation and its derivation, effect of power factor, vector diagram for different power factor.


Transposition of conductors and its necessity.

Skin effect and proximity effect.

Unit – III Extra High Voltage Transmission

Extra High Voltage AC (EHVAC) transmission line: Necessity, high voltage substation components such as transformers and other switchgears, advantages, limitations and applications and lines in India. Ferranti and Corona effect.

High Voltage DC (HVDC) Transmission Line: Necessity, components, advantages, limitations and applications. Layout of monopolar, bi-Polar and homo-polar transmission lines. Lines in India.

Features of EHVAC and HVDC transmission line.

Flexible AC Transmission line: Features, d types of FACTS controller.

New trends in wireless transmission of electrical power.

Unit – IV A.C Distribution System

AC distribution: Components classification, requirements of an ideal distribution system, primary and secondary distribution system.

Feeder and distributor, factors to be considered in design of feeder and distributor.
Types of different distribution schemes: radial, ring, and grid, layout, advantages, disadvantages and applications.
Voltage drop, sending end and receiving end voltage.
Distribution Sub-Station: Classification, site selection, advantages, disadvantages and applications.
Single Line diagram (layout) of 33/11KV Sub-Station, 11KV/400V sub-station, Symbols and functions of their components.

Unit– V Components of Transmission and Distribution Line

Overhead Conductors: Properties of material, types of conductor with trade names, significance of sag.
Line supports: Requirements, types of line structures and their specifications, methods of erection.
Line Insulators: Properties of insulating material, selection of material, types of insulators and their applications, causes of insulator failure, derivation of equation of string efficiency for string of three suspension insulator, methods of improving string efficiency.
Underground Cables: Requirements, classification, construction, comparison with overhead lines, cable laying and cable jointing.

References:

3. Soni;Gupta; Bhatnagar, A Course in Electrical Power, Dhanpat Rai and Sons New Delhi, ISBN: 9788177000207

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Interpret the normal operation of the electric transmission and distribution systems.
b) Maintain the functioning of the medium and high voltage transmission system.
c) Interpret the parameters of the extra high voltage transmission system.
d) Maintain the functioning of the low voltage AC distribution system.

e) Maintain the components of the transmission and distribution lines.

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<th>Course Code</th>
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<tr>
<td>Course Title</td>
<td>ELECTRIC POWER TRANSMISSION AND DISTRIBUTION LABORATORY</td>
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Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain the proper functioning of the electrical transmission and distribution systems.

Course contents:
Laboratory work is not applicable for this course.

Following are the suggested student-related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student’s) portfolio which will be useful for their placement interviews:

a. Prepare a report based on transmission line network in Maharashtra.

b. Collect the information on components of transmission line.

c. Evaluate transmission line performance parameters of a given line.

d. Library/Internet survey of electrical high voltage line and HVDC lines.

e. Visit to 33/11 KV and 11KV/400V Distribution Substation and write a report

Also one micro-project can be assigned to the student. A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare a model showing:
   i. Single line diagram of electric supply system.
   ii. Single line diagram of a given distribution system.
   iii. Short line and medium transmission line.
   iv. Write a report on the same by giving the details of lines in Maharashtra State.

b. Collect different samples of Overhead Conductors, Underground Cables, Line supports and Line Insulators.

c. Prepare a power point presentation:
   i. Extra High Voltage AC Transmission line.
   ii. High Voltage DC Transmission line.
   iii. Flexible AC Transmission line.
   iv. New trends in wireless transmission of electrical power.

d. Collect information on:
   i. A.C Distribution System adjacent to your institute.
ii. Draw a layout diagram of 11KV/400 V substation in your campus/ adjacent substation.

**Course outcomes:**
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Interpret the normal operation of the electric transmission and distribution systems.
b) Maintain the functioning of the medium and high voltage transmission system.
c) Interpret the parameters of the extra high voltage transmission system.
d) Maintain the functioning of the low voltage AC distribution system.
e) Maintain the components of the transmission and distribution lines.

Course Code : EEPC210
Course Title : INDUCTION, SYNCHRONOUS AND SPECIAL ELECTRIC MACHINES
Number of Credits : 3 (L: 2, T: 1, P: 0)
Prerequisites : NIL
Course Category : PC

**Course objectives:**
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain Induction, Synchronous and FHP Machines used in different applications.

**Course contents:**

**Unit – I Three Phase Induction Motor**
Working principle: production of rotating magnetic field, Synchronous speed, rotor speed and slip.
Rotor quantities: frequency, induced emf, power factor at starting and running condition.
Characteristics of torque versus slip (speed), Torques: starting, full load and maximum with relations among them.
Induction motor as a generalized transformer with phasor diagram.
Four quadrant operation, Power flow diagram
Starters: need and types; stator resistance, auto transformer, star delta, rotor resistance and soft starters.
Speed control methods: stator voltage, pole changing, rotor resistance and VVVF.
Motor selection for different applications as per the load torque-speed requirements.
Maintenance of three phase induction motors

**Unit – II Single phase induction motors**
Double field revolving theory, principle of making these motors self-start.
Construction and working: Resistance start induction run, capacitor start induction run, capacitor start capacitor run, shaded pole, repulsion type, series motor, universal motor, hysteresis motor.
Torque-speed characteristics for all of the above motors.
Motor selection for different applications as per the load torque-speed requirements.
Maintenance of single phase induction motors

Unit– III  Three phase Alternators
Principle of working, moving and stationary armatures.
Constructional details: parts and their functions, rotor constructions. Windings: Single and Double layer.
E.M.F. equation of an Alternator with numerical by considering short pitch factor and distribution factor.
Alternator loading: Factors affecting the terminal voltage of alternator; Armature resistance and leakage reactance drops.
Armature reaction at various power factors and synchronous impedance.
Voltage regulation: direct loading and synchronous impedance methods.
Maintenance of alternators

Unit– IV  Synchronous motors
Principle of working /operation, significance of load angle.
Torques: starting torque, running torque, pull in torque, pull out torque.
Synchronous motor on load with constant excitation (numerical), effect of excitation at constant load (numerical).
V-Curves and Inverted V-Curves.
Hunting and Phase swinging.
Methods of Starting of Synchronous Motor.
Losses in synchronous motors and efficiency (no numerical).
Applications areas

Unit– V  Fractional horse power (FHP) Motors
Construction and working: Synchronous Reluctance Motor, Switched Reluctance Motor, BLDC, Permanent Magnet Synchronous Motors, stepper motors, AC and DC servomotors.
Torque speed characteristics of above motors.
Applications of above motors.

References:
5. Theraja, B.L., Electrical Technology Vol-II (AC and DC machines), S.Chand and Co. Ltd., New Delhi, ISBN: 9788121924375
8. Hughes E., Electrical Technology, ELBS
9. Cotton H., Electrical Technology, ELBS

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Maintain three phase induction motor used in different applications.
b) Maintain single phase induction motor used in different applications.
c) Maintain three phase alternators used in different applications.
d) Maintain synchronous motors used in different applications.
e) Maintain FHP motors used in different applications.

Course Code: EEPC212
Course Title: INDUCTION, SYNCHRONOUS AND SPECIAL ELECTRIC MACHINES LABORATORY
Number of Credits: 1 (L: 0, T: 0, P: 2)
Prerequisites (Course code): NIL
Course Category: PC

Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain Induction, Synchronous and FHP Machines used in different applications.

Practicals:
1. Identify the different parts (along with function and materials) for the given single phase and three phase induction motor.
2. Connect and run the three phase squirrel cage induction motors (in both directions) using the DOL, star-delta, auto-transformer starters (any two)
3. Perform the direct load test on the three phase squirrel cage induction motor and plot the i) efficiency versus output, ii) power factor versus output, iii) power factor versus motor current and iv) torque – slip/speed characteristics.
4. Conduct the No-load and Blocked-rotor tests on given 3-Φ squirrel cage induction motor and determine the equivalent circuit parameters.
5. Conduct the No-load and Blocked-rotor tests on given 3-φ squirrel cage induction motor and plot the Circle diagram.
6. Control the speed of the given three phase squirrel cage/slip ring induction motor using the applicable methods: i) auto-transformer, ii) VVVF.
7. Measure the open circuit voltage ratio of the three phase slip ring induction motor.
8. Conduct the direct load test to determine the efficiency and speed regulation for different loads on the given single phase induction motor; plot the efficiency and speed regulation curves with respect to the output power.
9. Perform the direct loading test on the given three phase alternator and determine the regulation and efficiency.
10. Determine the regulation and efficiency of the given three phase alternator from OC and SC tests (Synchronous impedance method)
11. Conduct the test on load or no load to plot the ‘V’ curves and inverted ‘V’ curves (at no-load) of 3-φ synchronous motor.
12. Dismantling and reassembling of single phase motors used for ceiling fans, universal motor for mixer.
13. Control the speed and reverse the direction of stepper motor
14. Control the speed and reverse the direction of the AC servo motor
15. Control the speed and reverse the direction of the DC servo motor

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:
   a) Maintain three phase induction motor used in different applications.
   b) Maintain single phase induction motor used in different applications.
   c) Maintain three phase alternators used in different applications.
   d) Maintain synchronous motors used in different applications.
   e) Maintain FHP motors used in different applications.

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<td>Course Title</td>
<td>MICROCONTROLLER APPLICATIONS</td>
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Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:
   • Maintain different types of microcontroller based systems.

Course contents:
Unit – I Introduction to Microcontrollers
   Evolution of Microcontrollers
Block diagram of Microcomputer, elements of Microcomputer, types of buses
Von Neuman and Harward Architecture
Compare Microprocessor and Microcontrollers
Need of Microcontroller
Family of Microcontrollers and their specifications
Versions of Microcontroller 8951, 89C1051, 89C2051, 89C4051 with their specifications and comparison

Unit – II  Architecture of Microcontroller 8051
Block diagram of 8051, function of each block
Pin diagram, function of each pin
Concept of Internal memory and External memory (RAM and ROM)
Internal RAM structure
Reset and clock circuit
Various registers and SFRs of 8051

Unit– III 8051 Instruction Set and Programs
Overview of 8051 instruction set
Various addressing modes
Classification of instructions
Data transfer instructions
Arithmetic instructions
Logical instructions
Branching instructions
Bit manipulation instructions
Stack, subroutine and interrupt related instructions
Programs based on above instructions.

Unit– IV  Assembly Language Programming
Software development steps
Software development tools like Editor, Assembler, Linker, Loader and Hex converters.
Role of various files created at various levels in running a Assembly program using simulators like RIDE or KEIL.
Various directives of Assembly language programming
Programs using directives.

Unit– V  8051 Internal Peripherals and Related Programs
I/O ports- List, diagram, read write operation, instructions and related SFRs
Timers/counters – list, related SFRs, programming modes, operations with diagram.
Serial communication- Basics of serial communication, baud rate, related SFRs, programming modes, operations with diagram.
Interrupts-related SFRs, types, operations with diagram.
Power saving operation-modes, related SFR.

References:

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Interpret the salient features of various types of microcontrollers.
b) Interpret the salient features of architype of types microcontrollers IC 8051
c) Maintain the program features of the Microcontroller based application
d) Develop assembly language program
e) Develop programs to interface 8051 microcontrollers with LED/SWITCH

*******
Course Code : EEPC303
Course Title : MICROCONTROLLER APPLICATIONS LABORATORY
Number of Credits : 1 (L: 0, T: 0, P: 2)
Prerequisites : NIL
Course Category : PC

Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain microcontroller based systems.

Practicals:
1. Interpret details of Hardware kit for Microcontroller and practice to write and execute programs.
2. Identify different menus available in a simulator software RIDE/KEIL and demonstrate their use.
3. Develop and execute Assembly language programs using Arithmetic Instructions and demonstrate outcome for a given input data
4. Develop and execute Assembly language programs using Logical Instructions and demonstrate outcome for a given input
5. Develop and execute an Assembly language program for Addition of series of 8 bit nos, 16 bit result and demonstrate outcome for a given input data
6. Develop and execute Assembly language program for addition/subtraction of 16 bit no/multi-byte nos. and demonstrate outcome for a given input data
7. Develop and execute Assembly language program for Block transfer from and to Internal/External memory using directives and demonstrate outcome for a given input data.
8. Develop and execute Assembly language program Largest/smallest of given series of no. from Internal/External memory and demonstrate outcome for a given input data.
9. Develop and execute Assembly language program arrange no in ascending/descending order from Internal/External memory and demonstrate outcome for a given input data.
10. Develop and execute Assembly language program for LED blinking/LED sequences using delay/timer mode.
11. Develop and execute Assembly language program to interface LED with microcontroller.

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Interpret the salient features of various types of microcontrollers.
b) Interpret the salient features of archtype of types microcontrollers IC 8051
c) Maintain the program features of the Microcontroller based application
d) Develop assembly language program
c) Develop program to interface 8051 microcontrollers with LED/SWITCH

******
Course Code : EEPC305
Course Title : ENERGY CONSERVATION AND AUDIT
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : PC

Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Undertake energy conservation and energy audit.

Course contents:

Unit – I Energy Conservation Basics
Energy conservation and Energy audit; concepts and difference
Indian Electricity Act 2001; relevant clauses of energy conservation
BEE and its Roles
MEDA and its Roles
Star Labelling: Need and its benefits.

Unit – II Energy Conservation in Electrical Machines
Need for energy conservation in induction motor and transformer.
Energy conservation techniques in induction motor by:
Improving Power quality.
Motor survey
Matching motor with loading.
Minimizing the idle and redundant running of motor.
Operating in star mode.
Rewinding of motor.
Replacement by energy efficient motor
Periodic maintenance
Energy conservation techniques in Transformer.
Loading sharing
Parallel operation
Isolating techniques.
Replacement by energy efficient transformers. Periodic maintenance.
Energy efficient motor; significant features, advantages, applications and limitations.
Energy efficient transformers, amorphous transformers; epoxy Resin cast transformer / Dry type of transformer.

Unit– III  Energy conservation in Electrical Installation systems
Aggregated Technical and commercial losses (ATC); Power system at state, regional, national and global level.
Technical losses; causes and measures to reduce by.
   a) Controlling $I^2R$ losses.
   b) Optimizing distribution voltage
   c) Balancing phase currents
   d) Compensating reactive power flow
Commercial losses: pilferage, causes and remedies
Energy conservation equipment: Maximum Demand Controller, kVAR Controller, Automatic Power Factor controller (APFC)
Energy Conservation in Lighting System
   a) Replacing Lamp sources.
   b) Using energy efficient luminaries.
   c) Using light controlled gears.
   d) Installation of separate transformer / servo stabilizer for lighting.
   e) Periodic survey and adequate maintenance programs.
Energy Conservation techniques in fans, Electronic regulators.

Unit– IV  Energy conservation through Cogeneration and Tariff
Co-generation and Tariff; concept, significance for energy conservation
Co-generation
Types of cogeneration on basis of sequence of energy use (Topping cycle, Bottoming cycle)
Types of cogeneration basis of technology (Steam turbine cogeneration, Gas turbine cogeneration, Reciprocating engine cogeneration).
Factors governing the selection of cogeneration system.
Advantages of cogeneration.
Tariff: Types of tariff structure: Special tariffs; Time-off-day tariff, Peak-off-day tariff, Power factor tariff, Maximum Demand tariff, Load factor tariff.
Application of tariff system to reduce energy bill.

Unit– V  Energy Audit of Electrical System
Energy audit (definition as per Energy Conservation Act)
Energy audit instruments and their use.
Questionnaire for energy audit projects.
Energy flow diagram (Sankey diagram)
Simple payback period, Energy Audit procedure (walk through audit and detailed audit).
Energy Audit report format.
References:

2. O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Interpret energy conservation policies in India.
b) Implement energy conservation techniques in electrical machines.
c) Apply energy conservation techniques in electrical installations.
d) Use Co-generation and relevant tariff for reducing losses in facilities.
e) Undertake energy audit for electrical system.

Course Code : EEPC307
Course Title : ENERGY CONSERVATION AND AUDIT LABORATORY
Number of Credits : 1 (L: 0, T: 0, P: 2)
Prerequisites : NIL
Course Category : PC

Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

• Undertake energy conservation and energy audit.

Practicals:
1. Identify star labelled electrical apparatus and compare the data for various star ratings.
2. Determine the ‘% loading’ of the given loaded Induction motor.
3. Determine the reduction in power consumption in star mode operation of Induction motor compared to delta mode.
4. Use APFC unit for improvement of p. f. of electrical load.
5. Compare power consumption of different types of TL with choke, electronic ballast and LED lamps by direct measurements.

6. Determine the reduction in power consumption by replacement of lamps in a class room / laboratory.

7. Determine the reduction in power consumption by replacement of Fans and regulators in a class room / laboratory.

8. Collect electricity bill of an industrial consumer and suggest suitable tariff for energy conservation and its impact on energy bill.

9. Collect electricity bill of a commercial consumer and suggest suitable tariff for conservation and reduction of its energy bill.

10. Collect electricity bill of a residential consumer and suggest suitable means for conservation and reduction of the energy bill.

11. Estimate energy saving by improving power factor and load factor for given cases.

12. Prepare a sample energy audit questionnaire for the given industrial facility.

13. Prepare an energy audit report (Phase-I)

14. Prepare an energy audit report (Phase-II)

15. Prepare an energy audit report (Phase-III)

**Course outcomes:**

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Interpret energy conservation policies in India.

b) Implement energy conservation techniques in electrical machines.

c) Apply energy conservation techniques in electrical installations.

d) Use Co-generation and relevant tariff for reducing losses in facilities.

e) Undertake energy audit for electrical system.

*****
Course Code: EEPC302
Course Title: BUILDING ELECTRIFICATION
Number of Credits: 3 (L: 3, T: 0, P: 0)
Prerequisites: NIL
Course Category: PC

Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Design electrical installation systems in building complexes.

Course contents:

Unit – I  Wiring Tools and Accessories
Various tools required for wiring- screwdrivers, pliers, Try square, saws, hacksaw, chisel, hammers, mallet, rawl punch, hand drill machine, portable drilling machine, files, plumb bob, line thread, electricians knife, test lamp, tester and their BIS specifications, application, care & maintenance of tools.
Classification of electrical accessories- controlling, holding, safety, outlet
BIS symbols of following electrical accessories.
Switch – Their types according to construction such as surface switch, flush switch, and pull switch, rotary switch, knife switch, pendent switch, Main-switch (ICDP, ICTP). Their types according to working such as single pole, double pole, two-way, two-way centre off, intermediate, series parallel switch
Holders- Their types such as bayonet cap lamp holder; pendent holder, batten lamp holder; angle holder, bracket holder; tube light holder; screw type Edison and goliath Edison lamp holder; swivel lamp holder.
Socket outlets and plugs- two pin, three-pin, multi pin sockets, two-pin and three-pin plug.
Others- Iron connector, adaptor, and ceiling rose, distribution box, neutral link, bus-bar chamber.
Wooden/ mica boards, Moulded / MS Concealed boxes of different sizes. Modular accessories.

Unit – II Electrical Wires and Underground Cables
Conductors: - wire, cable, bus bar, stranded conductor, cable, armoured cable, flexible cable, solid conductor, PVC wires, CTS wire, LC wire, FR (Fire retardant) wire, Size of wire according to BIS. Tools used for measurement of wire size, Wire jointing methods.
Classification of cables, low tension, high tension, and extra high tension cables, solid, oil filled and gas filled type
Cable insulation materials –vulcanized rubber (VIR), polyvinyl chloride (PVC), cross linked polythene (XLPE), impregnated paper, Selection of suitable cable size and type from standard data
Cable jointing methods
Cable laying methods.
Factors determining selection of electric cables.
Unit– III  Wiring Methods and wiring layout

Factors determining the selection of wiring methods.
Classification of wiring methods.
PVC casing-capping wiring- wiring rules according to IS: 732-1983
Conduit wiring- Types of conduit, comparison between Metal and PVC conduit, types of conduit wiring (Surface/Concealed). Conduit wiring accessories, BIS rules for Metal and PVC conduit wiring.
Comparison of various wiring systems.
General BIS rules for domestic installations.
Design, working and drawing of following electrical circuits: Simple light and fan circuits, Stair case wiring, Go-down wiring circuit, Bedroom lighting circuit, Corridor lighting circuit, Series parallel circuit, Master switch control circuit, Different lighting circuit using - Intermediate switch, Call bell circuit using bell indicator, Design of wiring circuits according to user’s requirement

Unit– IV  Residential Building Electrification

Domestic Dwellings/Residential Buildings: reading of Civil Engineering building drawing, Interpretation of electrical installation plan and electrical diagrams, electrical symbols as per IS: 732.
Electrical installation for residential building as per part I section 9 of NEC-2011
Difference between residential and industrial load, rules/requirements related to lighting load followed in electrical installations, Positioning of equipment.
Lighting and power circuits: Light and fan circuit, Power circuit
Wiring and circuit Schematic diagram according to IS: 2042(Part-I)-1962: multiline and single line representation
Load assessment: Selection of size of conducto, Selection of rating of main switch and protective switch gear.
Design and drawing, estimation and costing of a residential installation having maximum 5 KW load; Sequence to be followed for preparing estimate; Calculation of length of wire and other materials, labour cost
Residential building Service Connection- types Underground and overhead. Calculation of Material required for service connection

Unit– V  Protection of Electrical Installation
Fuse in electric circuit: fuse element, fuse current rating, minimum fusing current, cut-off current, fusing factor, Fuse material
Types of fuses –Re-wirable, cartridge fuses (HRC and LRC), Fuse material Selection of fuse.
Miniature circuit Breaker (MCB)-Construction, Principle rating and uses, Earth Leakage Circuit Breaker (ELCB)-Construction, Principle rating and uses.
System and equipment earthing and its requirements, Earth, earth electrode, earth current, earth terminal, earthing wire, earthing lead, fault current, leakage current, Measurement of earth resistance using earth tester, Methods of reducing earth resistance,
Methods of earthing as per IS 3043: 1987 and their procedure- Driven pipe, pipe and plate earthing, modern methods of earthing.

**Unit– V  Illumination in Residential Installation**

Concept of Luminous flux, Luminous intensity, Lumen, Illumination or illuminance, Lux, Space-height ratio, utilization factor, depreciation factor, luminous efficiency- values for different luminaries.

Laws of Illumination-Inverse Square Law, Cosine Law, illumination received directly underneath, horizontal screen and screen moved horizontally at certain distance

Factors affecting the illumination. Different types of lighting arrangements,

Luminous flux of different types of light sources, Lux level required for different places as per SP 72: 2010.

**References:**

7. Bureau of Indian Standard, SP 72 National Lighting Codes 2010
8. E-REFERENCES:-
   - http://nptel.ac.in/courses/108108076/1, assessed on 18th January 2016
   - https://www.youtube.com/watch?v=A9KSGAnjo2U, assessed on 18th January 2016
   - www.slideshare.net/bawaparam/made-by-paramassesessed on 30 Jan2016

**Course outcomes:**

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Select accessories, wires, cables and wiring systems for electrification.

b) Design electrical wiring installation system for residential unit.

c) Design proper illumination scheme for residential unit.

d) Prepare wiring layouts on wiring board.

e) Locate and diagnose faults in electrical wiring installation.

f) Do proper earthing for building electrification.

******
Course Code : EEPC304
Course Title : BUILDING ELECTRIFICATION LABORATORY
Number of Credits : 1 (L: 0, T: 0, P: 2)
Prerequisites : NIL
Course Category : PC

Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Design electrical installation systems in building complexes.

Practicals:
1. Prepare series testing board.
2. Select the electric wire using measuring and testing instruments for particular applications.
3. Identify cables of different current ratings.
4. Prepare wiring installation on a board showing control of one lamp, one fan and one socket from one switch board in PVC surface conduit wiring system.
5. Prepare wiring installation on a board.
6. Control one lamp from two different places using PVC surface conduit wiring system.
7. Prepare wiring installation on a board. Control one lamp from three different places using PVC surface conduit wiring system.
8. Prepare wiring installation on a board.
9. Perform go-down wiring for three blocks using PVC casing capping.
10. Design 2 BHK residential installation scheme and estimate the material required. And draw the details required for installation on A4 size sheet.
11. Test wiring installation using megger.

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Select accessories, wires, cables and wiring systems for electrification.
b) Design electrical wiring installation system for residential unit.
c) Design proper illumination scheme for residential unit.
d) Prepare wiring layouts on wiring board.
e) Locate and diagnose faults in electrical wiring installation.
f) Do proper earthing for building electrification.

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PROGRAMME ELECTIVE COURSES (EEPE***) COURSES

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<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>INDUSTRIAL INSTRUMENTATION AND CONDITION MONITORING</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3 (L: 3, T: 0, P: 0)</td>
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<td>Prerequisites</td>
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Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Use instrumentation equipment for condition monitoring and control.

Course contents:

Unit – I Fundamentals of instrumentation
- Basic purpose of instrumentation.
- Basic block diagram (transduction, signal conditioning, signal presentation) and their function.
- Construction, working and application of switching devices- Push button, limit switch, float switch, pressure switch, thermostat, electromagnetic relay.

Unit – II Transducers
- Distinguish between Primary and Secondary, Electrical and Mechanical, Analog and Digital, Active and Passive. Mechanical devices pry. And sec. transducers
- Advantages of electric transducers
- Required characteristics of transducers.
- Factors affecting the choice of transducers
- Construction and principle of resistive transducer-Potentiometer – variac and strain gauges
- No derivation. Only definition and formula for gauge factor
- Types of strain gauges like unbonded, bonded and semiconductor.
- Construction and principle of Inductive transducers-L.V.D.T. and R.V.D.T., their applications.
- Construction, principle and applications of transducers – Piezo-Electric transducer, photoconductive cells, photo voltaic cells.

Unit– III Measurement of Non-Electrical Quantities
- Temperature measurement - Construction and Working of RTD, Thermistor and Thermocouple, radiation pyrometer; technical specifications and ranges.
- Pressure measurement – Construction and working of bourdon tube, bellow diaphragm and strain gauge, Combination of diaphragm and inductive transducer, Bourdon tube and LVDT, bellow and LVDT, diaphragm capacitance and bridge Circuit.
- Construction and Working of Speed Measurement by contacting and non-Contact Type- DC tachometer, photo- electric tachometer, tooted rotor tachometer Generator - magnetic pick-up and Stroboscope.
- Construction and Working of Vibration measurement by accelerometer-LVDT accelerometer,
Piezo electric type.
Construction and Working of Flow measurement by electromagnetic and Turbine Flow meter.
Construction and Working of Liquid level measurement by resistive, inductive, Capacitive gamma rays and Ultrasonic methods.
Construction and Working of Thickness measurement by resistive, inductive, capacitive, ultrasonic and Nuclear methods.

Unit– IV Signal Conditioning
Basic Concept of signal conditioning System.
Draw pin configuration of IC 741.
Define Ideal OP-AMP and Electrical Characteristics of OP-AMP.
Different Parameters of op-amp:- Input offset voltage, Input offset current, Input bias current, Differential input resistance, CMMR, SVRR, voltage gain, output voltage, slew rate, gain bandwidth, Output, short circuit current.
Use of op-amp as inverting, non-inverting mode, adder, subtractor, and Working of Differential amplifier and instrumentation amplifier.
Filters: Types of RC filters and frequency response - no derivation.
Sample and hold circuits - operation and its application.

Unit– V Data Acquisition System
Generalized DAS- Block diagram and description of Transducer, signal conditioner, multiplexer, converter and recorder
Draw Single Channel and Multi-channel DAS- Block diagram only. Difference between Signal Channel and Multi-Channel DAS.
Data conversion- Construction and Working of Analog to digital conversion- successive approximation method, ramp type method.
Digital to Analog conversion- Construction and Working of binary weighted resistance method.
Concept and methods of data transmission of electrical and electronic transmission.
Construction and principle of telemetry system and its type - Electrical telemetering system.
Digital display device- operation and its application of seven segment display, dot matrix display and concept of 3½, 4½ digits, LED and LCD applications

Unit– VI Condition Monitoring and Diagnostic Analysis
Definition of condition monitoring
Insulation deterioration Mechanism- factors affecting occurrence and rate of deterioration, types of stresses responsible for deterioration
Different tests on transformer, their purpose, and the necessary condition of machine.
Tests on Circuit breaker, purpose and required condition of machine
Tests on CT, purpose, item to be tested and required condition of machine.
Power factor, capacitance/tan delta test
Insulation and Polarization index, DC winding resistance test, Turns Ratio test
Tools and equipment used in Condition monitoring
References:

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Select relevant instruments used for measuring electrical and non-electrical quantities.
b) Select relevant transducers/sensors for various applications.
c) Use relevant instruments for measuring non-electrical quantities.
d) Check the signal conditioning and telemetry system for their proper functioning.
e) Use data acquisition systems in various applications.
f) Undertake condition monitoring for diagnostic analysis of electrical equipment

Course Code : EEPE***
Course Title : INDUSTRIAL INSTRUMENTATION AND CONDITION MONITORING LABORATORY
Number of Credits : 1 (L: 0, T: 0, P: 2)
Prerequisites : NIL
Course Category : PE

Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

• Use instrumentation equipment for condition monitoring and control.

Practicals:
1. Identify different switches used in instrumentation system.
2. Measure linear displacement by L.V.D.T.
3. Measure the strain with the help of strain gauge
4. Measure temperature by PT-100, thermistor, thermocouple along with simple resistance bridge.
5. Use Thermocouple to control the temperature of a furnace/machine.
6. Measure pressure using pressure sensor kit.
7. Measure angular speed using stroboscope and tachometer.
8. Measure the flow using flow meter.
9. Use op-amp as inverter, non-inverting mode, adder, differentiator and integrator.
10. Convert digital data into analog data by using analog to digital converters and analog data into digital data by digital to analog converter.
11. Visit to testing center of electrical testing lab for tan delta and diagnostic tests and determine polarization index.
12. Prepare a Report on various tools and equipment used for condition monitoring of electrical machines.

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

- a) Select relevant instruments used for measuring electrical and non-electrical quantities.
- b) Select relevant transducers/sensors for various applications.
- c) Use relevant instruments for measuring non-electrical quantities.
- d) Check the signal conditioning and telemetry system for their proper functioning.
- e) Use data acquisition systems in various applications.
- f) Undertake condition monitoring for diagnostic analysis of electrical equipment.

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<td>INDUSTRIAL AUTOMATION AND CONTROL</td>
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Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain Industrial Automation Systems.

Course contents:

Unit – I Introduction to Industrial Automation

Automation: Need and benefits.
Types of automation system: Fixed, Programmable, Flexible
Different systems used for Industrial automation: PLC, HMI, SCADA, DCS, Drives.
Evolution of PLC.

Unit – II PLC Fundamentals

Building blocks of PLC: CPU, Memory organization, Input- output modules (discrete and analog), Specialty I/O Modules, Power supply
Fixed and Modular PLC and their types, Redundancy in PLC module
Unit– III   PLC Programming and Applications

PLC I/O addressing

PLC programming Instructions: Relay type instructions, Timer instructions: On delay, off delay, retentive, Counter instructions: Up, Down, High speed, Logical instructions, Comparison Instructions, Data handling Instructions, Arithmetic instructions.

PLC programming language: Functional Block Diagram (FBD), Instruction List. Structured text, Sequential Function Chart (SFC), Ladder Programming.

Simple Programming examples using ladder logic: Language based on relay, timer counter, logical, comparison, arithmetic and data handling instructions.

PLC Based Applications: Motor sequence control, Traffic light control, Elevator control, Tank Level control, Conveyor system, Stepper motor control, Reactor Control Gate trigger circuits – Resistance and Resistance-Capacitance circuits.

Unit– IV   Electric Drives and special machines

Electric drives: Types, functions, characteristics, four quadrant operation.
DC and AC drive controls: V/F control, Parameters, direct torque control.


Unit– V   Supervisory Control and Data Acquisition System (SCADA)

Introduction to SCADA: Typical SCADA architecture/block diagram, Benefits of SCADA

Various editors of SCADA

Interfacing SCADA system with PLC: Typical connection diagram, Object Linking & embedding for Process Control (OPC) architecture, Steps in Creating SCADA Screen for simple object, Steps for Linking SCADA object (defining Tags and Items) with PLC ladder program using OPC.

Applications of SCADA: Traffic light control, water distribution, pipeline control.

References:


**Course outcomes:**
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Identify different types of automation systems.
b) Interface I/O devices with the PLC modules.
c) Develop PLC ladder programs for various applications.
d) Select the suitable motor drives for different applications
e) Prepare simple SCADA applications.

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**Course objectives:**
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain Industrial Automation Systems.

**Practicals:**

1. Identify various automation systems available in different appliances/ devices/ machines in day to day use.
2. Identify various parts of the given PLC and front panel status indicators.
3. Use PLC to test the START STOP logic using two inputs and one output.
4. Develop/Execute a ladder program for the given application using following: - timer, counter, comparison, logical, arithmetic instructions.
5. Use PLC to control the following devices like lamp, motor, push button switches, proximity sensor.
6. Measure the temperature of the given liquid using RTD or Thermocouple and PLC.
7. Develop/test ladder program to blink the LED/lamp.
8. Develop / test the Ladder program for sequential control application of lamps/ DC motors.
10. Develop and test ladder program for pulse counting using limit switch /Proximity sensor.
11. Develop /test ladder program for Automated car parking system.
12. Develop / test ladder program for Automated elevator control.
13. Develop / test ladder program for rotating stepper motor in forward and reverse direction at constant speed.
14. Develop /test ladder program for tank water level control.
15. Develop / test ladder program for control of speed of stepper motor with suitable drivers.
16. Identify various front panel controls of VFD (smart drive).
17. Control speed of AC/DC motor using VFD. (VFD-Variable Frequency Drive)
18. Use various functions of SCADA simulation editors to develop simple project.
19. Develop a SCADA mimic diagram for Tank level control.
20. Develop SCADA mimic diagram for Flow control in a given system.
21. Simulate Tank level control using available SCADA system.

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:
   a) Identify different types of automation systems.
   b) Interface I/O devices with the PLC modules.
   c) Develop PLC ladder programs for various applications.
   d) Select the suitable motor drives for different applications.
   e) Prepare simple SCADA applications.

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<td>Course Title</td>
<td>INDUSTRIAL DRIVES</td>
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<tr>
<td>Number of Credits</td>
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Course Objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain electric AC and DC Drives.

Course contents:

Unit – I Electric Drives

Need of Electric Drives, Functional Block diagrams of an electric drives.
DC Motors, Motor Rating
   a. Series, Shunt and compound DC motors.
   b. Universal motor
   c. Permanent magnet motor
   d. DC servo motor
   e. Moving coil motor
   f. Torque motor
Starting and Braking of DC Motors
Brushless DC Motors for servo applications.

Maintenance procedure.

**Unit – II  AC Motors**

Single phase AC Motors

a) Resistance split phase motors
b) Capacitor run motors
c) Capacitor start motors
d) Shaded pole motors

Three phase Induction Motors

a) Squirrel cage Induction motor
b) Slip ring Induction Motor
c) Starting methods of Induction Motor
d) Braking methods of Induction Motor

Determination of Motor Rating

Maintenance procedure.

**Unit– III  DC Drives**

Single phase SCR Drives

a) Half wave converter
b) Full wave converter
c) Semi converter
d) Dual converter

Three Phase SCR Drives

a) Half wave converter
b) Full wave converter
c) Semi converter
d) Dual converter

Reversible SCR Drives.

Speed control methods of DC series Motor

Chopper Controlled DC Drives

Solar and battery powered vehicles

Maintenance procedure.

**Unit– IV  AC Drives**

Starting and Braking of Induction motors.

Stator voltage control

Variable Frequency Control

Voltage Source Inverter Control

Current Source Inverter Control

Rotor Resistance Control
Slip Power Recovery
Solar powered pump drives
Maintenance procedure for AC drives
Sequences of stages & drives required in each stage for following applications:
   a) Textile mills
   b) Steel rolling mills
   c) Paper mills
   d) Sugar mills

Unit– V Advanced Techniques of Motor Control
Microcontroller/ Microprocessor based control for drives
Phase locked loop control of DC motor.
AC/DC motor drive using Microcomputer control
AC/DC motor drive using Microcontroller control.
Synchronous Motor drives.
Ratings & specifications of stepper motor.
Stepper motor drives employing microcontroller (No programming)

References:

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:
   a) Select relevant DC motor for various electric drive applications.
b) Select relevant AC motor for various electric drive applications.
c) Maintain DC Drives.
d) Maintain AC Drives.
e) Maintain microprocessor/micro controlled electric motors.

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Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain electric AC and DC Drives.

Practicals:

1. Dismantle the given DC motor and identify its different parts
2. Dismantle the given AC motor and identify its different parts
3. Control the speed of DC Motor using armature voltage control method
4. Control the speed of DC Motor using field current control method
5. Measure the output voltage of chopper for resistive load by varying the frequency and/or duty cycle of chopper.
6. Control the speed of three phase squirrel cage induction motor using stator voltage control method.
8. Observe the effect on speed of the given D.C. separately excited motor by varying voltage using step down chopper.
9. Control the speed of the given separately excited motor by changing the firing angle of SCR using single phase semi converter and measure the speed.
10. Control the speed of the given separately exited motor by changing the firing angle of SCR using single phase full converter and measure the speed.
11. Control the speed of the given three phase induction motor by using constant V/f method and plot the graph between speed and frequency.
12. Control the speed of the given three phase induction motor by varying frequency and plot the graph between speed and frequency.
13. Control the speed of the given synchronous motor drives using microcontroller.
14. Demonstrate High power SCR/power device and Heat sink and write their specifications and rating.
15. Control the speed of single phase capacitor split phase induction motor using DIAC -TRIAC circuit.
16. Control the speed of DC motor drives using microcontroller.
17. Identify different parts and assemble the given DC motor.
18. Identify different parts and assemble the given AC motor.

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Select relevant DC motor for various electric drive applications.
b) Select relevant AC motor for various electric drive applications.
c) Maintain DC Drives.
d) Maintain AC Drives.
e) Maintain microprocessor/micro controlled electric motors.

Course Code : EEPE***
Course Title : COMMUNICATION TECHNOLOGIES
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites (Course code) : NIL
Course Category : PE

Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Use relevant data communication technique.

Course contents:
Unit – I Data Communication and Modulation

Block diagram of communication system
Types of communication system: synchronous and asynchronous, simplex, half-duplex, Full duplex, serial and parallel communication
Classification of communication technique: AM, FM, & PM on the basis of definition, waveform, bandwidth, modulation index
Modulation and demodulation: Block diagram of AM, FM and PM
Pulse Modulation: Block diagram for waveform generation of PAM, PWM, PPM, working principle, advantages, disadvantages and applications.
Advantages of pulse modulation over AM and FM.

Unit – II Digital Modulation Techniques

Digital Communication: Block diagram and working principle, waveforms, strength and limitations
Sampling process Nyquist sampling theorem, quantization process, quantization error, quantization noise
PCM: Block diagram, working principle, waveforms, advantages, disadvantages, application of PCM.
Principle of ASK, PSK, FSK. Application of ASK, PSK, FSK

Unit– III Data Communication Media
Baud rate, Bit rate, types of errors in data communication and error correction techniques.
Types of communication media and frequency band of operation
Guided media: Types of cable-twisted pair cable, co-axial cable, fiber optic cable.
Unguided media: Microwave communication, Infrared communication.

Unit– IV Fibre Optics
Introduction to Fiber optic communication.
Strength and limitations of fiber optic system
Light propagation: reflection, refraction, Snell’s law
Light propagation through cable: Mode of propagation, index profile
Fibre optic cables: cable construction, fibre optics cable modes, single mode, step index fibre, multimode index fibre, multimode graded index fibre, fibre cable losses.
Light source and Detector: Light emitting diode (LED), Photo Transistor, Laser diode, opto-coupler.

Unit– V Data Communication Protocols and Interfacing Standard
OSI (Open Systems Interconnection) Reference model
Introduction to protocol, FTP, SMTP, TCP/IP, UDP
LAN standards.
Introduction to IEEE Standards for LAN and GPIB
RS-232 standard: Introduction, and working principle
Network topologies, introduction star, ring, tree, bus, mesh, hybrid
Basic functions of networking devices: modem, switches, routers, repeaters, hubs, bridges, gateway.

Unit– VI Advanced Data Communication
Introduction to Wi-Fi and Wi- Max
Bluetooth architecture and its layers,
Universal serial bus (USB) architecture.
Bluetooth and USB

References:
2. Reynders D., Steve Macky, Wright Edvin, Practical Industrial Data Communications, Newnes publication, ISBN 10:07506639523

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Identify the different types of data communication equipment and techniques.

b) Use relevant digital modulation techniques.

c) Interpret the specifications of the data communication media.

d) Maintain the fibre optics networks for data communication.

e) Use OSI model and relevant data communication protocols.

f) Maintain wireless network environment.

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Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

• Use relevant data communication technique.

Practicals:
1. Measure the modulation index of amplitude modulated wave and observe the effect of modulating signal voltage on it.
2. Measure the modulation index of the frequency modulated wave and observe the effect of modulating and Carrier signal voltage on Frequency Modulation.
3. Test Pulse Amplitude Modulation (PAM) signal.
4. Test Pulse Width Modulation signal.
5. Test Pulse Position Modulation Signal.
7. Test Amplitude Shift Keying Signal
8. Test Frequency Shift Keying Signal
10. Plot the V-I Characteristics of given Infra-Red Light Source (IR-LED)
11. Test UTP/STP cable in straight and crossover mode and by line tester.
12. Plot the V-I Characteristics of given Light Source (LED) and detector (photo transistor)
13. Use OFT trainer Kit given 1mm. diameter Plastic optical fibre at 650 nm to determine the Numerical Aperture (NA).
14. Create the scenario and study the performance of token ring LAN protocol through simulation and using trainer kit.
15. Install and configure TCP/IP protocol.
16. Perform the transfer of files from PC to PC using Windows
17. Perform the transfer of a file from PC to another PC using Serial port RS-232
18. Establish star topology using transmission media and network control device.
19. Establish Wireless Communication between five computers using wireless LAN.
20. Establish Bluetooth communication using 4G mobile and laptop.

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Identify the different types of data communication equipment and techniques.
b) Use relevant digital modulation techniques.
c) Interpret data communication media.
d) Use fibre optics in data communication.
e) Use OSI model and relevant data communication protocols.
f) Maintain wireless network environment.

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<td>Course Title</td>
<td>ELECTRICAL TESTING AND COMMISSIONING</td>
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</table>
Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Follow standard safety procedures in testing and commissioning of electrical equipment.

Course contents:
Unit – I Electrical Safety and Insulation
Do’s and don’ts regarding safety in domestic electrical appliances as well for substation/ power station operators
Electrical safety in industry/power stations/ substations at the time of operation/ control/ maintenance. Fire detection alarm, fire-fighting equipments
Factors affecting life of insulating materials, classifications of insulating materials as per IS:1271-1958
Measuring insulation resistance by different methods such as i) Polarization, ii) Dielectric absorption, iii) Megger and to predict the condition of insulation
Reconditioning of insulation,
Insulating oil - properties of insulating oil, causes of deterioration of oil,
testing of transformer oil as per IS 1866-1961

Unit – II Installation and Erection
Concept of foundation for installation of machinery. Requirements of foundation for static and rotating electrical machinery.
Concept of leveling and aligning Procedure for leveling and aligning alignment of direct coupled drive, effects of mis-alignment
Installation of transformer as per I.S.-1886-1967 and procedure of installation of transformer, Requirements of installation of pole mounted transformer
Requirements of installation of rotating electrical machines as per I.S. 900 - 1965
Devices and tools required for loading, unloading, lifting, and carrying heavy equipment and precautions to be taken while handling them.

Unit – III Testing and Commissioning
Concept of testing, Objectives of testing. Roles of I.S.S. in testing of electrical equipment, Types of tests and concepts, Routine tests, type tests, supplementary test, special tests, Methods of testing - Direct/Indirect/Regenerative testing.
Tolerances for the various items for equipment – transformer, induction motor, dc motor, synchronous machines
Commissioning, Tests before Commissioning for transformer, induction motor, alternator
Testing of transformer as per I.S.1886- 1967 and I.S.2026- 1962
Testing of synchronous machines as per ISS
Testing of D.C. machines
Unit– IV    Troubleshooting Plans

Internal and external causes for failure / abnormal operation of equipment.
List of mechanical faults, electrical faults and magnetic faults in the electrical equipment remedies, applications
Use of tools like bearing puller filler gauges, dial indicator, spirit level, megger, earth tester, and growler. Common troubles in electrical equipments and machines.
Preparation of trouble shooting charts for D.C. Machines, AC Machines and transformers.

Unit– V   Maintenance

Concept of maintenance, types of maintenance, Routine, preventive and breakdown maintenance.
Causes of failure of electrical machines
Preventive maintenance-procedure or developing maintenance schedules for electrical machines.
Factors affecting preventive maintenance schedules, Concept of TPM, Pillars of TPM
Identification of different types of faults developed such as mechanical/electrical/magnetic faults
Maintenance schedules of the following as per I.S.S.
   a) Distribution transformer as per I.S.1886-1967
   b) Single phase and three phase Induction motors as per I.S.900-1965.
   c) Batteries

References:


Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

   a) Follow safety procedures with respect to earthing and insulation of electrical equipment
   b) Select proper tools, equipment, for installation, testing, maintenance of electrical machines and transformers
   c) Test and commission electrical equipment in accordance with IS codes
   d) Make plans for troubleshooting electrical machines.
   e) Undertake regular preventive and breakdown maintenance.

******
# Course Title: ELECTRICAL TESTING AND COMMISSIONING LABORATORY

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<tr>
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<td>Prerequisites</td>
<td>NIL</td>
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<td>Course Category</td>
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**Course objectives:**

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Follow standard safety procedures in testing and commissioning of electrical equipment.

**Practicals:**

1. Determine breakdown strength of transformer oil.
2. Perform insulation resistance test on any one motor/transformer.
3. Prepare trouble shooting charts for electrical machines such as Transformer, D.C. machines, Induction motor, and Synchronous machines.
4. Measure impedance voltage and load losses of three-phase transformer.
5. Find regulation and efficiency of single-phase transformer by direct loading and back-to-back connection method and compare the results.
7. Determine efficiency of D.C. machine by Hopkinson’s test.
9. Measure no load losses and no load current of a transformer as per IS.
10. Perform no load test on single phase Induction motor for the measurements of no load current, power input, and speed at rated voltage as per I.S.

**Course outcomes:**

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Follow safety procedures with respect to earthing and insulation of electrical equipment.

b) Select proper tools, equipment, for installation, testing, maintenance of electrical machines and transformers.

c) Test and commission electrical equipment in accordance with IS codes.

d) Make plans for troubleshooting electrical machines.

e) Undertake regular preventive and breakdown maintenance.

******
Course Code: EEPE***
Course Title: ELECTRICAL ESTIMATION AND CONTRACTING
Number of Credits: 3 (L: 3, T: 0, P: 0)
Prerequisites: NIL
Course Category: PE

Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Design electrical installation with costing for tendering

Course contents:

Unit – I Electric Installation and Safety
Scope and features of National electric code 2011
Types of electrical installation
Fundamental principles for electrical installation
Permit to work, safety instructions and safety practices
Purpose of estimating and costing.

Unit – II Estimation and Costing
Meaning and purpose of- Rough estimate, detailed estimate, supplementary estimate, annual maintenance estimate and revised estimate
Factors to be considered while preparation of detailed estimate and economical execution of work
Contracts- Concepts of contracts, types of contracts, contractor, role of contractor
Tenders and Quotations- Type of tender, tender notice, preparation of tender document, and method of opening of tender
Quotation, quotation format, comparison between tender and quotation
Comparative statement, format comparative statement. Order format, placing of purchasing order.
Principles of execution of works, planning, organizing and completion of work, Billing of work

Unit– III Non-Industrial Installations
Types of Non-industrial installations-- Office buildings, shopping and commercial centre, residential installation, Electric service and supply
Design consideration of electrical installation in commercial buildings.
Design procedure of installation- steps involved in detail, Estimating and costing of unit
Earthing of commercial installation.
Design electrical installation scheme of commercial complex.
Erection, Inspection and testing of installation as per NEC

Unit– IV Industrial Installation
Classification of industrial buildings Classification based on power consumption,
Drawing of wiring diagram and singleline diagram for single phase and three phase Motors.
Design consideration in industrial installations Design procedure of installation-detailed steps
Design electrical installation scheme of factory/ small industrial unit, Preparation of material schedule and detailed estimation
Installation and estimation of agricultural pump and flourmill

Unit– V Public Lighting Installation
Classification of outdoor installations streetlight/ public lighting installation
Street light pole structures. Selection of equipments, sources used in street light installations. Cables, recommended types and sizes of cable. Control of street light installation.
Design, estimation and costing of streetlight
Preparation of tenders and abstracts.

Unit– VI Distribution Lines and LT Substation
Introduction to overhead and underground distribution line.
Materials used for distribution line HT and LV
Cables used for distribution line, factors determining selection of LT/ HT power Cables, cable laying and cable termination method according to IS
Design, estimation and costing of HT LT overhead line and underground cabling.
Types of 11 KV Distribution substations their line diagram, Estimation of load, Load factor, diversity factor and determination of rating of distribution.

References:

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:
   a) Follow National Electrical Code 2011 in electrical installations.
   b) Estimate the electrical installation works
c) Estimate the work of non-industrial electrical installations.
d) Estimate the work of industrial electrical installations.
e) Prepare abstract, tender, quotation of public lighting and other installations.
f) Prepare abstract, tender, quotation of low tension (LT) substations.

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<td>Number of Credits</td>
<td>1 (L: 0, T: 0, P: 2)</td>
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<tr>
<td>Prerequisites</td>
<td>NIL</td>
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<tr>
<td>Course Category</td>
<td>PE</td>
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</table>

Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Design electrical installation with costing for tendering.

Practicals:
1. Prepare a tender notice for purchasing a transformer of 200 KVA for commercial installation.
2. Prepare a quotation for purchasing different electrical material required.
3. Prepare a comparative statement for above material. Prepare purchase order for the same.
6. Estimate with a proposal of the electrical installation of streetlight scheme for small premises after designing.
8. Estimate with a proposal of the 500 KVA, 11/0.433 KV outdoor substation and prepare a report.

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Follow National Electrical Code 2011 in electrical installations.
b) Estimate the electrical installation works
c) Estimate the work of non-industrial electrical installations.
d) Estimate the work of industrial electrical installations.
e) Prepare abstract, tender, quotation of public lighting and other installations.
f) Prepare abstract, tender, quotation of low tension (LT) substations.

*******
Course Code : EEPE***
Course Title : ILLUMINATION PRACTICES
Number of Credits : 3      (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : PE

Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Design illumination schemes and associated electrification of buildings.

Course contents:

Unit – I Fundamentals of illumination
Basic illumination, Terminology, Laws of illumination
Polar curves, polar curve: its meaning and applications for designing the lamp.
Concept of Photometry, Measurement of illumination
Lighting calculation methods, Watt /m^2 method, Lumens or light flux method, Point to point method
Standards for illumination

Unit – II Types of lamps
Incandescent lamp, ARC lamps – AC and DC arc lamps, Fluorescent lamp
Types of other lamps: Mercury vapour lamp, HPMV lamp, Mercury iodide lamp, Sodium vapour lamp, Halogen Lamps, Ultraviolet Lamps, Neon Lamps. Neon Sign Tubes. Metal halides, HID and Arc lamps
LED lamps, CFL, Lasers
Selection Criteria for lamps

Unit – III Illumination Control and Control Circuits
Purpose of lighting control, and Dimmer, Resistance type Salt water Dimmer
Working principle and operation of Dimmer
Transformer and their types, Dimmer Transformer, Auto transformer dimmer, Two winding transformer dimmer
Electronic Dimmer: working principle and operation
a. Thyristor operated dimmer
b. Triac operated dimmer
Control of Enhance Lighting, Methods used for light control, Control circuits for lamps (refer): ON/OFF control
Control circuits for lamps: single lamp controlled by single switch, two switches.
Single Lamp control by two point method, three point method and four point method,
Unit– IV  Illumination for Interior Applications

Standard for various locations of Interior Illumination
Design considerations for Interior location of residences (1/2/3/4 BHK), Commercial, Industrial premises
Illumination scheme for different Interior locations of Residential, Commercial, industrial unit

Unit– V  Illumination for Interior Applications

Factory Lighting
Street Lighting (Latest Technology), Flood Lighting
Railway Lighting
Lighting for advertisement /Hoardings/sports lighting, Agriculture and Horticulture lighting, Health Care Centres / Hospitals, Decorating Purposes, Stage Lighting, Aquariums and Shipyards
Special purpose lamps used in photography video films.

References:
4. Butterworths, Lyons Stanley, Handbook of Industrial Lighting, Butterworths

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Select relevant lamps for various applications considering illumination levels
b) Select the lighting accessories required for selected wiring scheme.
c) Design relevant illumination schemes for interior applications.
d) Design Illumination schemes for various applications
e) Design Illumination schemes for various outdoor applications.

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Course Code: EEPE***
Course Title: ILLUMINATION PRACTICES LABORATORY
Number of Credits: 1  (L: 0, T: 0, P: 2)
Prerequisites: NIL
Course Category: PE

Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Design illumination schemes and associated electrification of buildings.

Practicals:
1. Conduct illumination level assessment in workplace using lux meter.
2. Fit the given lamp in the selected mounting
3. Interpret the polar curves of the given type of lamp and verify it using the lux meter
4. Measure the illumination output of different lamps (Incandescent, Fluorescent, CFL, LED, HPSV, HPMV) and compare it with their wattage.
5. Measure illumination level with and without reflectors used in the various Luminaries.
6. Estimate and compare luminous efficiency of incandescent and compact fluorescent lamp.
7. Prepare light dimmer arrangement using the relevant dimmer type of transformer
8. Identify the given types of dimmer transformer and their parts
9. Build an electronic dimmer – Part I
10. Build another type of electronic dimmer – Part II
11. Build a single lamp control by single switch
12. Build a single lamp control by two switches
13. Build a lamp control circuit for two-point method
14. Build a lamp control circuit for three-point method
15. Build a lamp control circuit for four-point method.

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Select the relevant Illumination levels for various applications
b) Select relevant lamps for various applications
c) Select the lighting accessories required for selected wiring scheme.
d) Design relevant illumination schemes for interior applications.
e) Design illumination schemes for various applications.
f) Design illumination schemes for various outdoor applications.

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## Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain switchgear and protection schemes used in electrical power systems.

## Course contents:

### Unit – I Basics of Protection

- Necessity, functions of protective system.
- Normal and abnormal conditions.
- Types of faults and their causes.
- Protection zones and backup protection
- Short circuit fault calculations in lines fed by generators through transformers
- Need of current limiting reactors and their arrangements.

### Unit – II Circuit Interruption Devices

- Isolators- Vertical break, Horizontal break and Pantograph type.
- HRC fuses – Construction, working, characteristics and applications.
- Arc formation process, methods of arc extinction (High resistance and Low resistance), Arc voltage, Recovery voltage, Re-striking voltage, RRRV.
- HT circuit breakers (Sulphur-hexa Fluoride (SF6), Vacuum circuit breaker) - Working, construction, specifications and applications.
- L.T. circuit breaker (Air circuit breakers (ACB), Miniature circuit breakers (MCB), Moulded case circuit breakers (MCCB) and Earth leakage circuit breaker (ELCB)) - Working and applications.
- Selection of LT and HT circuit breakers (ratings), Selection of MCCB for motors.
- Gas insulated switchgear.

### Unit– III Protective Relays

- Fundamental quality requirements: Selectivity, Speed, Sensitivity, Reliability, Simplicity, Economy.
- Basic relay terminology- Protective relay, Relay time, Pick up, Reset current, current setting, Plug setting multiplier, Time setting multiplier.
- Protective relays: Classification, principle of working, construction and operation of – Electromagnetic (Attracted armature type, Solenoid type, Watt-hour meter type) relay, Thermal relay. Block diagram and working of Static relay.
- Overcurrent relay-Time current characteristics.
Microprocessor based over current relays: Block diagram, working.
Distance relaying- Principle, operation of Definite distance relays.
Directional relay: Need and operation.
Operation of current and voltage differential relay.

**Unit- IV Protection of Alternator and Transformer**

**Alternator Protection**
Faults, Differential protection Over current, earth fault, overheating and field failure, protection.
Reverse power protection.

**Transformer Protection**
Faults, Differential, over current, earth fault, over heating protection, Limitations of differential protection.
Buchholz relay: Construction, operation, merits and demerits.

**Unit- V Protection of Motors, Bus-bar and Transmission Line Motor**

**Bus bar and Transmission line**
Faults on Bus bar and Transmission Lines.
Bus bar protection: Differential and Fault bus protection.
Transmission line: Over current, Distance and Pilot wire protection.

**References:**

**Course outcomes:**
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:
a) Identify various types of faults in power system.
b) Select suitable switchgears for different applications.
c) Test the performance of different protective relays.
d) Maintain protection systems of alternators and transformers.
e) Maintain protection schemes for motors and transmission lines.
f) Maintain protection schemes for power system against overvoltages.

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### Course Code

Course Code: EEPE***

### Course Title

Course Title: SWITCHGEAR AND PROTECTION LABORATORY

### Number of Credits

Number of Credits: 1 (L: 0, T: 0, P: 2)

### Prerequisites

Prerequisites: NIL

### Course Category

Course Category: PE

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### Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain switchgear and protection schemes used in electrical power systems.

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### Course contents:

1. Identify various switchgears in the laboratory and write their specifications.
2. Test HRC fuse by performing the load test.
3. Test MCB by performing the load test.
4. Dismantle MCCB/ELCB and identify various parts.
5. Dismantle ACB/VCB and identify different parts.
6. Set the plug and time (with PSM, TSM) of induction type electromagnetic relay.
7. Test electromagnetic over-current relay by performing load test.
8. Simulate differential protection scheme for transformer with power system simulation kit.
9. Test the working of the single phasing preventer using a three phase induction motor.
10. Simulate transmission line protection by using the impedance relay/over current relay for various faults. (On transmission line protection simulation Kit).
11. Dismantle Thyrite type arrester and identify different parts.
12. Perform neutral earthing at different substations / locations.

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### Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

- Identify various types of faults in power system.
- Select suitable switchgears for different applications.
- Test the performance of different protective relays.
- Maintain protection systems of alternators and transformers.
e) Maintain protection schemes for motors and transmission lines.
f) Maintain protection schemes for power system against overvoltages.

Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain the efficient operation of various types of solar power technologies

Course contents:

Unit – I Solar Energy
Solar Map of India: Global solar power radiation
Different types of Solar water heaters: Construction, working, specifications and installation
Solar Heating systems
Solar drying and different types of Solar cookers
Solar lighting.
Preventive maintenance of all of the above.

Unit – II Concentrated Solar Power (CSP)
Concentrated Solar Power (CSP) plants or solar thermal electric systems
Parabolic Trough: Construction, working and specifications
Parabolic Dish: Construction, working and specifications
Power Tower, Fresnel Reflectors: Construction, working and specifications
Solar Stirling engines
Preventive maintenance of all of the above

Unit – III Solar PV Systems
Solar PV cell: Types construction, working, Typical specifications of solar cells
Solar PV working principle: Series and parallel connections of solar modules
Solar Photovoltaic (PV) system: components layout and working.
Solar modules, arrays and their standard specifications
Roof top and streetlight solar PV systems and typical specifications
Maintenance of these systems
Unit– IV  Solar PV Electronics

Solar Charge controllers: working and specifications, switchgear and cables
Batteries: Different types for solar PV systems, maintenance and specifications
Solar Inverters: working and specifications
Signal conditioning systems: working and specifications
Solar Power tracking: construction, working, tilt angle, solar radiation, I-V, P-V characteristics, maximum power point tracking (MPPT)
Maintenance of these systems.

Unit– V  Solar PV Off-grid and Grid Tied Systems

Solar off grid systems: layout and specifications
Solar Grid tied (on grid) systems: Working principle of grid-tied dc-ac inverter, grid synchronization and active power export
Net metering: main features and working
Solar-wind Hybrid systems: Layout and specifications.

References:
5. Rachel, Sthuthi, Earnest, Joshua; -Wind Power Technologies, PHI Learning

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Maintain the solar non-electric equipment.
b) Maintain CSP plants
c) Maintain solar PV systems.
d) Maintain solar PV electronics and MPPT systems
e) Maintain off-grid and on-grid solar power plants.

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<td>Course Title</td>
<td>SOLAR POWER TECHNOLOGIES LABORATORY</td>
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<tr>
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<td>Course Category</td>
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</tbody>
</table>
Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain the efficient operation of various types of solar power technologies

Practicals:
1. Dismantle solar power heaters
2. Assemble solar power heaters
3. Assemble the parabolic dish CSP plant.
4. Dismantle the parabolic dish CSP plant.
5. Troubleshoot a CSP plant
6. Assemble the solar PV system.
7. Dismantle the solar PV system
8. Troubleshoot a solar PV system
9. Troubleshoot a solar PV panels and arrays
10. Troubleshoot solar inverters
11. Troubleshoot solar signal conditioners
12. Troubleshoot solar PV MPPT systems
13. Troubleshoot solar off-grid systems
14. Troubleshoot solar net metering systems
15. Troubleshoot solar-wind hybrid systems.

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Maintain the solar non-electric equipment.
b) Maintain CSP plants
c) Maintain solar PV systems.
d) Maintain solar PV electronics and MPPT systems
e) Maintain off-grid and on-grid solar power plants.

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<td>Course Title</td>
<td>: WIND POWER TECHNOLOGIES</td>
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<tr>
<td>Number of Credits</td>
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Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:
Maintain large wind power plants and small wind turbines.

Course contents:

Unit – I Wind Energy and Wind Power Plants

Wind power scenario in the world and India

**Characteristics of Wind Energy:** Wind movement, wind profile, roughness, effects of obstacles in wind path.

**Types of Wind Power Plants (WPPs):** Small and large wind turbines; Horizontal and Vertical axis; Upwind and Downwind, One, Two and Three blades; constant and variable Speed; Geared, Direct-Drive and Semi-Geared (Hybrid) WPPs; WECS, WEGs, WTs, WPPs,

**WPP Tower Types:** Lattice; tubular: steel, concrete, hybrid, ladders, cables.

**WPP substation:** Switchgear, transformers, inside layouts of Electric electronic panels at block level.

Unit – II Construction and Working of Large Wind Power Plants.

**Wind Turbine Terminologies:** Cut-in, cut-out and survival wind speeds, Threshold wind speeds, rated power, nominal power, Wind Power Curve,

**Major parts and Functions of WPP:** Rotor blades, hub, nacelle, tower, electric sub-station, nacelle layouts of Geared, Direct-Drive and Semi-Geared WPPs, Main shaft, gearbox, electric generator, electronic control panels

**Rotation principles:** Drag and Lift principle, thrust and torque of wind turbine rotor.

**Different types of Sensors:** Anemometer, wind vane, rpm sensors of main shaft and generator, temperature sensors of nacelle, gearbox and generator; cable untwisting and vibration sensors.

**Different types of Actuators:** Electric and hydraulic pitching and yawing mechanisms, cable untwisting and braking mechanisms

Unit – III Aerodynamic Control, Electric Generators and Grid Connection

Aerodynamic Control of WPPs: Stall Pitch and Active Stall.

Braking mechanisms of large WPPs.

**Electric Generator Types:** Working of Squirrel-Cage rotor Induction Generator (SCIG), Wound-Rotor Induction Generator (WRIG), Doubly-Fed Induction Generator (DFIG), wound rotor and permanent magnet synchronous generators.

Electric grid connection of WPPs: Local Impacts and system wide impact

Unit – IV Maintenance of Large Wind Power Plants

**General maintenance of WPPs:** preventive maintenance schedule of actuators such as yaw control, pitch control, braking mechanisms and sensors; oiling and greasing; electric and electronic equipment related; tower related; minor repairs; some tips,

**Scheduled Maintenance:** of Stall and Pitch and Active Pitch controlled WPPs

**Unscheduled maintenance:** operational factors, design faults, wear and tear of components, spurious trip, Major repairs.

Software related, warranty and insurance related issues
Unit– V  Construction and Working Small Wind Turbines

Types and working of different type of small wind turbines (SWT): Classification: Horizontal and Vertical axis, Upwind and Downwind, One, Two and Three blades; Constant and Variable Speed; Direct-Drive and Geared; braking of SWTs

Parts of SWTs: Rotor, generator, gearbox, tower, electric control panel, tale vane, anemometer, wind vane, temperature and rpm sensors.

Working SWTs: Direct-drive and Geared.

Electrical generators in SWTs: permanent magnet synchronous generators, induction generators

SWT towers: Lattice tubular type, hydraulic towers, ladders, cables,

Unit– VI  Maintenance of Small Wind Turbines

Small wind turbine assembly.

Installation of different types of small wind turbines (SWT): tubular and lattice types.

SWT Routine maintenance: Tips; Preventive maintenance schedule of: braking mechanisms, sensors; oiling and greasing related; electric and electronic equipment related; tower related; software related, minor repairs

Power electronic devices and converters in different types of SWTs: thyristors, power transistors

Common electrical and mechanical faults in SWTs

References:


Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Identify the various types of wind power plants and their auxiliaries.

b) Maintain the normal working of large wind turbines.

c) Optimize the aerodynamic and electric control of large wind power plants.

d) Troubleshoot the common faults of large wind power plants.
c) Maintain the normal working of small wind turbines.

f) Troubleshoot small wind turbines.

Course Code : EEPE***
Course Title : WIND POWER TECHNOLOGIES LABORATORY
Number of Credits : 1 (L: 0, T: 0, P: 2)
Prerequisites (Course code) : NIL
Course Category : PE

Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain large wind power plants and small wind turbines.

Practicals:
1. Identify the specified items of a wind farm after watching the video clip.
2. Identify the specified parts inside the nacelle of a large wind power plant after watching the video clips.
3. Check the performance of the temperature and vibration sensor used in 125/150 kW WPPs.
4. Check the performance of the SCIG
5. Check the performance of the PMSG
6. Check the performance of the hydraulic and electric pitch actuator and yaw actuator used in 125/150 kW WPPs.
7. Check the performance of the contactless RPM sensors used in WPPs
8. Troubleshoot the anemometer and wind vane
9. Check the generator performance of SWTs.
10. Identify the parts of a direct-drive SWT
11. Identify the parts of a geared SWT
12. Assemble/Dismantle a direct-drive SWT
13. Assemble/Dismantle a geared SWT
14. Check the performance of direct-drive SWT
15. Check the performance of geared SWT
16. Simulate faults in the small wind turbine trainer
17. Troubleshoot direct-drive SWT
18. Troubleshoot geared SWT
19. Interpret the wiring of a SWT electric-electronic control panel

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:
a) Identify the various types of wind power plants and their auxiliaries.
b) Maintain the normal working of large wind turbines.
c) Optimize the aerodynamic and electric control of large wind power plants.
d) Troubleshoot the common faults of large wind power plants.
e) Maintain the normal working of small wind turbines.
f) Troubleshoot small wind turbines.

Course Code : EEPE***  
Course Title : BIOMASS AND MICRO-HYDRO POWER PLANTS  
Number of Credits : 3  
Prerequisites : NIL  
Course Category : PE

Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain the efficient operation of various types of Biomass and Microhydro power plants.

Course contents:

Unit– I Basics of Biomass-based Power Plants
Properties of solid fuel for biomass power plants: bagasse, wood chips, rice husk, municipal waste
Properties of liquid and gaseous fuel for biomass power plants: Jatropha, bio-diesel gobar gas
Layout of a Bio-chemical based (e.g. biogas) power plant:
Layout of a Thermo-chemical based (e.g. Municipal waste) power plant
Layout of a Agro-chemical based (e.g. bio-diesel) power plant
Selection of biomass power plants.

Unit– II Biomass Gasification Power Plants
The basic principle to convert Agriculture and forestry products and wood processing remains (including rick husks, wood powder, branches, offcuts, corn straws, rice straws, wheat straws, cotton straws, fruit shells, coconut shells, palm shells, bagasse, corncobs) into combustible gas
General Construction and working of a typical gasifier
Power generating in gas engine:
Strengths and limitations of Agriculture and forestry products gasifier
Preventive maintenance steps different types of biomass gasifiers.

Unit– III Different Types of Gasifiers
Construction and working of the following types of gasifiers:
Rice Husk Gasification Power Plant and their specifications
Straw Gasification Power Plant and their specifications
Bamboo Waste, Bamboo Chips Gasification Power Plant and their specifications
Coconut shell, coconut peat, coconut husk, Gasification Power Plant and their specifications
Bagasse/Sugar Cane Trash Gasification Power Plant and their specifications
Gobar gas plant and its specifications
Breakdown maintenance of biomass power plant at the module level.

Unit– IV Micro-hydro Power Plants
- Locations of microhydro power plant
- Energy conversion process of hydro power plant.
- Classification of hydro power plant: High, medium and low head.
- General Layouts of typical micro-hydro power plant.
- Strengths and limitations of microhydro power plants

Unit– V Different types of Microhydopower plants
- Construction and working of High head – Pelton turbine and their specifications
- Construction and working of Medium head – Francis turbine and their specifications
- Construction and working of Low head – Kaplan turbine and their specifications
- Preventive and breakdown maintenance of microhydro power plants
- Safe Practices for microhydro power plants

References:
4. Rachel, Sthuthi, Earnest, Joshua;-Wind Power Technologies, PHI Learning

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:
   a) Select the relevant biomass power plant
   b) Undertake the preventive maintenance of different types of biomass gasifiers
   c) Undertake the breakdown maintenance of different types of biomass gasifiers
   d) Maintain the optimised working of large wind power plants
   e) Maintain the optimised working of small wind turbines.
   f) Maintain the optimised working of micro hydro power plants.

******
Course Code : EEPE***
Course Title : BIOMASS AND MICRO-HYDRO POWER PLANTS LABORATORY
Number of Credits : 1 (L: 0, T: 0, P: 2)
Prerequisites (Course code) : NIL
Course Category : PE

Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain the efficient operation of various types of Biomass and Microhydro power plants.

Practicals:
1. Identify different components of a typical Biomass power plant.
2. Identify different biomass resources and evaluate their energy potential.
3. Determine the carbon content of solid biomass.
4. Assemble the Biogas power plant.
5. Dismantle the Biogas power plant
6. Identify the components of the high head micro hydro power plant
7. Identify the components of the medium head micro hydro power plant
8. Identify the components of the low head micro hydro power plant
9. Assemble a high head micro hydro power plant
10. Assemble a medium head micro hydro power plant
11. Assemble a low head micro hydro power plant
12. Undertake preventive maintenance of the high head micro hydro power plant
13. Undertake preventive maintenance of the medium head micro hydro power plant
14. Undertake preventive maintenance of the low head micro hydro power plant
15. Check the performance of Pelton wheel micro hydro power plant

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Select the relevant biomass power plant
b) Undertake the preventive maintenance of different types of biomass gasifiers
c) Undertake the breakdown maintenance of different types of biomass gasifiers
d) Maintain the optimised working of large wind power plants
e) Maintain the optimised working of small wind turbines.
f) Maintain the optimised working of micro hydro power plants.

******
Course Code : EEPE ***  
Course Title : ELECTRIC VEHICLES  
Number of Credits : 3 (L: 3, T: 0, P: 0)  
Prerequisites : NIL  
Course Category : PE

Course objectives:  
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:  

- Maintain electric vehicles

Course contents:  

Unit – I Introduction to Hybrid Electric Vehicles  
Evolution of Electric vehicles  
Advanced Electric drive vehicle technology Vehiciles-Electric vehicles (EV), Hybrid Electric drive (HEV), Plug in Electric vehicle (PIEV),  
Components used Hybrid Electric Vehicle  
Economic and environmental impacts of Electric hybrid vehicle  
Parameters affecting Environmental and economic analysis  
Comparative study of vehicles for economic, environmental aspects

Unit – II Dynamics of hybrid and Electric vehicles  
General description of vehicle movement  
Factors affecting vehicle motion- Vehicle resistance, tyre ground adhesion, rolling resistance, aerodynamic drag, equation of grading resistance, dynamic equation  
Drive train configuration, Automobile power train, classification of vehicle power plant  
Performance characteristics of IC engine, electric motor, need of gear box  
Classification of motors used in Electric vehicles  
Basic architecture of hybrid drive trains, types of HEVs  
Energy saving potential of hybrid drive trains  
HEV Configurations-Series, parallel, Series-parallel, complex.

Unit- III DC-DC Converters for EV and HEV Applications  
EV and HEV configuration based on power converters  
Classification of converters –unidirectional and bidirectional  
Principle of step down operation  
Boost and Buck- Boost converters  
Principle of Step-Up operation  
Two quadrant converters; multi quadrant converters
Unit– IV   DC-AC Inverter & Motors for EV and HEVs

DC-AC Converters
Principle of operation of half bridge DC-AC inverter (R load, R-L load)
Single phase Bridge DC-AC inverter with R load, R-L load
Electric Machines used in EVs and HEVs, principle of operation, working & control
Permanent magnet motors, their drives, switched reluctance motor
Characteristics and applications of above motors

Unit– V   Batteries

Overview of batteries
Battery Parameters, types of batteries
Battery Charging, alternative novel energy sources-solar photovoltaic cells, fuel cells, super capacitors, flywheels
Control system for EVs and HEVs, overview, Electronic control unit ECU
Schematics of hybrid drive train, control architecture
Regenerative braking in EVs

References:
2. Fuhs, A. E. Hybrid Vehicles and the Future of Personal Transportation, CRC Press
3. Gianfranco, Electric and Hybrid Vehicles: Power Sources, Models, Sustainability, Infrastructure And The Market, Pistoia Consultant, Rome, Italy
5. Husain, I. Electric and Hybrid Electric Vehicles, CRC Press
7. Lechner G. and H. Naunheimer, Automotive Transmissions: Fundamentals, Selection, Design and Application, Springer

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Interpret the salient features of Hybrid electric vehicles.
b) Interpret the Dynamics of hybrid and Electric vehicles
c) Maintain the DC-DC converters in EV applications.
d) Maintain the DC-AC converters in EV applications
c) Select the batteries for EV applications.

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**Course objectives:**
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain electric vehicles

**Practicals:**
1. Develop block diagram of Electric vehicle and identify parts
2. Case study- Compare minimum four vehicles for economic and environmental analysis
3. Develop schematic diagram of hybrid electric vehicle and identify the components fluorescent lamp.
4. Prepare report on Plug in Electric vehicle by visiting a charging station
5. Inspect and install inverter of given lead acid battery
6. Prepare a report on batteries used from market survey
7. Collect specifications of converters and inverters used for Electric vehicles a single lamp control by two switches
8. Diagnose, repair and maintain battery used in electric vehicle
9. Prepare test procedure for equipment used in Electric vehicle
10. List safety procedures and schedule for handling HEVs and EVs.

**Course outcomes:**
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Interpret the salient features of Hybrid electric vehicles.
b) Interpret the Dynamics of hybrid and Electric vehicles
c) Maintain the DC-DC converters in EV applications.
d) Maintain the DC-AC converters in EV applications
e) Select the batteries for EV applications.

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Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain electric traction systems.

Course contents:

Unit - I Basics of Traction
General description of Electrical Traction system in India.
Advantages and Disadvantages of Electric Drive, Diesel Electric Drive, Battery Drive
Problems associated with AC traction System and remedies for it.
Voltage balance, current balance, production of harmonics, induction effects.
Metro rail system, features

Unit - II Power Supply Arrangements
Constituents of supply system:-
- Substation: layout, list of equipment and their functions
- Feeding post: list of equipment and their functions
- Feeding and sectioning Arrangements
- Sectioning and paralleling post
- Sub sectioning and Paralleling post
- Sub sectioning post
- Elementary section
Major equipment at substation, Miscellaneous equipment at control post or Switching station
Protection system for traction transformer and 25 kV centenary construction

Unit - III Overhead Equipment
Different types of overhead equipments
Pentagonal OHE Centenary Construction
Different Types of Centenary according to speed Limit
OHE Supporting Structure, Cantilever assembly diagram
Overhead system- Trolley collector, Bow collector, Pantograph Collector
Types and construction of pantograph

Unit - IV Electric Locomotive
Classification and Nomenclature of Electric Locomotive
Block diagram of AC locomotive
Power Circuit of AC Locomotive
Equipment (List and Function only) used in auxiliary circuit of AC Locomotive
Loco bogie classification according to wheel arrangements
Maintenance of AC systems
Unit V  Traction Motors and Train Lighting
Desirable characteristics of traction motor.
Types of motors used for traction with their characteristics and features
Control of motors used for traction and methods to control
Requirements of braking, types of braking
Electric braking, Regenerative braking
Systems of train lighting, Single battery, double battery parallel block system
SG, HOG, End on generation

Unit VI.  Signalling and Supervisory Control
Requirements of signaling systems
Types of signals, track circuits
Advantages of remote control
Systems of remote control, equipment and network
Metro rail-supply systems, advantages, schemes in India

References:
2. Gupta J.B., S.K.Kataria and Son, Utilization of Electric power and traction
4. Partab H., Dhanpat Rai and Co, Modern Electric Traction
5. Suryanarayana N.V., New Age International Publishers, Reprint 2010

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:
   a) Interpret the traction layout and its systems
   b) Maintain the power supply arrangements.
   c) Maintain the function of the overhead equipment for electric traction
   d) Maintain the different components of the electric locomotive.
   e) Maintain the traction motor and train lighting system
   f) Maintain the signalling and supervisory control systems.

******
Course Code : EEPE***
Course Title : ELECTRIC TRACTION LABORATORY
Number of Credits : 1 (L: 0, T: 0, P: 2)
Prerequisites (Course code) : NIL
Course Category : PE

Course objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain electric traction systems

Practicals:
1. Dismantle a traction motor
2. Assemble a traction motor
3. Troubleshoot a traction motor
4. Visit electric-traction train lighting system installation, identify components of system and prepare report
5. Visit electric-traction loco shed, investigate working of each section & prepare report
6. Visit to Traction Substation or feeding post (for layout and OHE) and write a report
7. Visit to Railway Station (for signalling and train lighting) and writing a report on visit
8. Draw traction substation Layout on drawing sheet and prepare report
9. Draw Pentagonal OHE Catenary, different Catenaries according to speed limit, OHE supporting structure on drawing sheet and prepare report

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Interpret the traction layout and its systems
b) Maintain the power supply arrangements.
c) Maintain the function of the overhead equipment for electric traction
d) Maintain the different components of the electric locomotive.
e) Maintain the traction motor and train lighting system
f) Maintain the signalling and supervisory control systems.

******
CHAPTER 5

Mechanical Engineering
Curriculum Structure
(III to VI Semesters)
## 5.1 List of Programme Core Courses [PC]

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**Total Credits**: 55
### 5.2 List of Program Elective Courses [PE]

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**Total Credits** 12

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### Manufacturing Technology

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### Applied Courses in Mechanical Engineering

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### 5.3 Semester-wise Detailed Curriculum

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### Mechanical Engineering Curriculum Structure

#### Semester V

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^one credit is carried forward from the V\textsuperscript{th} semester major project evaluation.
Semester III

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<th>Course Code</th>
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<tr>
<td>Course Title</td>
<td>BASIC MECHANICAL ENGINEERING</td>
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<td>Number of Credits</td>
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<td>Prerequisites</td>
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<tr>
<td>Course Category</td>
<td>PC</td>
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Course Objectives:
- To understand General Principles of Mechanical Engineering.
- To understand laws of thermodynamics, thermal and thermodynamic Processes.
- To understand working principles of power developing and power absorbing devices.
- To understand basic materials and manufacturing processes.

Course Content:


Reference Books:
4. Workshop Technology (Vol. 1 and 2) – B. S. Raghuvanshi, Dhanpath Rai and Sons, New Delhi
5. Basic Mechanical Engineering – J Benjamin
6. Elements of Mechanical Engineering – Roy and Choudhary
7. Engineering Thermodynamics – Spalding and Cole

Course outcomes:
At the end of the course, the student will be able to:

| CO1 | Understand basics of thermodynamics and components of a thermal power plant |
| CO2 | Understand basics of heat transfer, refrigeration and internal combustion engines |
| CO3 | Understand mechanism of thermal power plant and boiler operation |
| CO4 | Identify engineering materials, their properties, manufacturing methods encountered in engineering practice |
| CO5 | Understand functions and operations of machine tools including milling, shaping, grinding and lathe machines |

Course Code: MEPC203
Course Title: COMPUTER AIDED MACHINE DRAWING PRACTICE
Number of Credits: 2 (L: 0, T: 0, P:4)
Prerequisites: Engineering Graphics (ESC101)
Course Category: PC

Course Objectives:
- To use computer aided drafting,
- To prepare geometrical model of various machine elements
- To draw the different views of machine elements
- To interpret the drawing in engineering field and illustrate three dimensional objects

Course Content:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Topics for practice</th>
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<tr>
<td>I</td>
<td>Introduction to CAD software.</td>
</tr>
<tr>
<td>II</td>
<td>Drawing aids and editing commands.</td>
</tr>
<tr>
<td>III</td>
<td>Basic dimensioning, hatching, blocks and views.</td>
</tr>
<tr>
<td>IV</td>
<td>Isometric drawing, printing and plotting</td>
</tr>
<tr>
<td>V</td>
<td>Machine Drawing practice using Auto CAD: Detailed drawings of following machine parts are to be given to the students to assemble and draw the sectional or plain elevations, plans and side views with dimensioning and bill of materials using cad software (12 exercises). 1) Sleeve &amp; Cotter Joint 2) Spigot &amp; Cotter Joint 3) Knuckle Joint 4) Stuffing Box 5) Screw Jack 6) Foot Step Bearing 7) Universal Coupling 8) Plummer Block 9) Simple Eccentric 10) Machine Vice 11) Connecting Rod 12) Protected Type Flanged Coupling.</td>
</tr>
</tbody>
</table>

Reference Books:
Course outcomes:

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

| CO1  | Understand the representation of materials used in machine drawing |
| CO2  | Draw the development of surfaces for sheet metal working applications. |
| CO3  | Draw the machine elements including keys, couplings, cotters, riveted, bolted and welded joints. |
| CO4  | Construct an assembly drawing using part drawings of machine components |
| CO5  | Represent tolerances and the levels of surface finish of machine elements. |

Course Code : MEPC205
Course Title : MATERIAL SCIENCE & ENGINEERING
Number of Credits : 3  (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : PC

Course Objectives:

- To understand crystal structures and atomic bonds.
- To understand the properties of different types of ferrous metals and alloys.
- To understand the properties of different types of non-ferrous metals and alloys.
- To understand various metallic failures and acquire the knowledge of testing of materials.
- To understand the concept of corrosion and its prevention.

Course Content:

UNIT-I: Crystal structures and Bonds: Unit cell and space lattice: Crystal system: The seven basic crystal systems; Crystal structure for metallic elements: BCC, FCC and HCP; Coordination number for Simple Cubic, BCC and FCC; Atomic radius: definition, atomic radius for Simple Cubic, BCC and FCC; Atomic Packing Factor for Simple Cubic, BCC, FCC and HCP; Simple problems on finding number of atoms for a unit cell.

Bonds in solids: Classification - primary or chemical bond, secondary or molecular bond; Types of primary bonds: Ionic, Covalent and Metallic Bonds; Types of secondary bonds: Dispersion bond, Dipole bond and Hydrogen bond.

UNIT-II: Phase diagrams, Ferrous metals and its Alloys: Isomorphs, eutectic and eutectoid systems; Iron-Carbon binary diagram; Iron and Carbon Steels; flow sheet for production of iron and steel; Iron ores – Pig iron: classification, composition and effects of impurities on iron; Cast Iron: classification, composition, properties and uses; Wrought Iron: properties, uses/applications of wrought iron; comparison of cast iron, wrought iron and mild steel and high carbon steel; standard commercial grades of steel as per BIS and AISI; Alloy Steels – purpose of alloying; effects of alloying elements – Important alloy steels: Silicon steel, High Speed Steel (HSS), heat resisting steel, spring steel, Stainless Steel (SS): types of SS, applications of SS – magnet steel – composition, properties and uses.

Unit-IV: Failure analysis & Testing of Materials: Introduction to failure analysis; Fracture: ductile fracture, brittle fracture; cleavage; notch sensitivity; fatigue; endurance limit; characteristics of fatigue fracture; variables affecting fatigue life; creep; creep curve; creep fracture; Destructive testing: Tensile testing; compression testing; Hardness testing: Brinell, Rockwell; bend test; torsion test; fatigue test; creep test. Non-destructive testing: Visual Inspection; magnetic particle inspection; liquid penetrant test; ultrasonic inspection; radiography.

Unit-V: Corrosion & Surface Engineering: Nature of corrosion and its causes; Electrochemical reactions; Electrolytes; Factors affecting corrosion: Environment, Material properties and physical conditions; Types of corrosion; Corrosion control: Material selection, environment control and design; Surface engineering processes: Coatings and surface treatments; Cleaning and mechanical finishing of surfaces; Organic coatings; Electroplating and Special metallic plating; Electro polishing and photo-etching; Conversion coatings: Oxide, phosphate and chromate coatings; Thin film coatings: PVD and CVD; Surface analysis; Hard-facing, thermal spraying and high-energy processes; Process/material selection. Pollution norms for treating effluents as per standards.

Reference Books:

Course outcomes
At the end of the course, the student will be able to:

| CO1  | Explain about crystal structures and atomic bonds. |
| CO2  | Describe about classification of ferrous metals and their properties. |
| CO3  | Explain about non-ferrous metals, cutting tool materials and composites along with their properties. |
| CO4  | Describe about the various metallic failures and knowledge in testing of materials. |
| CO5  | Explain the principle of corrosion, their types and its prevention methods along with the various surface engineering processes. |

Course Code : MEPC207
Course Title : FLUID MECHANICS & HYDRAULIC MACHINERY
Number of Credits : 3 (L: 2, T: 1, P: 0)
Prerequisites : NIL
Course Category : PC

Course Objectives:
- To understand fluid flow & related machinery for power generation, water supply and irrigation.
- To Select and use appropriate flow measuring device.
- To Select and use appropriate pressure measuring device.
- To understand and analyze the performance of pumps and turbines.
Course Content:

**UNIT-I: Properties of fluid:** Density, Specific gravity, Specific Weight, Specific Volume, Dynamic Viscosity, Kinematic Viscosity, Surface tension, Capillarity, Vapour Pressure, Compressibility.

**Fluid Pressure & Pressure Measurement:** Fluid pressure, Pressure head, Pressure intensity, Concept of vacuum and gauge pressures, atmospheric pressure, absolute pressure, Simple and differential manometers, Bourdan pressure gauge, Concept of Total pressure on immersed bodies, center of pressure, Simple problems on Manometers.

**Unit-II: Fluid Flow:** Types of fluid flows, Path line and Stream line, Continuity equation, Bernoulli's theorem, Principle of operation of Venturimeter, Orifice meter and Pitot tube, Derivations for discharge, coefficient of discharge and numerical problems.

**Flow Through Pipes:** Laminar and turbulent flows; Darcy's equation and Chezy's equation for frictional losses, Minor losses in pipes, Hydraulic gradient and total gradient line, Numerical problems to estimate major and minor losses.

**Unit-III: Impact of jets:** Impact of jet on fixed vertical, moving vertical flat plates, Impact of jet on curved vanes with special reference to turbines & pumps, Simple Numericals on work done and efficiency.

**Unit-IV: Hydraulic Turbines:** Layout of hydroelectric power plant, Features of Hydroelectric power plant, Classification of hydraulic turbines, Selection of turbine on the basis of head and discharge available, Construction and working principle of Pelton wheel, Francis and Kaplan turbines, Draft tubes – types and construction, Concept of cavitation in turbines, Calculation of Work done, Power, efficiency of turbines, Unit quantities and simple numericals.

**Unit-V: Centrifugal Pumps:** Principle of working and applications, Types of casings and impellers, Concept of multistage, Priming and its methods, Cavitation, Manometric head, Work done, Manometric efficiency, Overall efficiency. Numericals on calculations of overall efficiency and power required to drive pumps.

**Reciprocating Pumps:** Construction, working principle and applications of single and double acting reciprocating pumps, Concept of Slip, Negative slip, Cavitation and separation.

**Reference Books:**

3. Hydraulics and fluid mechanics including Hydraulic machines – Modi P.N. and Seth S.M., Standard Book House. New Delhi
5. Hydraulic, fluid mechanics & fluid machines – S. Ramamrutham, Dhanpat Rai and Sons, New Delhi

**Course outcomes**

At the end of the course, the student will be able to:
CO1 Measure various properties such as pressure, velocity, flow rate using various instruments.

CO2 Calculate different parameters such as co-efficient of friction, power, efficiency etc of various Systems.

CO3 Describe the construction and working of turbines and pumps.

CO4 Test the performance of turbines and pumps.

CO5 Plot characteristics curves of turbines and pumps.

******

Course Code : MEPC209
Course Title : MANUFACTURING ENGINEERING
Number of Credits : 3  (L: 3, T: 0, P: 0)
Prerequisites : Basic Mechanical Engineering (MEPC102)
Course Category : PC

Course Objectives:
• To understand the importance of cutting fluids & lubricants in machining.
• To study various types of basic production processes. To select, operate and control the appropriate processes for specific applications.
• To understand the concept of gear making and list various gear materials.
• To understand the importance of press tools and understand various die operations.
• To understand Grinding and finishing processes.

Course Content:
UNIT-I: Cutting Fluids & Lubricants: Introduction; Types of cutting fluids, Fluids and coolants required in turning, drilling, shaping, sawing & broaching; Selection of cutting fluids, methods of application of cutting fluid; Classification of lubricants (solid, liquid, gaseous), Properties and applications of lubricants.

Lathe Operations: Types of lathes – light duty, Medium duty and heavy duty geared lathe, CNC lathe; Specifications; Basic parts and their functions; Operations and tools – Turning, parting off, Knurling, facing, Boring, drilling, threading, step turning, taper turning.

UNIT-II: Broaching Machines: Introduction to broaching; Types of broaching machines – Horizontal type (Single ram & duplex ram), Vertical type, Pull up, pull down, and push down; Elements of broach tool; broach teeth details; Nomenclature; Tool materials.

Drilling: Classification; Basic parts and their functions; Radial drilling machine; Types of operations; Specifications of drilling machine; Types of drills and reamers.

UNIT-III: Welding: Classification; Gas welding techniques; Types of welding flames; Arc Welding – Principle, Equipment, Applications; Shielded metal arc welding; Submerged arc welding; TIG / MIG welding; Resistance welding - Spot welding, Seam welding, Projection welding; Welding defects; Brazing and soldering: Types, Principles, Applications.

Milling: Introduction; Types of milling machines: plain, Universal, vertical; constructional details – specifications; Milling operations: simple, compound and differential indexing; Milling cutters – types; Nomenclature of teeth; Teeth materials; Tool signature of milling cutter; Tool & work holding devices.

UNIT-IV: Gear Making: Manufacture of gears – by Casting, Moulding, Stamping, Coining - Extruding, Rolling, Machining; Gear generating methods: Gear Shaping with pinion cutter & rack cutter; Gear hobbing; Description of gear hob; Operation of gear hobbing machine; Gear finishing processes; Gear materials and specification; Heat treatment processes applied to gears.

Press working: Types of presses and Specifications, Press working operations - Cutting, bending,
drawing, punching, blanking, notching, lancing; Die set components- punch and die shoe, guide pin, bolster plate, stripper; stock guide, feed stock, pilot; Punch and die clearances for blanking and piercing, effect of clearance.

Unit-V: Grinding and finishing processes: Principles of metal removal by Grinding; Abrasives – Natural & Artificial; Bonds and binding processes: Vitrified, silicate, shellac, rubber, bakelite; Factors affecting the selection of grind wheels: size and shape of wheel, kind of abrasive, grain size, grade and strength of bond, structure of grain, spacing, kinds of bind material; Standard marking systems: Meaning of letters & numbers sequence of marking, Grades of letters; Grinding machines classification: Cylindrical, Surface, Tool & Cutter grinding machines; Construction details; Principle of centreless grinding; Advantages & limitations of centre less grinding; Finishing by grinding: Honing, Lapping, Super finishing; Electroplating: Basic principles, Plating metals, applications; Hot dipping: Galvanizing, Tin coating, Parkerising, Anodizing; Metal spraying: wire process, powder process and applications; Organic coatings: Oil base Paint, Lacquer base, Enamels, Bituminous paints, rubber base coating; Finishing specifications.

Reference Books:

Course outcomes:
At the end of the course, the student will be able to:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Know and identify basic manufacturing processes for manufacturing different components.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Operate &amp; control different machines and equipments.</td>
</tr>
<tr>
<td>CO3</td>
<td>Produce jobs as per specified dimensions and inspect the job for specified dimensions.</td>
</tr>
<tr>
<td>CO4</td>
<td>Select the specific manufacturing process for getting the desired type of output.</td>
</tr>
<tr>
<td>CO5</td>
<td>Adopt safety practices while working on various machines.</td>
</tr>
</tbody>
</table>

******

Course Code : MEPC211
Course Title : THERMAL ENGINEERING - I
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : Basic Mechanical Engineering (MEPC102)
Course Category : PC

Course Objectives:
- To give a good understanding of and thorough insight into all important aspects of thermal systems, energy control and the general issue of energy.
- To understand the principles & working of various power producing & power absorbing devices.
- To study, analyze and evaluate the operation and the performance of I.C. engines, compres-
ors and refrigerators, to apply pinch technology and to critically analyze and describe the
global behavior of integrated thermal systems.

Course Content:
UNIT-I: Sources of Energy: Brief description of energy Sources: Classification of energy sources
- Renewable, Non-Renewable; Fossil fuels, including CNG, LPG; Solar Energy: Flat plate and concen-
trating collectors & its applications (Solar Water Heater, Photovoltaic Cell, Solar Distillation); Wind
Energy; Tidal Energy; Ocean Thermal Energy; Geothermal Energy; Biogas, Biomass, Bio-diesel; Hy-
draulic Energy, Nuclear Energy; Fuel cell.

Unit-II: Internal Combustion Engines: Assumptions made in air standard cycle analysis; Brief de-
scription of Carnot, Otto and Diesel cycles with P-V and T-S diagrams; Internal and external com-
bustion engines; advantages of I.C. engines over external combustion engines; classification of I.C.
engines; neat sketch of I.C. engine indicating component parts; Function of each part and materials
used for the component parts - Cylinder, crank case, crank pin, crank, crank shaft, connecting rod,
wrist pin, piston, cooling pins cylinder heads, exhaust valve, inlet valve; Working of four-stroke and
two-stroke petrol and diesel engines; Comparison of two stroke and four stroke engines; Compar-
ison of C.I. and S.I. engines; Valve timing and port timing diagrams for four stroke and two stroke
engines.

Unit-III: I.C. Engine Systems: Fuel system of Petrol engines; Principle of operation of simple and Ze-
nith carburetors; Fuel system of Diesel engines; Types of injectors and fuel pumps; Cooling system
- air cooling, water cooling system with thermo siphon method of circulation and water cooling sys-
tem with radiator and forced circulation (description with line diagram). Comparison of air cooling
and water cooling system; Ignition systems – Battery coil ignition and magneto ignition (description
and working). Comparison of two systems; Types of lubricating systems used in I.C. engines with
line diagram; Types of governing of I.C. engines – hit and miss method, quantitative method, qualita-
tive method and combination methods of governing; their applications; Objective of super charging.

Unit-IV: Performance of I.C. Engines: Brake power; Indicated power; Frictional power; Brake and
Indicated mean effective pressures; Brake and Indicated thermal efficiencies; Mechanical efficiency;
Relative efficiency; Performance test; Morse test; Heat balance sheet; Methods of determination of

Unit-V: Air Compressors: Functions of air compressor; Uses of compressed air; Types of air com-
pressors; Single stage reciprocating air compressor - its construction and working (with line dia-
gram) using P-V diagram; Multi stage compressors – Advantages over single stage compressors; Ro-
tary compressors: Centrifugal compressor, axial flow type compressor and vane type compressors.
Refrigeration & Air-conditioning: Refrigeration; Refrigerant; COP; Air Refrigeration system: com-
ponents, working & applications; Vapour Compression system: components, working & applications;
Air conditioning; Classification of Air-conditioning systems; Comfort and Industrial Air-Condition-
ing; Window Air-Conditioner; Summer Air-Conditioning system, Winter Air-Conditioning system, Year-round Air-Conditioning system.

Reference Books:

Course outcomes:
At the end of the course, the student will be able to:
CO1 Know various sources of Energy and their applications.

CO2 Classify I.C. engines and understand their working and constructional features.

CO3 Draw the energy flow diagram of an I.C. engine and evaluate its performance.

CO4 Describe the constructional features of air compressor and working of different air compressors.

CO5 Know the applications of refrigeration and Classify air-conditioning systems.

*******

Course Code : MEPC213
Course Title : MANUFACTURING ENGINEERING LAB-I
Number of Credits : 1.5     (L: 0, T: 0, P: 3)
Prerequisites : Basic Mechanical Engineering (MEPC102) Manufacturing Engineering (MEPC207)
Course Category : PC

Course Objectives:
- To Practice the casting principles and operations in foundry.
- To Practice the operation of Lathe.
- To Practice the joining of metals using different Welding techniques.

Course Content:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Topics for practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Moulding &amp; casting of (i) Connecting rod (ii) Solid bearing (iii) V-Pulley/Gear Pulley</td>
</tr>
<tr>
<td>II</td>
<td>Arc welding (i) Lap Joint (ii) Butt Joint (iii) T-Joint</td>
</tr>
<tr>
<td>III</td>
<td>Gas welding (i) Lap Joint (ii) Butt Joint</td>
</tr>
<tr>
<td>IV</td>
<td>Spot welding (i) Lap Joint</td>
</tr>
<tr>
<td>V</td>
<td>Turning Exercise (i) Facing, Step Turning &amp; Chamfering (ii) Step Turning &amp; Taper Turning (iii) Step Turning &amp; Groove Cutting (iv) Step Turning &amp; &amp; Knurling (v) Step Turning &amp; Thread Cutting (vi) Turning and Drilling</td>
</tr>
<tr>
<td>VI</td>
<td>Grinding the Lathe Cutting tools to the required angles</td>
</tr>
<tr>
<td>VII</td>
<td>Study of Lathe, Drilling machine, shaping machine and slotting machine</td>
</tr>
<tr>
<td>VIII</td>
<td>The dismantling some of the components of lathe and then assemble the same</td>
</tr>
<tr>
<td>IX</td>
<td>List the faults associated with lathe and its remedies</td>
</tr>
<tr>
<td>X</td>
<td>The routine and preventive maintenance procedure for lathe</td>
</tr>
</tbody>
</table>

Reference Books:

Course outcomes:
At the end of the course, the student will be able to:
Course Objectives:
- To calibrate the given flow measuring device.
- To apply the knowledge acquired in theory subject.
- To analyse the performance of turbines and pumps.

Course Content:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Topics for practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Verification of Bernoulli’s theorem.</td>
</tr>
<tr>
<td>II</td>
<td>Determination of Coefficient of Discharge of Venturimeter.</td>
</tr>
<tr>
<td>III</td>
<td>Determination of Coefficient of Discharge, coefficient of contraction and coefficient of velocity of Orificemeter.</td>
</tr>
<tr>
<td>IV</td>
<td>Determination of coefficient of friction of flow through pipes.</td>
</tr>
<tr>
<td>V</td>
<td>Determination of force exerted by the jet of water on the given vane.</td>
</tr>
<tr>
<td>VI</td>
<td>Determination of minor losses of flow through pipes.</td>
</tr>
<tr>
<td>VII</td>
<td>Calibration of pressure gauge using dead weight pressure gauge tester.</td>
</tr>
<tr>
<td>VIII</td>
<td>Trial on centrifugal pump to determine overall efficiency.</td>
</tr>
<tr>
<td>IX</td>
<td>Trial on reciprocating pump to determine overall efficiency.</td>
</tr>
<tr>
<td>X</td>
<td>Trial on Pelton wheel to determine overall efficiency.</td>
</tr>
<tr>
<td>XI</td>
<td>Trial on Francis/Kaplan turbine to determine overall efficiency.</td>
</tr>
</tbody>
</table>


Course outcomes:

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

<table>
<thead>
<tr>
<th>CO1</th>
<th>Measure various properties such as pressure, velocity, flow rate using various instruments.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Calculate different parameters such as co-efficient of friction, power, efficiency etc. of various systems.</td>
</tr>
<tr>
<td>CO3</td>
<td>Understand the need and importance of calibration of pressure gauges.</td>
</tr>
<tr>
<td>CO4</td>
<td>Describe the construction and working of turbines and pumps.</td>
</tr>
<tr>
<td>CO5</td>
<td>Test the performance of turbines and pumps and Plot characteristics curves.</td>
</tr>
</tbody>
</table>
Course Code : MEPC217
Course Title : Thermal Engineering Lab – I
Number of Credits : 1 (L:0; T:0; P:2)
Prerequisites : Thermal Engineering – I (MEPC207)
Course Category : PC

Course Objectives:
- To understand the importance of fuel properties and learn the methods of determination of various properties of fuels.
- To understand the working principles of various methods used in determination of properties of fuels.
- To observe different parts of I.C. engine and understand their working.
- To identify the physical differences between S.I. and C.I. engines and 2-S and 4-S engines.

Course Content:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Topics for practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Flash &amp; Fire point tests using Able’s/Cleveland/Pensky Martin Apparatus</td>
</tr>
<tr>
<td>II</td>
<td>Viscosity measurement usi/Saybolt viscometer</td>
</tr>
<tr>
<td>III</td>
<td>Calorific value tests using Bomb Calorimeter (Solid and Liquid fuels) and Junkers Gas Calorimeter (Gaseous fuels)</td>
</tr>
<tr>
<td>IV</td>
<td>Carbon residue test using Conradson’s apparatus.</td>
</tr>
<tr>
<td>V</td>
<td>Assembling and disassembling of I.C. Engines</td>
</tr>
<tr>
<td>VI</td>
<td>Port timing diagram of Petrol engine</td>
</tr>
<tr>
<td>VII</td>
<td>Port timing diagram of Diesel engine</td>
</tr>
<tr>
<td>VIII</td>
<td>Valve timing diagram of Petrol engine</td>
</tr>
<tr>
<td>IX</td>
<td>Valve timing diagram of Diesel engine</td>
</tr>
<tr>
<td>X</td>
<td>Study of petrol and diesel engine components and Models</td>
</tr>
</tbody>
</table>

Reference Books:

Course outcomes:
At the end of the course, the student will be able to:

| CO1   | Understand the determination of flash and fire point of a given sample of fuel using given apparatus (Abels, Cleveland & Penesky martin) |
| CO2   | Understand the determination of Viscosity of a given sample of oil using given apparatus. |
| CO3   | Understand the determination of Calorific value of a given sample of fuel using given apparatus. |
| CO4   | Understand the determination of amount of carbon residue of a given sample of petroleum product. |
| CO5   | Draw VTD /PTD of given I.C. Engine and understand how the processes are controlled during its operation. |
| CO6   | Understand the functions of various parts of IC engines and the working of IC engines. |

******
### Course Code
MEPC202

### Course Title
MEASUREMENTS & METROLOGY

### Number of Credits
3 (L: 2, T: 1, P: 0)

### Prerequisites
NIL

### Course Category
PC

### Course Objectives:
- To study advances in technology, measurement techniques, types of instrumentation devices, innovations, refinements.
- To study the principles of instrumentation, transducers & measurement of non-electrical parameters like temperature, pressure, flow, speed, force and stress.

### Course Content:

**UNIT-I: Introduction to measurements**
Definition of measurement; Significance of measurement; Methods of measurements: Direct & Indirect; Generalized measuring system; Standards of measurements: Primary & Secondary; Factors influencing selection of measuring instruments; Terms applicable to measuring instruments: Precision and Accuracy, Sensitivity and Repeatability, Range, Threshold, Hysteresis, calibration; Errors in Measurements: Classification of errors, Systematic and Random error.

**Measuring instruments**
Introduction; Thread measurements: Thread gauge micrometre; Angle measurements: Bevel protractor; Sine Bar; Gauges: plain plug gauge, ring Gauge, snap gauge, limit gauge; Comparators: Characteristics of comparators, Types of comparators; Surface finish: Definition, Terminology of surface finish, Talysurf surface roughness tester; Co-ordinating measuring machine.

**UNIT-II: Transducers and Strain gauges**
Introduction; Transducers: Characteristics, classification of transducers, two coil self-inductance transducer, Piezoelectric transducer; Strain Measurements: Strain gauge, Classification, mounting of strain gauges, Strain gauge rosettes-two and three elements.

**Measurement of force, torque, and pressure**
Introduction; Force measurement: Spring Balance, Proving ring, Load cell; Torque measurement: Prony brake, Eddy current, Hydraulic dynamometer; Pressure measurement: Mcloed gauge.

**UNIT-III: Applied mechanical measurements**
Speed measurement: Classification of tachometers, Revolution counters, Eddy current tachometers; Displacement measurement: Linear variable Differential transformers (LVDT); Flow measurement: Rotometers, Turbine meter; Temperature measurement: Resistance thermometers, Optical Pyrometer.

**Miscellaneous measurements**
Humidity measurement: hair hygrometer; Density measurement: hydrometer; Liquid level measurement: sight glass, Float gauge; Biomedical measurement: Sphygmonometer.

**UNIT-IV: Limits, Fits & Tolerances**
Concept of Limits, Fits, and Tolerances; Selective Assembly; Interchangeability; Hole And Shaft Basis System; Taylor’s Principle; Design of Plug; Ring Gauges; IS 919-1993 (Limits, Fits & Tolerances, Gauges) IS 3477-1973; concept of multi gauging and inspection.

**Angular Measurement**
Concept; Instruments For Angular Measurements; Working and Use of Universal Bevel Protractor, Sine Bar, Spirit Level; Principle of Working of Clinometers; Angle Gauges (With Numerical on Setting of Angle Gauges).

**Screw thread Measurements**
ISO grade and fits of thread; Errors in threads; Pitch errors; Mea-
measurement of different elements such as major diameter, minor diameter, effective diameter, pitch; Two wire method; Thread gauge micrometer; Working principle of floating carriage dial micrometer.

**Unit-V: Gear Measurement and Testing:** Analytical and functional inspection; Rolling test; Measurement of tooth thickness (constant chord method); Gear tooth vernier; Errors in gears such as backlash, runout, composite.

**Machine tool testing:** Parallelism; Straightness; Squareness; Coaxiality; roundness; run out; alignment testing of machine tools as per IS standard procedure.

**Reference Books:**

5. *Dimensional Metrology* – Connie Dotson, DELMAR, Cenage learning, 2007

**Course outcomes**

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

| CO1 | Define accuracy, precision, calibration, sensitivity, repeatability and such relevant terms in metrology. |
| CO2 | Distinguish between various types of errors. |
| CO3 | Understand the principle of operation of an instrument and select suitable measuring device for a particular application. |
| CO4 | Appreciate the concept of calibration of an instrument. |
| CO5 | Analyze and interpret the data obtained from the different measurements processes and present it in the graphical form, statistical form. |

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| **Course Code** | MEPC204 |
| **Course Title** | STRENGTH OF MATERIALS |
| **Number of Credits** | 3 (L: 2, T: 1, P: 0) |
| **Prerequisites** | Engineering Mechanics (ESC201) |
| **Course Category** | PC |
Course Objectives:

- To understand the concept of Simple Stresses and Strains.
- To understand the concept of Strain Energy.
- To understand the concept of Shear Force and Bending Moment Diagrams.
- To understand the concept of Theory of Simple Bending and Deflection of Beams.
- To understand the concept of Torsion in Shafts and Springs.
- To understand the concept of Thin Cylindrical Shells.

Course Content:

UNIT-I: Simple Stresses and Strains: Types of forces; Stress, Strain and their nature; Mechanical properties of common engineering materials; Significance of various points on stress – strain diagram for M.S. and C.I. specimens; Significance of factor of safety; Relation between elastic constants; Stress and strain values in bodies of uniform section and of composite section under the influence of normal forces; Thermal stresses in bodies of uniform section and composite sections; Related numerical problems on the above topics.

Strain Energy: Strain energy or resilience, proof resilience and modulus of resilience; Derivation of strain energy for the following cases: i) Gradually applied load, ii) Suddenly applied load, iii) Impact/shock load; Related numerical problems.

Unit-II: Shear Force & Bending Moment Diagrams: Types of beams with examples: a) Cantilever beam, b) Simply supported beam, c) Over hanging beam, d) Continuous beam, e) Fixed beam; Types of Loads – Point load, UDL and UVL; Definition and explanation of shear force and bending moment; Calculation of shear force and bending moment and drawing the S.F and B.M. diagrams by the analytical method only for the following cases: a) Cantilever with point loads, b) Cantilever with uniformly distributed load, c) Simply supported beam with point loads, d) Simply supported beam with UDL, e) Over hanging beam with point loads, at the centre and at free ends, f) Over hanging beam with UDL throughout, g) Combination of point and UDL for the above; Related numerical problems.

Unit-III: Theory of Simple Bending and Deflection of Beams: Explanation of terms: Neutral layer, Neutral Axis, Modulus of Section, Moment of Resistance, Bending stress, Radius of curvature; Assumptions in theory of simple bending; Bending Equation \( M/I = \sigma/Y = E/R \) with derivation; Problems involving calculations of bending stress, modulus of section and moment of resistance; Calculation of safe loads and safe span and dimensions of cross-section; Definition and explanation of deflection as applied to beams; Deflection formulae without proof for cantilever and simply supported beams with point load and UDL only (Standard cases only); Related numerical problems.

Unit-IV: Torsion in Shafts and Springs: Definition and function of shaft; Calculation of polar M.I. for solid and hollow shafts; Assumptions in simple torsion; Derivation of the equation \( T/I = f/R = G\theta/L \); Problems on design of shaft based on strength and rigidity; Numerical Problems related to comparison of strength and weight of solid and hollow shafts; Classification of springs; Nomenclature of closed coil helical spring; Deflection formula for closed coil helical spring (without derivation); stiffness of spring; Numerical problems on closed coil helical spring to find safe load, deflection, size of coil and number of coils.

Unit-V: Thin Cylindrical Shells: Explanation of longitudinal and hoop stresses in the light of circumferential and longitudinal failure of shell; Derivation of expressions for the longitudinal and hoop stress for seamless and seam shells; Related numerical Problems for safe thickness and safe working pressure.
Reference Books:

Course outcomes:
At the end of the course, the student will be able to:

| CO1 | Compute stress and strain values and find the changes in axial, lateral and volumetric dimensions of bodies of uniform section and of composite section under the influence of normal forces. |
| CO2 | Calculate thermal stresses, in bodies of uniform section and composite sections. |
| CO3 | Define resilience, proof – resilience and modulus of resilience and obtain expressions for instantaneous stress developed in bodies subjected to different loads. |
| CO4 | Compute shear force and bending moment at any section of beam and draw the S.F & B.M diagrams of for UDL and Point loads. |
| CO5 | Calculate the safe load, safe span and dimensions of cross section. |
| CO6 | Compare strength and weight of solid and hollow shafts of the same length and material and compute the stress and deflection of the closed coil helical spring. |

Course Code : MEPC206
Course Title : THERMAL ENGINEERING - II
Number of Credits : 3 (L: 2, T: 1, P: 0)
Prerequisites : Thermal Engineering - I (MEPC205)
Course Category : PC

Course Objectives:
- To understand the working and applications of Gas turbines & Jet Propulsion.
- To understand the methods of computing various properties of steam.
- To understand the working of various Steam Boilers, functions of various accessories and mountings of boilers.
- To understand the Working of Steam Nozzles and Steam turbines.
- To understand the necessity of compounding and governing of a turbine.

Course Content:
UNIT-I: Gas Turbines: Air-standard Brayton cycle; Description with p-v and T-S diagrams; Gas turbines Classification: open cycle gas turbines and closed cycle gas turbines; comparison of gas turbine with reciprocating I.C. engines and steam turbines. Applications and limitations of gas turbines; General lay-out of Open cycle constant pressure gas turbine; P-V and T-S diagrams and working; General lay-out of Closed cycle gas turbine; P-V and T-S diagrams and working.

Jet Propulsion: Principle of jet propulsion; Fuels used for jet propulsion; Applications of jet propulsion; Working of a turbojet engine; Principle of Ram effect; Working of a Ram jet engine; Principle of Rocket propulsion; Working principle of a rocket engine; Applications of rocket propulsion; Compar-
ison of jet and rocket propulsions.

**Unit-II: Properties of Steam:** Formation of steam under constant pressure; Industrial uses of steam; Basic definitions: saturated liquid line, saturated vapour line, liquid region, vapour region, wet region, superheat region, critical point, saturated liquid, saturated vapour, saturation temperature, sensible heat, latent heat, wet steam, dryness fraction, wetness fraction, saturated steam, superheated steam, degree of superheat; Determination of enthalpy, internal energy, internal latent heat, entropy of wet, dry and superheated steam at a given pressure using steam tables and Mollier chart for the following processes: Isochoric process, Isobaric process, Hyperbolic process, Isothermal process, Isentropic process, Throttling process, Polytropic process; Simple direct problems on the above using tables and charts; Steam calorimeters: Separating, throttling, Combined Separating and throttling calorimeters – problems.

**Unit-III: Steam Generators:** Function and use of steam boilers; Classification of steam boilers with examples; Brief explanation with line sketches of Cochran, Babcock and Wilcox Boilers; Comparison of water tube and fire tube boilers; Description with line sketches and working of modern high pressure boilers Lamont and Benson boilers; Boiler mountings: Pressure gauge, water level indicator, fusible plug, blow down cock, stop valve, safety valve, (dead weight type, spring loaded type, high pressure and low water safety alarm); Boiler accessories: feed pump, economiser, super heater and air pre-heater; Study of steam traps & separators; Explanation of the terms: Actual evaporation, equivalent evaporation, factor of evaporation, boiler horse power and boiler efficiency; Formula for the above terms without proof; Simple direct problems on the above; Draught systems (Natural, forced & induced).

**Unit-IV: Steam Nozzles:** Flow of steam through nozzle; Velocity of steam at the exit of nozzle in terms of heat drop using analytical method and Mollier chart; Discharge of steam through nozzles; Critical pressure ratio; Methods of calculation of cross-sectional areas at throat and exit for maximum discharge; Effect of friction in nozzles and Super saturated flow in nozzles; Working steam jet injector; Simple numerical problems.

**Unit-V: Steam Turbines:** Classification of steam turbines with examples; Difference between impulse & reaction turbines; Principle of working of a simple De-lavel turbine with line diagrams- Velocity diagrams; Expression for work done, axial thrust, tangential thrust, blade and diagram efficiency, stage efficiency, nozzle efficiency; Methods of reducing rotor speed; compounding for velocity, for pressure or both pressure and velocity: Working principle with line diagram of a Parson’s Reaction turbine-velocity diagrams; Simple problems on single stage impulse turbines (without blade friction) and reaction turbine including data on blade height. Bleeding, re-heating and re-heating factors (Problems omitted); Governing of steam turbines: Throttle, By-pass & Nozzle control governing.

**Reference Books:**


**Course outcomes:**

At the end of the course, the student will be able to:
### Course Objectives:
- To identify the type of material based on its grain structure
- To learn the procedure for identifying the cracks in the material
- To understand various material testing methods to determine mechanical properties such as yield stress, Ultimate stress, percentage elongation, Young's Modulus etc.

### Course Content:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Topics for practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Prepare a specimen and examine the microstructure of the Ferrous and Non-ferrous metals using the Metallurgical Microscope.</td>
</tr>
<tr>
<td>II</td>
<td>Detect the cracks in the specimen using (i) Visual inspection and ring test (ii) Die penetration test (iii) Magnetic particle test.</td>
</tr>
<tr>
<td>III</td>
<td>Determination of Rockwell's Hardness Number for various materials like mild steel, high carbon steel, brass, copper and aluminium.</td>
</tr>
<tr>
<td>IV</td>
<td>Finding the resistance of materials to impact loads by Izod test and Charpy test.</td>
</tr>
<tr>
<td>V</td>
<td>Torsion test on mild steel – relation between torque and angle of twist determination of shear modulus and shear stress.</td>
</tr>
<tr>
<td>VI</td>
<td>Finding Young's Modulus of Elasticity, yield points, percentage elongation and percentage reduction in area, stress strain diagram plotting, tests on mild steel.</td>
</tr>
<tr>
<td>VII</td>
<td>Determination of modulus of rigidity, strain energy, shear stress and stiffness by load deflection method (Open &amp; Closed coil spring)</td>
</tr>
<tr>
<td>VIII</td>
<td>Single or double Shear test on M.S. bar to finding the resistance of material to shear load.</td>
</tr>
</tbody>
</table>

### Reference Books:
At the end of the course, the student will be able to:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Identify the given specimen by viewing the micro structure using metallurgical microscope</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Identify the cracks in the specimen using different techniques</td>
</tr>
<tr>
<td>CO3</td>
<td>Determine the various types of stress and plot the stress strain diagram for mild steel.</td>
</tr>
<tr>
<td>CO4</td>
<td>Determine the torsion, bending, impact and shear values of given materials</td>
</tr>
<tr>
<td>CO5</td>
<td>Determine the modulus of rigidity, strain energy, shear stress and stiffness of coil spring</td>
</tr>
</tbody>
</table>

Course Code : MEPC210
Course Title : MEASUREMENTS & METROLOGY LAB
Number of Credits : 1 ( L:0, T:0, P:2)
Prerequisites : Measurements & Metrology (MEPC202)
Course Category : PC

Course Objectives:
- To understand techniques for precise measurement of the dimensions of various objects and shapes.

Course Content:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Topics for practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Measure the diameter of a wire using micrometre and compare the result with digital micrometre</td>
</tr>
<tr>
<td>II</td>
<td>Measure the angle of the machined surface using sine bar with slip gauges.</td>
</tr>
<tr>
<td>III</td>
<td>Measure the angle of a V-block / Taper Shank of Drill / Dovetail using universal bevel protractor.</td>
</tr>
<tr>
<td>IV</td>
<td>Measure the dimensions of ground MS flat/cylindrical bush using Vernier Caliper compare with Digital/Dial Vernier Caliper.</td>
</tr>
<tr>
<td>V</td>
<td>Measure the geometrical dimensions of V-Thread using thread Vernier gauge.</td>
</tr>
<tr>
<td>VI</td>
<td>Measure the thickness of ground MS plates using slip gauges</td>
</tr>
</tbody>
</table>

Reference Books:
2. Engineering precision metrology – R. C. Gupta

Course outcomes:
At the end of the course, the student will be able to:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Measure various component of linear measurement using Vernier calipers and Micrometre.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Measure various component of angle measurement using sine bar and bevel Protractor</td>
</tr>
<tr>
<td>CO3</td>
<td>Measure the geometrical dimensions of V-thread and spur gear</td>
</tr>
</tbody>
</table>

*********
Course Code : MEPC212
Course Title : THERMAL ENGINEERING LAB-II
Number of Credits : 1.5 (L: 0, T: 0, P: 3)
Prerequisites : Thermal Engineering - I (MEPC207)
                Thermal Engineering - II (MEPC206)
Course Category : PC

Course Objectives:
- To understand the working of boilers, compressors and IC engines.
- To observe various parts of engines and understand their functions.
- To perform various tests on IC engines and calculate performance parameters.
- To understand economical and optimum running conditions of the engines.

Course Content:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Topics for practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Study of high pressure boiler with model</td>
</tr>
<tr>
<td>II</td>
<td>Study of boiler mountings and accessories</td>
</tr>
<tr>
<td>III</td>
<td>Conduct performance test on VCR test rig to determine COP of the refrigerator</td>
</tr>
<tr>
<td>IV</td>
<td>Conduct performance test on multi stage reciprocating compressor</td>
</tr>
<tr>
<td>V</td>
<td>Conduct Morse test to determine the indicated power of individual cylinders</td>
</tr>
<tr>
<td>VI</td>
<td>Conduct Performance test on 2-S CI/SL engine.</td>
</tr>
<tr>
<td>VII</td>
<td>Conduct Performance test on 4-S CI/SL engine.</td>
</tr>
<tr>
<td>VIII</td>
<td>Conduct Heat balance test on CI/SL engine.</td>
</tr>
<tr>
<td>IX</td>
<td>Conduct Economical speed test on 4-S CI/SL engine.</td>
</tr>
<tr>
<td>X</td>
<td>Thermal conductivity test on 1) Thick slab 2) Composite wall 3) Thick cylinder</td>
</tr>
<tr>
<td>XI</td>
<td>Leak detection of refrigeration equipment</td>
</tr>
<tr>
<td>XII</td>
<td>Conduct performance test on A/C test rig to determine COP of the refrigerator</td>
</tr>
</tbody>
</table>

Reference Books:

Course outcomes
At the end of the course, the student will be able to:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Evaluate the performance characteristics of single cylinder diesel/petrol engine at different loads and draw the heat balance sheet.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Find the indicated power of individual cylinders of an engine by using morse test.</td>
</tr>
<tr>
<td>CO3</td>
<td>Evaluate the performance characteristics Multi stage air compressor</td>
</tr>
<tr>
<td>CO4</td>
<td>Evaluate the coefficient of performance of refrigerator</td>
</tr>
<tr>
<td>CO5</td>
<td>Find the thermal conductivity of material</td>
</tr>
</tbody>
</table>
SEMESTER V

<table>
<thead>
<tr>
<th>Course Code</th>
<th>MEPC301</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>ADVANCED MANUFACTURING PROCESSES</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3   (L: 3, T: 0, P: 0)</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>Basic Mechanical Engineering (MEPC102) Manufacturing Engineering (MEPC207)</td>
</tr>
<tr>
<td>Course Category</td>
<td>PC</td>
</tr>
</tbody>
</table>

**Course Objectives:**
- To Know the functions of Jigs and Fixtures.
- To know the applications of jig-boring machines.
- To identify different fabrication methods of plastic processing viz., sheet forming, blow moulding, laminating and reinforcing of plastics.
- To distinguish between non-conventional machining and traditional machining processes.
- To know about the advancements in the area of manufacturing and production processes.
- To impart knowledge & skills necessary for working in modern manufacturing environment.
- To get familiarized with working principles and operations performed on non-traditional machines, machining center, SPM, automated machines and maintenance of machine tools.

**Course Content:**

**UNIT-I: Jigs & Fixtures:** Definition of jig; Types of jigs: Leaf jig, Box and Handle jig, Template jig, Plate jig, Indexing jig, Universal jig, Vice jigs - constructional details of the above jigs; General consideration in the design of drill jigs; Drill bush; Types of fixtures: Vice fixtures, Milling fixtures, Boring fixtures, Grinding fixtures - constructional details of the above fixtures; Basic principles of location; Locating methods and devices; Basic principles of the clamping; Types of clamps: Strap clamps, Cam clamps, Screw clamps, Toggle clamps, Hydraulic and Pneumatic clamps.

**Unit-II: Jig Boring:** Introduction; Jig boring on vertical milling machine; Types jig boring machines: Open front machine, Cross rail type machine - constructional details & their working; System of location of holes.

**Plastic Processing:** Processing of plastics; Moulding processes: Injection moulding, Compression moulding, Transfer moulding; Extruding; Casting; Calendering; Fabrication methods-Sheet forming, Blow moulding, Laminating plastics (sheets, rods & tubes), Reinforcing; Applications of Plastics.

**Unit-III: Modern Machining Processes:** Introduction – comparison with traditional machining; Ultrasonic Machining: principle, Description of equipment, applications; Electric Discharge Machining: Principle, Description of equipment, Dielectric fluid, tools (electrodes), Process parameters, Output characteristics, applications; Wire cut EDM: Principle, Description of equipment, Controlling parameters; applications; Abrasive Jet Machining: principle, description of equipment, application; Laser Beam Machining: principle, description of equipment, application; Electro Chemical Machining: description of equipment, application.

**Unit-IV: CNC Milling Machines:** Vertical and horizontal machining center: Constructional features, Axis identification, Electronic control system. Automatic tool changer and tool magazine. CNC programming: Preparatory functions (G code), miscellaneous functions (M code), Part programming including subroutines and canned cycles. Principles of computer aided part programming.

**Machine Tool Automation:** Introduction and Need; (A) Single spindle automates, transfer lines.
Elements of control system, Limit switches, Proximity switches, Block diagram for feedback and servo control system, Introduction to PLC, Block diagram of PLC.

Unit-V: Special Purpose Machines (SPM): Concept, General elements of SPM, Productivity improvement by SPM, Principles of SPM design.


Reference Books:
1. Production Technology – HMT, Bangalore, Tata Mc-Graw Hill
2. CNC machines – Pabla B. S. & M. Adithan, New Age international limited.
5. Advanced manufacturing technology – David L. Goetsch

Course outcomes:
At the end of the course, the student will be able to:

| CO1 | Know the Operation and control of different advanced machine tools and equipments. |
| CO2 | Produce jobs as per specified requirements by selecting the specific machining process. |
| CO3 | Develop the mind set for modern trends in manufacturing and automation. |
| CO4 | Identify the different fabrication methods viz., sheet forming, blow moulding, laminating and reinforcing of plastics. |
| CO5 | Know different non-traditional machining processes, CNC milling machines, special purpose machines. |
| CO6 | Work as maintenance engineer. |

******

Course Code : MEPC303
Course Title : THEORY OF MACHINES & MECHANISMS
Number of Credits : 3 (L: 2, T: 1, P: 0)
Prerequisites : Engineering Mechanics (ESC201)
Course Category : PC

Course Objectives:
- To understand different types of cams and their motions and also to draw cam profiles for various motions.
- To understand the mechanism of various types of drives available for transmission of power.
- To understand the design of Brakes, Dynamometers, Bearings and Clutches and their function and working.
- To understand the need for balancing of masses in the same plane.
- To Know different types of governors.
Course Content:

UNIT I: Cams and Followers: Concept; Definition and application of Cams and Followers; Classification of Cams and Followers; Different follower motions and their displacement diagrams like uniform velocity, SHM, uniform acceleration and Retardation; Drawing of profile of radial cam with knife-edge and roller follower with and without offset with reciprocating motion (graphical method).

UNIT II: Power Transmission: Types of Drives – Belt, Chain, Rope, Gear drives & their comparison; Belt Drives - flat belt, V– belt & its applications; Material for flat and V-belt; Angle of lap, Belt length. Slip and Creep; Determination of Velocity Ratio, Ratio of tight side and slack side tension; Centrifugal tension and Initial tension; Condition for maximum power transmission (Simple numericals); Chain Drives – Advantages & Disadvantages; Selection of Chain & Sprocket wheels; Methods of lubrication; Gear Drives – Spur gear terminology; Types of gears and gear trains, their selection for different applications; Train value & Velocity ratio for compound, reverted and simple epicyclic gear train; Methods of lubrication; Law of gearing; Rope Drives – Types, applications, advantages & limitations of Steel ropes.

UNIT III: Flywheel and Governors: Flywheel - Concept, function and application of flywheel with the help of turning moment diagram for single cylinder 4-Stroke I.C. Engine (no Numericals); Coefficient of fluctuation of energy, Coefficient of fluctuation of speed and its significance; Governors - Types and explanation with neat sketches (Centrifugal, Watt and Porter); Concept, function and applications & Terminology of Governors; Comparison between Flywheel and Governor.

UNIT IV: Brakes, Dynamometers, Clutches & Bearings: Function of brakes and dynamometers; Types of brakes and Dynamometers; Comparison between brakes and dynamometers; Construction and working of i) shoe brake, ii) Band Brake, iii) Internal expanding shoe brake iv) Disc Brake; Concept of Self Locking & Self energizing brakes; Numerical problems to find braking force and braking torque for shoe & band brakes; Construction and working of i) Rope Brake Dynamometer, ii) Hydraulic Dynamometer, iii) Eddy current Dynamometers; Clutches- Uniform pressure and Uniform Wear theories; Function of Clutch and its application; Construction and working of i) Single plate clutch, ii) Multiplate clutch, iii) Centrifugal Clutch iv) Cone clutch and v) Diaphragm clutch. (Simple numericals on single and Multiplate clutch); Bearings – i) Simple Pivot, ii) Collar Bearing, iii) Conical pivot. Torque & power lost in friction (no derivation). Simple numericals.

UNIT V: Balancing & Vibrations: Concept of balancing; Balancing of single rotating mass; Graphical method for balancing of several masses revolving in same plane; Concept and terminology used in vibrations, Causes of vibrations in machines; their harmful effects and remedies.

Reference Books:

Course outcomes:
At the end of the course, the student will be able to:

| CO1 | Know different machine elements and mechanisms. |
Course Objectives:

- To take the right decisions to optimize resources utilization by improving productivity of the Lands, Buildings, People, Materials, Machines, Money, Methods and Management effectively.
- To eliminate unproductive activities under the control of the Management, Supervisor, worker and the Design of Products and Processes.
- To use the Charts to record the Activities of the people, materials and Equipment to find alternative methods which minimize waste and to implement the best method.

Course Content:

UNIT-I: Plant Engineering: Plant; Selection of site of industry; Plant layout; Principles of a good layout; Types; Process; Product and Fixed position; Techniques to improve Layout; Principles of Material handling equipment; Plant maintenance; Importance; Break down maintenance; Preventive maintenance and Scheduled maintenance.

Plant Safety: Importance; Accident: Causes and Cost of an Accident, Accident Proneness, Prevention of Accidents; Industrial disputes; Settlement of Industrial disputes; Collective bargaining; Conciliation; Mediation; Arbitration; Indian Factories Act 1948 and its provisions related to health, welfare and safety.

UNIT-II: Work Study: Productivity; Standard of living; Method of improving Productivity; Objectives; Importance of good working conditions.

Method Study: Definition; Objectives; Selection of a job for method study; Basic procedure for conduct of Method study; Tools used; Operation process chart; Flow process chart; Two handed process chart; Man Machine chart; String diagram and flow diagram.

Work Measurement: Definition; Basic procedure in making a time study; Employees rating factor; Application of time allowances: Rest, Personal, Process, Special and Policy allowances; Calculation of standard time; Numerical Problems; Basic concept of production study; Techniques of Work Measurement; Ratio delay study; Synthesis from standard data; Analytical estimating and Pre determined Motion Time System (PMTS).

UNIT-III: Production Planning and Control: Introduction; Major functions of Production Planning and Control; Pre planning; Methods of forecasting; Routing and Scheduling; Dispatching and Controlling; Concept of Critical Path Method (CPM); Types of Production: Mass Production, Batch Pro-
duction and Job Order Production; Characteristics; Economic Batch Quantity (EBQ); Principles of
Product and Process Planning; Make or Buy decision; Numerical problems.

Quality Control: Definition; Objectives; Types of Inspection: First piece, Floor and Centralized In-
spection; Advantages and Disadvantages; Statistical Quality Control; Types of Measurements; Meth-
od of Variables; Method of Attributes; Uses of X, R, p and c charts; Operating Characteristics curve
(O.C curve); Sampling Inspection; Single and Double Sampling plan; Concept of ISO 9001:2008 Qual-
ity Management System Registration/Certification procedure; Benefits of ISO to the organization.

UNIT-IV: Principles of Management: Definition of Management; Administration; Organization; F.W.
Taylor’s and Henry Fayol’s Principles of Management; Functions of Manager; Types of Organization:
Line, Staff, Taylor’s Pure functional types; Line and staff and committee type; Directing; Leadership;
Styles of Leadership; Qualities of a good leader; Motivation; Positive and Negative Motivation; Mod-
ern Management Techniques; Just In Time; Total Quality Management (TQM); Quality circle; Zero
defect concept; 5S Concept; Management Information Systems. Personnel Management: Responsi-
bility of Human Resource Management; Selection Procedure; Training of Workers; Apprentice Train-
ing; On the Job training and Vestibule School Training; Job Evaluation and Merit Rating; Objectives
and Importance; Wages and Salary Administration; Components of Wages; Wage Fixation; Type of
Wage Payment: Halsey’s 50% Plan, Rowan’s Plan and Emerson’s efficiency plan; Numerical Problems.

UNIT-V: Financial Management: Fixed and Working Capital; Resources of Capital; Shares Prefer-
eence and Equity Shares; Debentures; Type of debentures; Public Deposits; Factory Costing; Direct
Cost; Indirect Cost; Factory Overhead; Selling Price of a product; Profit; Numerical Problems; Depre-
ciation; Causes; Methods: Straight line, sinking fund and percentage on Diminishing Value Method;
Numerical Problems.

Material Management: Objectives of good stock control system; ABC analysis of Inventory; Procure-
cement and Consumption cycle; Minimum Stock, Lead Time, Reorder Level-Economic Order Quan-
ty problems; Supply Chain.

Reference Books:
1. Industrial Engineering & Management, S.C. Sharma, Khanna Book Publishing Co. (P) Ltd., Delhi
   (P) Ltd., New Delhi – 110002.

Course outcomes:
At the end of the course, the student will be able to:

| CO1 | Explain the different types of layout and plant maintenance with safety |
| CO2 | List and explain the need of method study and work measurements |
| CO3 | Explain the production planning and quality control, and its functions |
| CO4 | Understand the basic principles, approaches and functions of management and identify concepts to specific situations |
| CO5 | List and explain the different financial sources and methods of inventory management |

******
### Course Code
MEPC307

### Course Title
CAD/CAM LAB

### Number of Credits
1 \( (L: 0, T: 0, P: 2) \)

### Prerequisites
Computer Aided Machine Drawing (MEPC104)

### Course Category
PC

### Course Objectives:
- To understand the fundamentals and use CAD.
- To conceptualize drafting and modeling in CAD.
- To interpret the various features in the menu of solid modeling package.
- To synthesize various parts or components in an assembly.
- To prepare CNC programmes for various jobs.

### Course Content:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Topics for practice</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PART-A</strong></td>
<td><strong>Introduction:</strong> Part modelling; Datum Plane; constraint; sketch; dimensioning; extrude; revolve; sweep; blend; protrusion; extrusion; rib; shell; hole; round; chamfer; copy; mirror; assembly; align; orient. Exercises: 3D Drawings of 1). Geneva Wheel; 2). Bearing Block; 3). Bushed bearing; 4). Gib and Cotter joint; 5). Screw Jack; 6). Connecting Rod: Note: Print the orthographic view and sectional view from the above assembled 3D drawing.</td>
</tr>
<tr>
<td><strong>CNC Programming and Machining:</strong> Introduction; 1). Study of CNC lathe, milling; 2). Study of international standard codes: G-Codes and M-Codes; 3). Format – Dimensioning methods; 4). Program writing – Turning simulator – Milling simulator, IS practice – commands menus; 5). Editing the program in the CNC machines; 6). Execute the program in the CNC machines; Exercises: Note: Print the Program from the Simulation Software and make the Component in the CNC Machine.</td>
<td></td>
</tr>
<tr>
<td><strong>PART-B</strong></td>
<td><strong>CNC Turning Machine:</strong> (Material: Aluminium/Acrylic/Plastic rod) 1. Using Linear and Circular interpolation - Create a part program and produce component in the Machine. 2. Using Stock removal cycle – Create a part program for multiple turning operations and produce component in the Machine. 3. Using canned cycle - Create a part program for thread cutting, grooving and produce component in the Machine. <strong>CNC Milling Machine</strong> (Material: Aluminium/ Acrylic/ Plastic) 1. Using Linear interpolation and Circular interpolation – Create a part program for grooving and produce component in the Machine. 2. Using canned cycle - Create a part program for drilling, tapping, counter sinking and produce component in the Machine. 3. Using subprogram - Create a part program for mirroring and produce component in the Machine.</td>
</tr>
</tbody>
</table>
Reference Books:
2. Mechanical Draughtsmanship - G.L. Tamta Dhanpat Rai & Sons, Delhi, 1992
5. Engineering AutoCAD, A.P. Gautam & Pradeep Jain, Khanna Book Publishing Co., Delhi

Course outcomes:
At the end of the course, the student will be able to:

| CO1 | Explain the 3D commands and features of a CAD software |
| CO2 | Create 3D solid model and find the mass properties of simples solids |
| CO3 | Demonstrate the working of CNC turning and milling machine |
| CO4 | Develop the part program using simulation software for Lathe and Milling |
| CO5 | Assess the part program, edit and execute in CNC turning and machining centre |

Course Code : MEPC309
Course Title : MANUFACTURING ENGINEERING LAB-II
Number of Credits : 1 (L: 0, T: 0, P: 2)
Prerequisites : Manufacturing Engineering (MEPC205)
Course Category : PC

Course Objectives:
- To Know the working of Drilling machine, shaper, slotter, planer, milling and grinding machines and be in a position to operate the same.
- To make use of various measuring instruments for taking dimensions.
- To Practice different operations on drilling shaper, slotter, planer, milling and grinding machines.

Course Content:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Topics for practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Drilling Exercise (Three different sized holes for different materials maintaining uniform distance between them)</td>
</tr>
<tr>
<td>II</td>
<td>Milling-square-hexagon from round bars with indexing and without indexing</td>
</tr>
<tr>
<td>III</td>
<td>Generation of spur gear teeth on a round bar</td>
</tr>
<tr>
<td>IV</td>
<td>Simple planning exercise cutting ‘T’ slots (one model)</td>
</tr>
<tr>
<td>V</td>
<td>Shaping a Hexagon on a round bar, key ways, grooves splines</td>
</tr>
<tr>
<td>VI</td>
<td>Shaping step block cut dovetail to angles 60, 90, 120 degrees</td>
</tr>
<tr>
<td>VII</td>
<td>Cylindrical grinding of external surface and internal surface using universal grinding machines</td>
</tr>
<tr>
<td>VIII</td>
<td>Grinding Cutting tools to the required angles</td>
</tr>
<tr>
<td>IX</td>
<td>Grinding of milling cutters etc, on a tool and cutter grinder</td>
</tr>
</tbody>
</table>
Grinding flat surface on a surface grinder using magnetic chuck and clamping devices

Dismantling some of the components of drilling machine and service, assemble the same

Dismantling some of the components of shaper head and then assemble the same

Dismantling some of the components of Milling machines and service, assemble the same

Servicing of universal grinding machine

Reference Books:


Course outcomes:

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

<table>
<thead>
<tr>
<th>CO1</th>
<th>Dismantle and assemble the components on drilling, shaping, milling and grinding machines.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Perform operations on drilling, shaping, milling and grinding machines.</td>
</tr>
<tr>
<td>CO3</td>
<td>Produce articles of industrial application such as Spur gear, square headed bolt, V-block</td>
</tr>
<tr>
<td>CO4</td>
<td>Make use of various measuring instruments for taking dimensions</td>
</tr>
</tbody>
</table>

*******
Course Code : MEPC302
Course Title : Design of Machine Elements
Number of Credits : 3 (L: 2, T: 1, P: 0)
Prerequisites : Engineering Mechanics (ESC201)
Strength of Materials (MEPC204)
Theory of Machines & Mechanisms (MEPC206)
Course Category : PC

Course Objectives:

- To enable the student to design and draw simple machine components used in small and medium scale industries.
- To understand the basic philosophy and fundamentals of Machine Design.
- To understand the modes of failures of m/c components and decide the design criteria and equations.
- To analyze and evaluate the loads, forces, stresses involved in components and subassemblies and decide the dimensions.
- To develop analytical abilities to give solutions to engineering design problems.

Course Content:

UNIT-I: Introduction to Design: Machine Design philosophy and Procedures; General Considerations in Machine Design; Fundamentals: Types of loads, concepts of stress, Strain, Stress – Strain Diagram for Ductile and Brittle Materials, Types of Stresses; Bearing pressure Intensity; Crushing; Bending and Torsion; Principal Stresses; Simple Numericals; Creep strain and Creep Curve; Fatigue; S-N curve; Endurance Limit; Factor of Safety and Factors governing selection of factor of Safety; Stress Concentration: Causes & Remedies; Converting actual load or torque into design load or torque using design factors like velocity factor, factor of safety & service factor; Properties of Engineering materials; Designation of materials as per IS and introduction to International standards & advantages of standardization; Use of design data book; Use of standards in design and preferred numbers series; Theories of Elastic Failures; Principal normal stress theory; Maximum shear stress theory & Maximum distortion energy theory.

UNIT-II: Design of simple machine parts: Cotter Joint; Knuckle Joint; Turnbuckle; Design of Levers: Hand/Foot Lever & Bell Crank Lever; Design of C–Clamp; Off-set links; Overhang Crank; Arm of Pulley.

Antifriction Bearings: Classification of Bearings; Sliding contact & Rolling contact; Terminology of Ball bearings: Life Load relationship, Basic static load rating and Basic dynamic load rating, limiting speed; Selection of ball bearings using manufacturer’s catalogue.

UNIT-III: Design of Shafts, Keys, Couplings and Spur Gears: Types of Shafts; Shaft materials; Standard Sizes; Design of Shafts (Hollow and Solid) using strength and rigidity criteria; ASME code of design for line shafts supported between bearings with one or two pulleys in between or one overhung pulley; Design of Sunk Keys; Effect of Keyways on strength of shaft; Design of Couplings – Muff Coupling, Protected type Flange Coupling, Bush-pin type flexible coupling; Spur gear design considerations; Lewis equation for static beam strength of spur gear teeth; Power transmission capacity of spur gears in bending.

UNIT-IV: Design of Power Screws: Thread Profiles used for power Screws - Relative merits and demerits of each; Torque required to overcome thread friction; Self-locking and overhauling property;
Efficiency of power screws; Types of stresses induced; Design of Screw Jack; Toggle Jack.

**Design of springs:** Classification and Applications of Springs; Spring terminology; Materials and Specifications; Stresses in springs; Wahl's correction factor; Deflection of springs; Energy stored in springs; Design of Helical, Tension and Compression springs subjected to uniform applied loads like I.C. engine valves, Weighing balance, Railway buffers and Governor springs; Leaf springs: Construction and Application.

**UNIT-V: Design of Fasteners:** Stresses in Screwed fasteners; Bolts of Uniform Strength; Design of Bolted Joints subjected to eccentric loading; Design of Parallel and Transverse fillet welds; Axially loaded symmetrical section; Merits and demerits of screwed and welded joints.

**Ergonomics & Aesthetic consideration in design:** Ergonomics of Design: Man–Machine relationship; Design of Equipment for control, environment & safety; Aesthetic considerations regarding shape, size, color & surface finish.

**Reference Books:**

**Course outcomes:**
At the end of the course, the student will be able to:

| **CO1** | Analyze the various modes of failure of machine components under different load patterns. |
| **CO2** | Design and prepare part and assembly drawings. |
| **CO3** | Use design data books and different codes of design. |
| **CO4** | Select standard components with their specifications from manufacturer's catalogue. |
| **CO5** | Develop drawings on CAD software. |

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<table>
<thead>
<tr>
<th>Course Code</th>
<th>MEPC304</th>
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</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>PRODUCTION &amp; OPERATIONS MANAGEMENT</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3 (L: 3, T: 0, P: 0)</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>NIL</td>
</tr>
<tr>
<td>Course Category</td>
<td>PC</td>
</tr>
</tbody>
</table>

**Course Objectives:**
• One of the most critical areas for success in any business enterprise is how Production and Operations are managed.

• To study the statistics, economics, finance, organizational behaviour and strategy into a consolidated production and operation related decisions.

• To discuss the role of location strategy and the criteria for location decisions.

• To define quality and explain quality management, including TQM and its tools.

**Course Content:**


**UNIT-II: Production Forecasting:** Introduction of production forecasting, The strategic role of forecasting in supply chain, Time frame, Demand behavior, Forecasting methods- Qualitative and Quantitative, Forecast accuracy.

**Scheduling:**


**UNIT-III: Break-Even Analysis:** Introduction, Break-even analysis charts, Breakeven analysis for process, plant and equipment selection.

**Aggregate Operations Planning:** Aggregate production planning, Adjusting capacity to meet the demand, Demand management, Hierarchical and collaborative planning, Aggregate planning for services.

**UNIT-IV: Assembly Line Balancing:** Assembly lines, Assembly line balancing, Splitting tasks, Flexible and U-shaped line layouts, Mixed model line balancing, Current thoughts on assembly lines, Computerized assembly line balancing.

**UNIT-V: Material Management:** Introduction, Importance and objectives, Purchasing and Stores: policies and procedures, Vendor development, selection, analysis and rating.

**Reference Books:**


Course outcomes:
At the end of the course, the student will be able to:

| CO1 | Define operations management and explain its relationship to productivity. And also understand tools and techniques. |
| CO2 | Describe the importance of forecasting and explain the effective application of the different forecasting approaches and methods. |
| CO3 | Explain layout strategy and how operations managers determine facility arrangements and size. |
| CO4 | Describe how operations managers achieve a reasonable work environment and set expectations related to employee productivity. |
| CO5 | Understand make-or-buy decisions, and the selection and integration of suppliers. And how much to order and when to order. |

Course Objectives:
- To understand metal cutting and forming process and factors affecting machinability.
- To develop knowledge of tools, dies and tool materials.
- To understand processes for increased productivity and quality.

Course Content:

UNIT-I: Metal Cutting: Mechanics of Metal cutting; requirements of tools; cutting forces; types of chips; chip thickness ratio; shear angle; simple numericals only; types of metal cutting process; orthogonal; oblique and form cutting;
Cutting fluids: types; characteristics and applications.
Tool wear: types; Tool life; Tool life equations.

Unit-II: Machinability: definition; factors affecting machinability; machinability index.
Tool materials: Types; characteristics; applications; Heat treatment of tool steels; Specification of carbide tips; Types of ceramic coatings.
Cutting Tool Geometry: Single point cutting tool; drills; reamers; milling; cutters.

Unit-III: Types of dies and construction: Simple Die; Compound Die; Progressive Die; Combination Die.
Punch & Die mountings: pilots; strippers; misfeed detectors; Pressure Pads; Knock outs; stock guide; Feed-Stop; guide bush; guide pins.

Unit-IV: Die Design Fundamentals: Die Operations; blanking; piercing; shearing; cropping; notch-
ing; lancing; coining; embossing; stamping; curling; drawing; bending; forming; Die set; Die shoe; Die area; Calculation of clearances on die and punch for blanking and piercing dies; Strip layout; Calculation of material utilization factor.

**Unit-V: Forming Dies:** Bending methods; Bending Dies; bend allowance; spring back; spanking; bending pressure; pressure pads; development of blank length.

**Drawing:** operations; Metal flow during drawing; Calculation of Drawing blank size; variables affecting metal flow during drawing; single action and double action dies; combination dies.

**Fundamentals of other Tools:** Constructional features of - Pressure Die casting dies; metal extrusion dies; injection molding dies; forging dies; plastic extrusion dies.

**Reference Books:**

**Course outcomes:**
At the end of the course, the student will be able to:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Understand concepts, principles and procedures of tool engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Classify and explain various tools and tool operations</td>
</tr>
<tr>
<td>CO3</td>
<td>Select proper tool and a die for a given manufacturing operation to achieve highest productivity</td>
</tr>
<tr>
<td>CO4</td>
<td>Estimate tool wear and tool life</td>
</tr>
</tbody>
</table>

**Course Code**: MEPE####

**Course Title**: COMPUTER INTEGRATED MANUFACTURING

**Number of Credits**: 3 (L: 3, T: 0, P: 0)

**Prerequisites**: NIL

**Course Category**: PE

**Course Objectives:**
- To understand General Principles of Mechanical Engineering.
- To understand laws of thermodynamics, thermal and thermodynamic Processes
- To understand working principles of power developing and power absorbing devices
- To understand basic materials and manufacturing processes

**Course Content:**

**UNIT-I:** Concept of Computer Integrated Manufacturing (CIM); Basic components of CIM; Distributed database system; distributed communication system, computer networks for manufacturing; future automated factory; social and economic factors

**Unit-II:** Computer Aided Design (CAD): CAD hardware and software; product modelling, automatic
drafting; engineering analysis; FEM design review and evaluation; Group Technology Centre.

**Unit-III:** Computer Aided Manufacturing (CAM), Computer assisted NC part programming; Computer assisted robot programming; computer aided process planning (CAPP); computer aided material requirements planning (MRP)

**Unit-IV:** Computer aided production scheduling; computer aided inspection planning; computer aided inventory planning; Flexible manufacturing system (FMS); concept of flexible manufacturing.

**Unit-V:** Integrating NC machines, robots, AGVs, and other NC equipment; Computer aided quality control; business functions, computer aided forecasting; office automation

**Reference Books:**

**Course outcomes:**
At the end of the course, the student will be able to:

| CO1 | Understand the formulation of Linear Programming |
| CO2 | Analyze and Convert the problem into a mathematical model. |
| CO3 | Understand the dual LP and Primal Dual relation problems |
| CO4 | Understand and implement the transportation problems at workplace |
| CO5 | Solve the assignment problems, solving linear programming approach using software |

<table>
<thead>
<tr>
<th>Course Code</th>
<th>MEPE###</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>COMPUTER AIDED DESIGN AND MANUFACTURING</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3 (L: 3, T: 0, P: 0)</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>Computer Aided Machine Drawing Practice (MEPC104)</td>
</tr>
<tr>
<td>Course Category</td>
<td>PE</td>
</tr>
</tbody>
</table>

**Course Objectives:** To provide an overview of how computers are being used in design, development of manufacturing plans and manufacture.

- To understand concepts of drafting and modelling using CAD.
- To understand the need for integration of CAD and CAM.
- To understand the concepts of flexible manufacturing system.

**Course Content:**

**UNIT-I: Fundamentals of CAD/CAM:** Automation; Design process; Application of computers for design; Benefits of CAD; Computer configuration for CAD applications; Design workstation; Graphic terminal; CAD Software: Definition of system software and application software; CAD database and structure.

**Geometric Modeling:** 3D-Wire frame modeling; Wire frame entities and their definitions; Interpolation and Approximation of curves; Concept of Parametric and Non-parametric representation of curves; Curve fitting techniques.
Unit-II: Surface Modeling: Algebraic and Geometric form; Parametric space of surface; Blending functions; Parametrization of surface patch; Subdividing; Cylindrical surface; Ruled surface; Surface of revolution; Spherical surface; Composite surface; Bezier surface; Solid Modelling: Definition of cell composition and spatial occupancy enumeration; Sweep representation; Constructive solid geometry; Boundary representations.

Unit-III: NC Control Production Systems: Numerical control; Elements of NC system; NC part programming; Methods of NC part programming; Manual part programming, Computer assisted part programming; Post processor; Computerized part program.

Unit-IV: Group Technology: Part families; Parts classification and coding; Production analysis; Machine cell design; Computer aided process planning: Retrieval type and Generative type; Machinability data systems; MRP and its Benefits.

Unit-V: Flexible manufacturing system: F.M.S equipment; Layouts; Analysis methods and benefits; Computer aided quality control; Automated inspection: Off-line, On-line, Contact, Non-contact; Coordinate measuring machines; Machine vision; CIM system and Benefits.

Reference Books:
1. CAD/CAM Principles and Applications, P.N.Rao, Tata McGraw-Hill
3. CAD/CAM/CIM, RadhaKrishna P. & Subramanyam, Wiley Eastern Ltd

Course outcomes:
At the end of the course, the student will be able to:

| CO1 | Develop mathematical models to represent curves and surfaces and Model engineering components using solid modeling techniques. |
| CO2 | Understand geometric transformation techniques in CAD. |
| CO3 | Develop programs for CNC to manufacture industrial components. |
| CO4 | Understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system. |
| CO5 | Utilize Flexible manufacturing system tools. |

Course Code : MEPE###
Course Title : INDUSTRIAL ROBOTICS & AUTOMATION
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites (Course code) : NIL
Course Category : PE

Course Objectives:
- To introduce the basic concepts, parts of robots and types of robots.
- To make the student familiar with the various drive systems for robot, sensors and their applications in robots and programming of robots.
- To select the robots according to its usage.
• To discuss about the various applications of robots, justification and implementation of robot.
• To Conceptualize automation and understand applications of robots in various industries.

Course Content:

UNIT-I: Fundamentals of Robotics: Introduction; Definition; Robot anatomy (parts) and its working; Robot Components: Manipulator, End effectors; Construction of links, Types of joints; Classification of robots; Cartesian, Cylindrical, Spherical, Scara, Vertical articulated; Structural Characteristics of robots; Mechanical rigidity; Effects of structure on control work envelope and work Volume; Robot work Volumes, comparison; Advantages and disadvantages of robots.

Unit-II: Robotic Drive System and Controller: Actuators; Hydraulic, Pneumatic and Electrical drives; Linear actuator; Rotary drives; AC servo motor; DC servo motors and Stepper motors; Conversion between linear and rotary motion; Feedback devices; Potentiometers; Optical encoders; DC tachometers; Robot controller; Level of Controller; Open loop and Closed loop controller; Microprocessor based control system; Robot path control: Point to point, Continuous path control and Sensor based path control; Controller programming.

Unit-III: Sensors: Requirements of a sensor; Principles and Applications of the following types of sensors: Position sensors (Encoders, Resolvers, Piezo Electric); Range sensors (Triangulation Principle, Structured lighting approach); Proximity sensing; Force and torque sensing.

Introduction to Machine Vision: Robot vision system (scanning and digitizing image data); Image processing and analysis; Cameras (Acquisition of images); Videocon camera (Working principle & construction); Applications of Robot vision system: Inspection, Identification, Navigation & serving.

Unit-IV: Robot kinematics and Robot Programming: Forward Kinematics; Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two Degrees of Freedom (In 2 Dimensional); Deviations and Problems. Teach Pendant Programming; Lead through programming; Robot programming Languages; VAL Programming; Motion Commands; Sensor Commands; End effector commands; and Simple programs

Unit-V: Automation: Basic elements of automated system, advanced automation functions, levels of automation.

Industrial Applications: Application of robots in machining; welding; assembly and material handling.

Reference Books:

7. Elements of Robotics Process Automation, Mukherjee, Khanna Publishing House, Delhi, 2018
Course outcomes:
At the end of the course, the student will be able to:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Explain the robot anatomy, classification, characteristics of robot, advantages and disadvantages.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Explain the various robotic actuators on hydraulic, pneumatic and electrical drives.</td>
</tr>
<tr>
<td>CO3</td>
<td>Explain about various types of sensors and concepts on robot vision system.</td>
</tr>
<tr>
<td>CO4</td>
<td>Explain the concepts of robot programming languages and various methods of robot programming.</td>
</tr>
<tr>
<td>CO5</td>
<td>Explain the various applications of robots.</td>
</tr>
</tbody>
</table>

Course Code: MEPE###
Course Title: HEAT TRANSFER
Number of Credits: 3 (L: 3, T: 0, P: 0)
Prerequisites: Basic Mechanical Engineering (MEPC102)
Course Category: PE

Course Objectives:
- To understand the concepts of conduction.
- To understand the concepts of Fins heat transfer.
- To understand the concepts of radiation.
- To understand the concepts of convection.
- To understand the basics of heat exchangers.

Course Content:

UNIT-I: Conduction: Fourier law of heat conduction for isotropic material; Thermal conductivity; Derivation of the energy equation in three dimensions including transient effect; Nondimensional - thermal diffusivity and Fourier number; Types of boundary conditions (Dirchlet, Neumann, mixed type); One dimensional solution with and without heat generation; Analogy with electrical circuits.


UNIT-III: Convection: Introduction, Newton’s law of cooling; Momentum and energy equations in two dimensions; nondimensionalisation, importance of nondimensional quantities and their physical significance. Velocity and thermal boundary layer thickness by integral method. Analogies between momentum, heat and mass transfer. Natural convection, effect of coupling on the conservation equations.


Reference Books:

Course outcomes:
At the end of the course, the student will be able to:

| CO1 | Understand the concepts of conduction |
| CO2 | understand the concepts of fins |
| CO3 | Understand the concepts of radiation. |
| CO4 | Understand the concepts of convection |
| CO5 | Understand the basic concepts of heat exchangers. |

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Course Code : MEPE###
Course Title : REFRIGERATION AND AIR-CONDITIONING
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : Thermal Engineering - I (MEPC202)
Course Category : PE

Course Objectives:
- To understand the basics of Refrigeration cycles.
- To understand basics of vapour compression and vapour absorption systems.
- To identify components and refrigerants and lubricants of a refrigeration system.
- To understand control strategies for refrigeration system.
- To understand the basics about air conditioning systems.

Course Content:
UNIT-I: Introduction to Refrigeration: Definition of Refrigeration; Refrigerating effect-unit of refrigeration- Coefficient of performance; Types of Refrigeration-Ice, dry ice, Steam jet, Throttling, Liquid nitrogen refrigeration; Carnot refrigeration Cycle; Air refrigeration- Bell - Coleman cycle, PV & TS diagram; Advantage and disadvantages in air refrigeration; Simple problems

Unit-II: Refrigeration systems: Basic Components, Flow diagram of working of Vapour compression cycle; Representation of the vapour compression cycle on P-H, T-S & P-V Diagram; Expression for Refrigerating effect, work done and power required; Types of Vapour Compression cycle; Effects of super heating and under cooling, its advantages and disadvantages; Simple Vapour absorptions cycle and its flow diagram; Simple Electrolux system for domestic units; Comparison of Vapour absorption and vapour compression system; Simple problems on vapour compression cycle.
Unit-III: Refrigeration equipments: Compressor - types of compressors; Hermetically sealed and Semi hermetically sealed compressor; Condensers - Air Cooled, water cooled, natural and forced draught cooling system; Advantages and disadvantages of air cooled and water cooled condensers; Evaporators - natural, convection, forced convection types.

Refrigerants and lubricants: Introduction to refrigerants; Properties of good refrigerants; Classification of refrigerants by group number and commonly used refrigerants in practice; Detection of refrigerants leakage; Charging the system with refrigerant; Lubricants used in refrigeration and their properties.

Unit-IV: Refrigerant flow controls: Capillary tube; Automatic Expansion valve; Thermo static expansion valve; High side and low side float valve; Solenoid valve; Evaporator pressure regulator.

Application of refrigeration: Slow and quick freezing; Cold storage and Frozen storage; Dairy refrigeration; Ice making industry; Water coolers.

Unit-V: Air conditioning: Introduction to Air conditioning; Factors affecting Air conditioning; Psychometric chart and its use; Psychometric process-sensible heating and cooling, Humidifying and dehumidifying; Adiabatic saturation process; Equipments used in air conditioning cycle; Air conditioning units and plants.

Refrigeration and Air-conditioning tools: Tools used in refrigeration and Air conditioner installation; Installation procedure; Faults in refrigeration and air conditioning system; Servicing procedure.

Reference Books:

Course outcomes
At the end of the course, the student will be able to:

| CO1 | Define refrigeration and types of Refrigeration cycles |
| CO2 | Explain Vapour Compression and Vapour Absorption System working principles |
| CO3 | Identify the components required for refrigeration system. |
| CO4 | Identify the controlling components for a refrigeration system. |
| CO5 | Explain the working principles of Air-conditioning. |

*******
Course Objectives:

- To understand the basic structure and components of an automobile.
- To understand the concepts of cooling and lubricating systems.
- To understand the concepts of Ignition and transmission and steering systems.
- To understand the classification and necessity of suspension system.
- To identify different special vehicles.

Course Content:

UNIT-I: Introduction to basic structure of an automobile: Basic engine components; Cylinder block; Cylinder head; Gaskets; cylinder liners, types of cylinder liners; Piston and piston pin; piston rings, types of piston rings; Connecting rod; Crank shaft; Cam shaft; Crankcase; Engine valves; Flywheel and Governor.

Unit-II: Cooling and lubrication system: The necessity of cooling system; Types of cooling system-air cooling and water cooling; Air cooling system; Types of water cooling system –Thermosyphon system and pump circulation system; Advantages and disadvantages of air cooling and water cooling systems; The components of water cooling system –fan, radiator, pump and thermostat; The necessity of lubrication system; S.A.E rating of lubrication system; Types of lubrication system; Petrol lubrication and high pressure lubrication system.

Fuel feed system: Conventional fuels and alternative fuels: Cetane and octane numbers; Types of carburettors; Working of simple carburettor; Multi point and single point fuel injection systems; Different fuel transfer pumps; Working of S.U electrical and A.C mechanical pump; Fuel filters; Fuel injection pump; Fuel injectors.

UNIT-III: Ignition system: Introduction to ignition system; Battery Ignition systems and magneto Ignition system; Electronic Ignition system; Construction and working of lead acid battery; Elements of charging system; Elements of starting system; Types of lights used in the automobile;

Transmission and steering system: General arrangement of clutch; Principle of friction clutches; Constructional details of Single plate clutch; Constructional details of multi-plate clutch; Constructional details of centrifugal clutch; Necessity for gear ratios in transmission; Types of gear boxes; Working of sliding mesh gear box; Working of constant mesh gear box; Working of propeller shaft Working of universal joint; Working of differential; Types of rear axle; Purpose of front axle; Necessity of steering system; Caster, camber and king pin inclination; Rack and pinion steering system; Power steering.

Unit-IV: Suspension system: Necessity of suspension system; Torsion bar suspension systems; Leaf spring and coil spring suspension system; Independent suspension for front wheel and rear wheel; Working of telescopic shock absorber; Functions of brakes; Types of brakes; Working of internal expanding brake; Working of disc brake.
Unit-V: **Special vehicles:** Introduction to Special vehicles; Tractor; Motor grader; Scrappers; Excavators; Duper trucks.

**Reference Books:**

**Course outcomes**
At the end of the course, the student will be able to:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Identify the components of an automobile with their working</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Explain the concepts of cooling and lubricating systems.</td>
</tr>
<tr>
<td>CO3</td>
<td>Explain the concepts of Ignition and Transmission and steering systems.</td>
</tr>
<tr>
<td>CO4</td>
<td>Identify different suspension systems and their applications.</td>
</tr>
<tr>
<td>CO5</td>
<td>Differentiate the special vehicles according to the usage.</td>
</tr>
</tbody>
</table>

*****

**Course Code**: MEPE###
**Course Title**: POWER PLANT ENGINEERING
**Number of Credits**: 3 (L: 3, T: 0, P: 0)
**Prerequisites**: Thermal Engineering - I (MEPC202)
**Course Category**: PE

**Course Objectives:**
- To understand the present scenario of power in India.
- To recognize various load terminologies used in power plants.
- To understand hydro working principles
- To understand working of Diesel, Gas and Nuclear power plants.
- To understand the issues and safety precautions in power plants.

**Course Content:**
**UNIT-I: Introduction to Power plant**: Introduction to power plant; Indian Energy scenario in India; Location of power plant; Choice of Power plant; Classification of power plants.

**Unit-II: Economics of power plant**: Terminology used in power plant: Peak load, Base load, Load factor; Load curve; Various factor affecting the operation of power plant; Methods of meeting the fluctuating load in power plant; Load sharing- cost of power-tariff methods; Performance and operating characteristics of power plant.
Unit-III: Hydro power plant: Introduction to Hydro electric power plant; Rainfall, Runoff and its measurement, Hydrograph, flow duration curve; Selection of sites for hydro electric power plant; General layout of Hydro electric power plant and its working; Classification of the Plant-Run off river plant, storage river plant, pumped storage plant; Advantages and disadvantages of hydro electric power plant.

Unit-IV: Diesel and Gas turbine plant: The layout of diesel power plant; Components and the working of diesel power plant; Advantages and disadvantages of diesel power plant; Gas turbine power Plant-Schematic diagram, components and its working; Combined cycle power generation- Combined gas and steam turbine power plant operation (only flow diagram).

Nuclear power plant: Introduction; Nuclear Power-Radio activity-Radioactive charge-types of reactions; Working of a nuclear power plant; Thermal fission Reactors- PWR, BWR and gas cooled reactors; Advantages and Disadvantages of Nuclear power plant.

Unit-V: Environmental impact of Power plant: Social and Economical issues of power plant; Green house effect; Acid precipitation-Acid rain, Acid snow, Dry deposition, Acid fog; Air, water, Thermal pollution from power plants; Radiations from nuclear power plant effluents.

Power plant safety: Plant safety concept; Safety policy to be observed in power plants; Safety practices to be observed in boiler operation; Safety in oil handling system; Safety in Chemical handling system; Statutory provision related to boiler operation.

Reference Books:

Course outcomes
At the end of the course, the student will be able to:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Familiarised with the present and future power scenario of India.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Enlist various load terminologies in power plants</td>
</tr>
<tr>
<td>CO3</td>
<td>Working and classifications in hydro power plant</td>
</tr>
<tr>
<td>CO4</td>
<td>Working principles of Diesel, Gas and Nuclear power plants.</td>
</tr>
<tr>
<td>CO5</td>
<td>Understand the issues and necessity of safety concepts of power plants.</td>
</tr>
</tbody>
</table>

*******
Course Code: MEPE###
Course Title: FARM EQUIPMENT AND FARM MACHINERY
Number of Credits: 3 (L: 3, T: 0, P: 0)
Prerequisites: NIL
Course Category: PE

**Course Objectives:**
- To find and characterize the machinery based on crop production.
- To find the field efficiency and capacities to calculate the economics of machinery.
- To find the machines usages for different tillage, and its power requirement calculations.
- To understand sowing, planting & transplanting equipment based on crop.
- To understand machinery materials and heat effects for different farm machinery equipment.

**Course Content:**

**UNIT-I:** Introduction to farm mechanization. Classification of farm machines. Unit operations in crop production. Identification and selection of machines for various operations on the farm. Hitching systems and controls of farm machinery.

**UNIT-II:** Calculation of field capacities and field efficiency. Calculations for economics of machinery usage, comparison of ownership with hiring of machines. Introduction to seed-bed preparation and its classification. Familiarization with land reclamation and earth moving equipment.

**UNIT-III:** Introduction to machines used for primary tillage, secondary tillage, rotary tillage, deep tillage and minimum tillage. Measurement of draft of tillage tools and calculations for power requirement for the tillage machines. Introduction to tillage machines like mould-board plough, disc plough, chisel plough, sub-soiler, harrows, puddler, cultivators, identification of major functional components. Attachments with tillage machinery.

**UNIT-IV:** Introduction to sowing, planting & transplanting equipment. Introduction to seed drills, no-till drills, and strip-till drills. Introduction to planters, bed planters and other planting equipment like sugarcane, potato. Study of types of furrow openers and metering systems in drills and planters. Calibration of seed-drills/planters. Adjustments during operation.


**Reference Books:**
2. Farm Machinery and Equipment - H. P. Smith
3. Farm Machinery and equipment - C. P. Nakra
Course Outcomes:
At the end of the course, the student will be able to:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Classify the Farm Machineries, equipment and materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Describe the objectives of Farm mechanization.</td>
</tr>
<tr>
<td>CO3</td>
<td>Explain selection of the machineries</td>
</tr>
<tr>
<td>CO4</td>
<td>Discuss the forces acting on tillage tools and hitching systems</td>
</tr>
<tr>
<td>CO5</td>
<td>Understand the calibration, constructional features and working of various farm equipment</td>
</tr>
</tbody>
</table>

Course Objectives:
- To know the operational features of the material handling equipment & its practical applications.
- To understand, select, operate and maintain the material handling equipments.
- To understand different material handling processes used in industries.
- To understand & appreciate safety instrumentation for equipment.

Course Content:

UNIT-I: Introduction to Material Handling System: Main types of Material handling equipments & their applications; Types of load to be handled; Types of Movements; Methods of stacking, loading & unloading systems; Principles of Material Handling Systems; Modern trends in Materials handling.

UNIT-II: Hoisting Machinery & Equipments: Construction, Working & Maintenance of different types of hoists such as Lever operated hoist, Portable hand chain hoist, Differential hoists, Worm geared and Spur geared hoists, Electric & Pneumatic hoists, Jumper; Construction, Working & Maintenance of different types of cranes such as Rotary cranes, Trackless cranes, Mobile cranes, Bridge cranes, Cable cranes, Floating cranes & Cranes traveling on guide rails; Construction, Working & Maintenance of Elevating equipments such as Stackers, Industrial lifts, Freight elevators, Passenger lifts, and Mast type's elevators, Vertical skip hoist elevators.

UNIT-III: Conveying Machinery: Construction, Working & Maintenance of Traction type conveyors such as Belt conveyors, Chain conveyors, Bucket elevators, Escalators; Construction, Working & Maintenance of Traction less type conveyors such as Gravity type conveyors, Vibrating & Oscillating conveyors, Screw conveyors, Pneumatic & Hydraulic conveyors, Hoppers gates & Feeders.
Surface Transportation Equipment: Construction, Function, Working of Trackless equipment such as Hand operated trucks, Powered trucks, Tractors, Automatic Guided vehicle, Industrial Trailers; Construction, Function, Working of Cross handling equipment such as Winches, Capstans, Turntables, Transfer tables, Monorail conveyors.

UNIT-IV: Components of Material Handling Systems: Flexible hoisting appliances such as Welded load chains, Roller chains, Hemp ropes, Steel wire ropes, Fastening methods of wire & chains, Eye bolts, Lifting tackles, Lifting & Rigging practices; Load handling attachments: a) Various types of hooks-Forged, Triangular eye hooks, Appliances for suspending hooks b) Crane grab for unit & piece loads c) Electric lifting magnet, vacuum lifter. d) Grabbing attachment for loose materials e) Crane attachment for handling liquids/molten metals; Construction & Working of Arresting gear & Brakes; Construction & use of electromagnetic shoe brakes, Thruster operated shoe brakes, Control brakes.

UNIT-V: Mechanism used in Material Handling Equipment: Steady state motion; Starting & stopping of motion in following mechanisms: Hoisting mechanism, Lifting Mechanism, Traveling Mechanism, Slewing Mechanism, Rope & chain operated Cross- Traverse Mechanism.

Selection of Material Handling Equipment: Factors affecting choice of material handling equipment such as Type of loads, Hourly capacity of the unit, Direction & length of travel, Methods of stocking at initial, final & intermediate points, Nature of production process involved, Specific load conditions & Economics of material handling system.

Reference Books:
1. Material handling (Principles & Practice) – Allegri T. H., CBS Publisher, New Delhi.
5. Material Handling Equipment – Y. I. Oberman, MIR Publisher, Moscow.

Course outcomes
At the end of the course, the student will be able to:

| CO1 | Understand constructional & operational features of various materials handling systems. |
| CO2 | Identify, compare & select proper material handling equipment for specified applications. |
| CO3 | Know the controls & safety measures incorporated on material handling equipment. |
| CO4 | Appreciate the role of material handling devices in mechanization & automation of industrial process. |
| CO5 | Understand & appreciate safety instrumentation for equipment |

*********
Course Objectives:

- To understand the basics of electric vehicle history and components.
- To understand properties of batteries.
- To understand the electrical machine properties and classifications.
- To understand the properties of electric vehicle drive systems
- To understand the concepts of hybrid electric vehicles.

Course Content:

**UNIT-I: Electric Vehicles:** Introduction; History of Hybrid and Electric Vehicles; Social and Environmental importance of Hybrid and Electric Vehicles; Components, Vehicle mechanics: Roadway fundamentals, Vehicle kinetics, Dynamics of vehicle motion; Propulsion System Design.

**Unit-II: Battery:** Basics; Types; Parameters: Capacity, Discharge rate, State of charge, State of Discharge, Depth of Discharge; Technical characteristics, Battery pack Design, Properties of Batteries.

**Unit-III: DC & AC Electrical Machines:** Motor and Engine rating; Requirements; DC machines; Three phase A/c machines; Induction machines; Permanent magnet machines; Switched reluctance machines.

**Unit-IV: Electric Vehicle Drive Train:** Transmission configuration; Components: Gears, Differential, Clutch, Brakes; Regenerative braking, Motor sizing; Fuel efficiency analysis.

**Unit-V: Hybrid Electric Vehicles:** Types: Parallel, Series, Parallel and Series configurations; Drive train; Sizing of components; Basics of Micro, Mild, Mini, Plug-in and Fully hybrid.

Reference Books:

1. Electric & Hybrid Vehicles – A.K. Babu, Khanna Publishing House, New Delhi, 2018

Course outcomes:

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

| CO1 | Understand the basics of electrical vehicle history and components. |
| CO2 | Understand the properties of batteries. |
| CO3 | Understand the electrical machine properties and classifications. |
| CO4 | Understand the properties of electrical vehicle drive systems. |
| CO5 | Understand the concepts of hybrid electric vehicles. |

******
Course Objectives:

- To understand the basic concepts and characteristics of measurement systems.
- To learn various types of sensors and transducers various mechanical, electrical and pneumatic actuation systems.
- To learn various mechanical, electrical and pneumatic actuation systems.
- To learn the concepts of digital communications and develop PLC programs.
- To evaluate the performance of mechatronic systems.

Course Content:

UNIT-I: Introduction to Mechatronics: Mechatronics; Importance of Mechatronics; Systems: Measurement systems; Control systems and their types; Closed-loop control System; Automatic water level controller; Sequential controllers-washing machine

Measurement System terminology: Displacement, Position & Proximity Sensors; Velocity and Motion Sensors; Force Sensors; Fluid Pressure Sensors; Flow Sensors; Liquid Level Sensors; Temperature Sensors; Light Sensors; Selection of Sensors.

UNIT-II: Mechanical Actuation Systems: Types of motion; Freedom and constraints; Loading; Gear Trains; Pawl & Ratchet; Belt & Chain drives; Bearings: Selection, Ball & Roller bearings; Mechanical aspects of motor selection.

Electrical Actuation Systems: Switches & Relays; Solenoids; D.C Motors; A.C.Motors; Stepper Motors: Specifications and Control of stepper motors; Servomotors: D.C Servomotor and A.C Servomotor.

Pneumatic & Hydraulic Systems: Power supplies; DCV; PCV; Cylinders; Rotary actuators.

UNIT-III: Mathematical Model: Introduction to Mathematical model; Mechanical System building blocks; Electrical System building blocks; Fluid System building blocks; Thermal System building blocks.


Input/Output Systems: Interfacing; Input/output ports; Interface requirements: Buffers, Handshaking, Polling and interrupts, Serial interfacing; Introduction to PIA; Serial communications interface; Example of interfacing of a seven-segment display with a decoder.

UNIT-IV: Programmable Logic Controller (PLC): Definition; Basic block diagram and structure of PLC; Input/Output processing; PLC Programming: Ladder diagram, its logic functions, Latching and Sequencing; PLC mnemonics; Timers; Internal relays and Counters; Shift registers; Master and Jump Controls; Data handling; Analog input/output; Selection of PLC.

UNIT-V: Design Examples & Advanced Applications in Mechatronics: Design process stages;
Traditional Vs Mechatronics designs; Possible design solutions: Timed switch, Wind-screen wiper motion, Bath room scale; Case studies of Mechatronics systems: A pick-and-place robot, Car park barrier, Car engine management system, Automatic Camera and Automatic Washing Machine only.

**Sensors for Condition Monitoring Systems of Production Systems:** Examples of Monitoring methods: Vibration monitoring, Temperature monitoring, Wear behavior monitoring; Mechatronics control in automated manufacturing; Monitoring of Manufacturing processes, On-line quality monitoring, Model based systems, Hardware in-the-loop simulation, Supervisory control in manufacturing inspection, Integration of heterogeneous systems.

**Reference Books:**
5. Mechatronics System – Devadas Shetty, PWS Publishing

**Course outcomes**
At the end of the course, the student will be able to:

| CO1 | Describe about various types of sensors and transducers. |
| CO2 | Explain the various mechanical, electrical and pneumatic actuation systems. |
| CO3 | Explain the basic mathematical building blocks for mechanical, electrical, thermal and fluid actuation system and its interfacing of input/output requirements. |
| CO4 | Explain the basic PLC architecture and PLC programming concepts. |
| CO5 | Describe the design examples of mechatronics system. Explain the condition monitoring of production systems using sensors. |

******
Production Engineering
Curriculum Structure
(III to VI Semesters)
### 6.1 List of Programme Core Courses [PC]

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Code No.</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Semes-ter</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>1.</td>
<td>PEPC201</td>
<td>Basic Mechanical Engineering</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>PEPC203</td>
<td>Computer Aided Machine Drawing Practical</td>
<td>0</td>
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Note: PEPE### to be assigned as per the course offered in a particular semester
### 6.3 Semester-wise Detailed Curriculum

#### Semester III

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**Total** | 13 L 3 T 12 | 28 | 22+2
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^One credit is carried forward from the V\textsuperscript{th} semester major project evaluation.
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**Course Learning Objectives:**
- To understand General Principles of Mechanical Engineering
- To understand laws of thermodynamics, thermal and thermodynamic Processes
- To understand working principles of Thermal Machines and Power Transmitting Devices
- To understand basic materials and manufacturing processes

**Course Content:**


**UNIT-II: Heat transfer & Thermal Power Plant:** Modes of Heat Transfer; Conduction: Composite Walls and Cylinders, Combined Conduction and Convection: Overall Heat Transfer Co-efficient, Simple Numerical Problems: Thermal Power Plant Layout; Rankine Cycle; Fire Tube and Water Tube boilers, Babcock & Wilcox, Cochran Boilers;

**UNIT-III: Steam Turbines:** Impulse and Reaction Turbines; Condensers: Jet & Surface Condensers, Cooling Towers; Internal Combustion Engines and Refrigeration: Otto, Diesel and Dual cycles; P-V and T-S Diagrams; IC Engines: 2 - Stroke and 4 - Stroke I.C. Engines, S.I. and C.I. Engines.


**Reference Books:**
5. Basic Mechanical Engineering – J Benjamin
6. Elements of Mechanical Engineering – Roy and Choudhary
7. Engineering Thermodynamics – Spalding and Cole

**Course outcomes:**
At the end of the course, the student will be able to:

| CO1 | Understand basics of thermodynamics and components of a thermal power plant |
| CO2 | Understand basics of heat transfer, refrigeration and internal combustion engines |
| CO3 | Understand mechanism of thermal power plant and boiler operation |
| CO4 | Identify engineering materials, their properties, manufacturing methods encountered in engineering practice |
| CO5 | Understand functions and operations of machine tools including milling, shaping, grinding and lathe machines |

**Course Code**: PEPC203

**Course Title**: COMPUTER AIDED MACHINE DRAWING PRACTICAL

**Number of Credits**: 2 (L: 0, T: 0, P: 4)

**Prerequisites**: NIL

**Course Category**: PC

**Course Learning Objectives**:
- To use computer aided drafting,
- To prepare geometrical model of various machine elements
- To draw the different views of machine elements
- To interpret the drawing in engineering field and illustrate three dimensional objects

**Course Content**:
1. Introduction to CAD software
2. Drawing aids and editing commands
3. Basic dimensioning, hatching, blocks and views
4. Isometric drawing, printing and plotting
5. CAD drawing practice detailed drawings of following machine parts are given to students to assemble and draw the sectional or plain elevations / plans / and side views with dimensioning and bill of materials using cad software – 12 exercises: sleeve & cotter joint, spigot & cotter joint, knuckle joint, stuffing box, screw jack, foot step bearing, universal coupling, plummer block, simple eccentric, machine vice, connecting rod, protected type flanged coupling.

**Reference Books**:

**Course outcomes**:
At the end of the course, the student will be able to:

| CO1 | Understand the representation of materials used in machine drawing |
| CO2 | Draw the development of surfaces for sheet metal working applications. |
Course Code : PEPC205
Course Title : METROLOGY & MEASUREMENTS
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : PC

Course Learning Objectives:

- To study advances in technology, measurement techniques, types of instrumentation devices, innovations, refinements.
- To study the principles of instrumentation, transducers & measurement of non-electrical parameters like temperature, pressure, flow, speed, force and stress.

Course Content:

UNIT-I: Introduction to measurements: Definition of measurement; Significance of measurement; Methods of measurements: Direct & Indirect; Generalized measuring system; Standards of measurements: Primary & Secondary; Factors influencing selection of measuring instruments; Terms applicable to measuring instruments: Precision and Accuracy, Sensitivity and Repeatability, Range, Threshold, Hysteresis, calibration; Errors in Measurements: Classification of errors, Systematic and Random error.

Measuring instruments: Introduction; Thread measurements: Thread gauge micrometer; Angle measurements: Bevel protractor, Sine Bar; Gauges: plain plug gauge, ring Gauge, snap gauge, limit gauge; Comparators: Characteristics of comparators, Types of comparators; Surface finish: Definition, Terminology of surface finish, Talysurf surface roughness tester; Co-ordinating measuring machine.

Unit-II: Transducers and Strain gauges: Introduction; Transducers: Characteristics, classification of transducers, two coil self-inductance transducer, Piezoelectric transducer; Strain Measurements: Strain gauge, Classification, mounting of strain gauges, Strain gauge rosettes-two and three elements.

Measurement of force, torque, and pressure: Introduction; Force measurement: Spring Balance, Proving ring, Load cell; Torque measurement: Prony brake, Eddy current, Hydraulic dynamometer; Pressure measurement: Mcloed gauge.

Unit-III: Applied mechanical measurements: Speed measurement: Classification of tachometers, Revolution counters, Eddy current tachometers; Displacement measurement: Linear variable Differential transformers (LVDT); Flow measurement: Rotometers, Turbine meter; Temperature measurement: Resistance thermometers, Optical Pyrometer.

Miscellaneous measurements: Humidity measurement: hair hygrometer; Density measurement: hydrometer; Liquid level measurement: sight glass, Float gauge; Biomedical measurement: Sphygmonometer.

Unit-IV: Limits, Fits & Tolerances: Concept of Limits, Fits, and Tolerances; Selective Assembly; Interchangeability; Hole And Shaft Basis System; Taylor’s Principle; Design of Plug; Ring Gauges; IS
919-1993 (Limits, Fits & Tolerances, Gauges) IS 3477-1973; concept of multi gauging and inspection.

**Angular Measurement:** Concept; Instruments For Angular Measurements; Working and Use of Universal Bevel Protractor, Sine Bar, Spirit Level; Principle of Working of Clinometers; Angle Gauges (With Numerical on Setting of Angle Gauges).

**Screw thread Measurements:** ISO grade and fits of thread; Errors in threads; Pitch errors; Measurement of different elements such as major diameter, minor diameter, effective diameter, pitch; Two wire method; Thread gauge micrometer; Working principle of floating carriage dial micrometer.

**Unit-V: Gear Measurement and Testing:** Analytical and functional inspection; Rolling test; Measurement of tooth thickness (constant chord method); Gear tooth vernier; Errors in gears such as backlash, runout, composite.

**Machine tool testing:** Parallelism; Straightness; Squareness; Coaxiality; roundness; run out; alignment testing of machine tools as per IS standard procedure.

**Reference Books:**

5. Dimensional Metrology – Connie Dotson, DELMAR, cenage learning, 2007

**Course outcomes**

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

| CO1 | Define accuracy, precision, calibration, sensitivity, repeatability and such relevant terms in metrology. |
| CO2 | Distinguish between various types of errors. |
| CO3 | Understand the principle of operation of an instrument and select suitable measuring device for a particular application. |
| CO4 | Appreciate the concept of calibration of an instrument. |
| CO5 | Analyze and interpret the data obtained from the different measurements processes and present it in the graphical form, statistical form. |

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<table>
<thead>
<tr>
<th>Course Code</th>
<th>PEPC207</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>FLUID MECHANICS &amp; HYDRAULIC MACHINERY</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3 (L: 2, T: 1, P: 0)</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>NIL</td>
</tr>
<tr>
<td>Course Category</td>
<td>PC</td>
</tr>
</tbody>
</table>
Course Learning Objectives:

- To understand fluid flow & related machinery for power generation, water supply and irrigation.
- To Select and use appropriate flow measuring device.
- To Select and use appropriate pressure measuring device.
- To understand and analyze the performance of pumps and turbines.

Course Content:

UNIT-I: Properties of fluid: Density, Specific gravity, Specific Weight, Specific Volume, Dynamic Viscosity, Kinematic Viscosity, Surface tension, Capillarity, Vapour Pressure, Compressibility.

Fluid Pressure & Pressure Measurement: Fluid pressure, Pressure head, Pressure intensity, Concept of vacuum and gauge pressures, atmospheric pressure, absolute pressure, Simple and differential manometers, Bourdan pressure gauge, Concept of Total pressure on immersed bodies, center of pressure, Simple problems on Manometers.

UNIT-II: Fluid Flow: Types of fluid flows, Path line and Stream line, Continuity equation, Bernoulli’s theorem, Principle of operation of Venturimeter, Orifice meter and Pitot tube, Derivations for discharge, coefficient of discharge and numerical problems.

Flow Through Pipes: Laminar and turbulent flows; Darcy’s equation and Chezy’s equation for frictional losses, Minor losses in pipes, Hydraulic gradient and total gradient line, Numerical problems to estimate major and minor losses


UNIT-V: Centrifugal Pumps: Principle of working and applications, Types of casings and impellers, Concept of multistage, Priming and its methods, Cavitation, Manometric head, Work done, Manometric efficiency, Overall efficiency. Numericals on calculations of overall efficiency and power required to drive pumps.

Reciprocating Pumps: Construction, working principle and applications of single and double acting reciprocating pumps, Concept of Slip, Negative slip, Cavitation and separation.

Reference Books:

2. Hydraulic, fluid mechanics & fluid machines – Ramamrutham S, Dhanpath Rai and Sons, New Delhi
3. Hydraulics and fluid mechanics including Hydraulic machines – Modi P.N. and Seth S.M., Standard Book House. New Delhi
5. Hydraulic, fluid mechanics & fluid machines – S. Ramamrutham, Dhanpat Rai and Sons

**Course outcomes:**
At the end of the course, the student will be able to:

| CO1 | Measure various properties such as pressure, velocity, flow rate using various instruments. |
| CO2 | Calculate different parameters such as co-efficient of friction, power, efficiency etc of various Systems. |
| CO3 | Describe the construction and working of turbines and pumps. |
| CO4 | Test the performance of turbines and pumps. |
| CO5 | Plot characteristics curves of turbines and pumps. |

Course Code : PEPC209
Course Title : INDUSTRIAL PRODUCTION TECHNOLOGY-I
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : PC

**Course Learning Objectives:**
- To understand the types of pattern, casting, moulding, furnaces and casting processes.
- To know the construction and working principles various welding processes.
- To understand various forming technologies and metal powder manufacturing methods.

**Course Content:**

**UNIT-I: Foundry Technology**

**UNIT-II: Casting:** Shell mould casting – Investment casting – Pressure die casting – Hot chamber die casting – Cold chamber die casting – Gravity die casting – Centrifugal casting – Continuous casting – Defects in casting – causes and remedies.

**UNIT-III: Welding Technology**

UNIT-IV: Forming Technology


Reference Books:

Course outcomes:
At the end of the course, the student will be able to:

| CO1 | Demonstrate understanding of casting process |
| CO2 | Illustrate principles of forming processes |
| CO3 | Demonstrate applications of various types of welding processes. |
| CO4 | Explains the concepts of rolling, forming and forging. |
| CO5 | Illustrates the concept of powder metallurgy |

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Course Code : PEPC211
Course Title : HEAT POWER ENGINEERING
Number of Credits : 3 (L: 2, T: 1, P: 0)
Prerequisites : NIL
Course Category : PC

Course Learning Objectives:
- Describe internal combustion engine.
- Select appropriate type of compressor to suit the requirements.
- Calculate performance parameters of Air compressor.
- Understand Refrigeration & Air-conditioning processes and their application.
Course Content:


UNIT-V: Refrigeration and Air-Conditioning: Introduction - COP of Heat Pump and refrigerator; Tonnes of Refrigeration. Vapour compression system - Vapour compression refrigeration cycle, com-

**Reference Books:**


**Course outcomes:**

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

<table>
<thead>
<tr>
<th>CO1</th>
<th>Explain the basics of systems and laws of thermodynamics and thermodynamic processes. Explain different Air Cycles.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Apply steady flow energy equation for nozzles and condensers.</td>
</tr>
<tr>
<td>CO3</td>
<td>Familiarize the parts, functions and types of Air compressors and determine their efficiency. Describe the working of the gas turbines.</td>
</tr>
<tr>
<td>CO4</td>
<td>Explain different type of fuels and their combustion phenomenon.</td>
</tr>
<tr>
<td>CO5</td>
<td>Explain the types and functions of IC engines.</td>
</tr>
</tbody>
</table>

**Course Code**: PEPC213  
**Course Title**: PRODUCTION DRAWING LAB  
**Number of Credits**: 1 (L: 0, T: 0, P: 2)  
**Prerequisites**: NIL  
**Course Category**: PC

**Course Learning Objectives**

- Production Drawing provides a convenient means to create designs for almost every engineering discipline.
- Computer Aided Design software can be used for the component drawings and explaining clearly the tolerances, surface roughness’s etc.

**Course Content**

1. Representation Materials & Machine Components
2. Limits and Fits
3. Form and Positional Tolerances
4. Surface Roughness and its Indication & Heat and Surface Treatment Symbols
5. Detailed and Part Drawings
   a. Stuffing Box
   b. Crosshead
   c. Eccentric
   d. Connecting rod
e. Screw jack
f. Pipe vice
g. Plummer block
h. Lathe tool post
i. Oldham coupling
j. Universal coupling
k. Spring
l. Loaded relief valve
m. Air cock valve

Reference Books:
4. Machine Drawing with AutoCAD, Pohit and Ghosh, PE
5. Geometrical Dimensioning and Tolerancing, James D. Meadows, B.S. Publications

Course outcomes:
At the end of the course, the student will be able to:

| CO1 | Draw the conventional representation of different materials used in engineering practice like wood, glass, metal etc., and the limits and tolerances |
| CO2 | Understand and indication of form and position tolerances on drawings, types of run-out, total run-out and their indication. |
| CO3 | Improve visualization ability of surface roughness and its indications with respect to the material surface. |
| CO4 | Apply the drawing techniques to draw various part drawings and assembly, tolerances, roughness etc. |
| CO5 | Explains the internal features of different part drawings and assembly |

Course Code : PEPC215
Course Title : INDUSTRIAL PRODUCTION TECHNOLOGY LAB-I
Number of Credits : 1.5 (L: 0, T: 0, P: 3)
Prerequisites : PEPC205 INDUSTRIAL PRODUCTION TECHNOLOGY-I
Course Category : PC

Course Learning Objectives:
- To impart knowledge about principles/methods of casting with detail design of gating/riser system needed for casting, defects in cast objects and requirements for achieving sound casting.
- To impart knowledge about welding behaviour of machine and process during welding, analysis of common and newer welding techniques and metallurgical and weldability aspects of different common engineering materials.

Course Content:
- Prepare the green sand mould using the following patterns.
  - Solid pattern
1. Stepped pulley
2. Bearing top
  - **Split pattern**
    3. Bent Pipe with core print
    4. T-pipes with core print
    5. Tumbles
  - **Loose Piece Pattern**
    6. Dovetail

- **Core preparation**
  7. Core preparation for Bent pipe/T-pipe

- **Make the following welding joint/cutting.**

- **Arc welding (Raw Material: 25 mmx6mm MS flat)**
  1. Lap joint
  2. Butt joint
  3. T-joint

- **Gas Welding (Raw Material: 25mmx3mm Ms flat)**
  4. Lap joint
  5. Butt joint

- **Gas cutting: (GI/MS Sheet-3mm thickness)**
  6. Profile cutting—circular profile

- **Spot welding: (GI/MS Sheet)**
  7. Lap joint

**Reference Books:**

**Course outcomes:**
At the end of the course, the student will be able to:

| CO1 | Identify the tools used in foundry. |
| CO2 | Make sand mould by using the different types of pattern. |
| CO3 | Make sand core for bend pipe and T pipe |
| CO4 | Identify the tools used and safety precautions in welding. |
| CO5 | Apply the knowledge to make different types of joints by arc and gas welding. |

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Course Code : PEPC217
Course Title : PRECISION METROLOGY LAB
Number of Credits : 1 (L: 0, T: 0, P: 2)
Prerequisites : PEPC201 Metrology & Measurements
Course Category : PC

Course Learning Objectives

• To understand techniques for precise measurement of the dimensions of various objects and shapes.

Course Content:

I. LINEAR MEASUREMENTS:

1. Determine the thickness of ground MS flat to an accuracy of 0.02mm using Vernier caliper.
2. Determine the diameter and length of cylindrical objects to an accuracy of 0.02mm using vernier caliper.
3. Determine the inside diameter of a bush component to an accuracy of 0.02 using Vernier caliper.
4. Determine the diameter of a cylindrical component to an accuracy of 0.01mm using micrometer and check the result with digital micrometer.
5. Determine the height of gauge block or parallel bars to an accuracy of 0.02mm using Vernier height gauge.
6. Determine the depth of a blind bore component to an accuracy of 0.02mm using vernier depth gauge.
7. Determine the thickness of ground MS plates using slip gauges.

II. ANGULAR MEASUREMENTS:

8. Determine the angle of V-block, Taper Shank of Drill and Dovetails in mechanical components using universal bevel protractor.
9. Determine the angle of machined surfaces of components using sine bar with slip gauges.

III. GEOMETRIC MEASUREMENT

10. Measure the geometrical dimensions of V-Thread
11. Measure the geometrical dimensions of spur gear.

IV. MACHINE TOOL TESTING

Geometrical Test: Position of machine tool components and displacement of machine tool components relative to one another is checked.

The instruments required for Geometrical tests are Dial Gauge, test mandrel, Straight edge, Squareness, spirit level.

• Test for level of installation of machine tool in Horizontal and Vertical Planes.
• Test for Flatness of machine bed and for straightness and parallelism of bed ways on bearing surface.
• Test for perpendicular of guide ways to other guide ways or bearing surface.
• Test for true running of the main spindle and its axial movements.
• Test for parallelism of spindle axis to guide ways or bearing surfaces.
• Test for line of movements of various members like spindle and table cross slides.
• Practical test in which some test pieces are done and their accuracy and finish is checked.
Reference Books:
2. Mechanical and Industrial measurements- R. K. Jain
3. Engineering precision metrology – R. C. Gupta

Course outcomes:
At the end of the course, the student will be able to:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Measure various component of linear measurement using Vernier calipers and Micrometer</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Measure various component of angle measurement using sine bar and bevel Protractor</td>
</tr>
<tr>
<td>CO3</td>
<td>Measure the geometrical dimensions of V-thread and spur gear</td>
</tr>
</tbody>
</table>

Course Code : PEPC219
Course Title : HEAT POWER ENGINEERING LAB
Number of Credits : 1.5 (L: 0, T: 0, P: 3)
Prerequisites : PEPC207 HEAT POWER ENGINEERING
Course Category : PC

Course Learning Objectives:
- To understand working of various IC Engines and familiarise with various parts of different engines physically.
- To understand and relate the working of an engine as studied in theory.
- Understand troubleshooting to rectify some of the problems normally occurring in engines and automobiles.
- Understand and familiarise with the working of air compressor, refrigeration system and steam boilers.

Course Content:
List of Experiments:

**PART-A**
1. Determine flash and fire point of the given oil using open cup apparatus.
2. Determine flash and fire point of the given oil using closed cup apparatus.
3. Determine the absolute viscosity of the given lubricating oil using Redwood viscometer.
4. Determine the absolute viscosity of the given lubricating oil using Say bolt viscometer.
5. Port timing diagram of two stroke petrol Engine
6. Valve time diagram for four stroke petrol Engine.
7. Valve time diagram for four stroke diesel engines.

**PART-B**
8. Load test (Performance test) on Four Stroke Petrol Engine.
10. Morse test on Multi-cylinder petrol engine.
13. Volumetric efficiency of Air Compressor.
14. Thermal Conductivity measurement using guarded plate apparatus
15. Determination of COP of Refrigeration System

PART-C
16. Study of high-pressure boiler.
17. Study of boiler mountings and Accessories.

Reference Books:
2. Basic and applied thermodynamics by P. K. Nag ,Tata McGraw hill New delhi 2009
3. Heat engines(Vol-I & Vol-II) by Patel and Karmachandani
4. I. C. Engine Fundamentals by Hey wood
5. Thermal Engineering by R. S. Khurmi

Course outcomes:
At the end of the course, the student will be able to:

| CO1  | Appreciate the practical applications of Bomb calorimeter /Boy's gas calorimeter |
| CO2  | Appreciate the Mechanism of valve functioning in 2 and 4-stroke diesel engine |
| CO3  | Understand the method of evaluating the performance characteristics of single cylinder diesel engine at different loads and draw the heat balance sheet |
| CO4  | Understand the method of finding the indicated power of individual cylinders of an engine by using morse test |
| CO5  | Study of high pressure boiler with model |

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SEMESTER IV

Course Code : PEPC202
Course Title : INDUSTRIAL PRODUCTION TECHNOLOGY-II
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : PEPC208 INDUSTRIAL PRODUCTION TECHNOLOGY LAB-II
Course Category : PC

Course Learning Objectives:

- To understand basic production processes and technologies of relevance to the manufacturing industry and related sectors, particularly in the production, process and development areas.
- To select, operate and control the appropriate processes for specific applications and production processes, surface finishing processes and plastic processes.

Course Content:

UNIT-I: Theory of Metal Cutting: Theory of Metal Cutting: Cutting tool material-High carbon Steel-High Speed Steel-Stellites-Cemented carbides-ceramics-Composition and applications for the above-Single point cutting tool-nomenclature-tool life- Chip Breakers.


Boring Machines: Boring machines-horizontal and vertical types-fine boring machines-boring tools

UNIT-II: Reciprocating Machines: Planer: Types of planers-description of double housing planer specifications- principles of operation-drives-quick return mechanism-feed mechanism- work holding devices and special fixtures-types of tools various operation.

Shaper: Types of shapers-specifications-standard-plain-universal principles of operations-drives-quick return mechanism-crank and slotted link-feed mechanism-work holding devices-Special fixture-various operations.

Slotter: Types of slotters-specifications-method of Operation-Whitworth quick return mechanism-feed mechanism-work holding devices-types of tools.


Gear Generating Processes: Gear shaper-Gear hobbing-Principle of operation only-Gear finishing processes-Burnishing-Shaving-Grinding and Lapping; Gear materials-Cast iron, Steel, Alloy steels, Brass, Bronze, Aluminum and Nylon

grinding wheels—selection of grinding wheel—mounting of grinding wheels—Dressing and Truing of wheels—Balancing of grinding wheels.

Broaching: Types of broaching machine—horizontal, vertical and continuous broaching—principles of operation—types of broaches classification—broach tool nomenclature—broaching operations—simple examples


Non-Conventional Machining Processes: Construction, working and applications of Ultrasonic machining—chemical machining—electro chemical grinding—electrical discharge machining—plasma arc machining—LASER machining—Advantages – Disadvantages.

Reference Books:


Course outcomes:

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

| CO1 | Use the basic machine tools like lathe, drilling and milling. |
| CO2 | Understand and select the gear cutting processes. |
| CO3 | Demonstrate understanding of metal cutting principles and mechanism |
| CO4 | Identify cutting tool geometry of single point and multipoint cutting tool |
| CO5 | Demonstrate concepts and use of jigs and fixtures |

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| Course Code | : | PEPC204 |
| Course Title | : | STRENGTH OF MATERIALS |
| Number of Credits | : | 3 (L: 2, T: 1, P: 0) |
| Prerequisites | : | Engineering Mechanics (ESC201) |
| Course Category | : | PC |

Course Learning Objectives

• To understand the concept of Simple Stresses and Strains.
• To understand the concept of Strain Energy.
• To understand the concept of Shear Force and Bending Moment Diagrams.
• To understand the concept of Theory of Simple Bending and Deflection of Beams.
• To understand the concept of Torsion in Shafts and Springs.
• To understand the concept of Thin Cylindrical Shells.
Course Content

UNIT-I: Simple Stresses and Strains: Types of forces; Stress, Strain and their nature; Mechanical properties of common engineering materials; Significance of various points on stress – strain diagram for M.S. and C.I. specimens; Significance of factor of safety; Relation between elastic constants; Stress and strain values in bodies of uniform section and of composite section under the influence of normal forces; Thermal stresses in bodies of uniform section and composite sections; Related numerical problems on the above topics.

Strain Energy: Strain energy or resilience, proof resilience and modulus of resilience; Derivation of strain energy for the following cases: i) Gradually applied load, ii) Suddenly applied load, iii) Impact/shock load; Related numerical problems.

UNIT-II: Shear Force & Bending Moment Diagrams: Types of beams with examples: a) Cantilever beam, b) Simply supported beam, c) Over hanging beam, d) Continuous beam, e) Fixed beam; Types of Loads – Point load, UDL and UVL; Definition and explanation of shear force and bending moment; Calculation of shear force and bending moment and drawing the S.F and B.M. diagrams by the analytical method only for the following cases: a) Cantilever with point loads, b) Cantilever with uniformly distributed load, c) Simply supported beam with point loads, d) Simply supported beam with UDL, e) Over hanging beam with point loads, at the centre and at free ends, f) Over hanging beam with UDL throughout, g) Combination of point and UDL for the above; Related numerical problems.

UNIT-III: Theory of Simple Bending and Deflection of Beams: Explanation of terms: Neutral layer, Neutral Axis, Modulus of Section, Moment of Resistance, Bending stress, Radius of curvature; Assumptions in theory of simple bending; Bending Equation \( M/I = \sigma/Y = E/R \) with derivation; Problems involving calculations of bending stress, modulus of section and moment of resistance; Calculation of safe loads and safe span and dimensions of cross-section; Definition and explanation of deflection as applied to beams; Deflection formulae without proof for cantilever and simply supported beams with point load and UDL only (Standard cases only); Related numerical problems.

UNIT-IV: Torsion in Shafts and Springs: Definition and function of shaft; Calculation of polar M.I. for solid and hollow shafts; Assumptions in simple torsion; Derivation of the equation \( T/J=f_s/R=G\Theta/L \); Problems on design of shaft based on strength and rigidity; Numerical Problems related to comparison of strength and weight of solid and hollow shafts; Classification of springs; Nomenclature of closed coil helical spring; Deflection formula for closed coil helical spring (without derivation); stiffness of spring; Numerical problems on closed coil helical spring to find safe load, deflection, size of coil and number of coils.

UNIT-V: Thin Cylindrical Shells: Explanation of longitudinal and hoop stresses in the light of circumferential and longitudinal failure of shell; Derivation of expressions for the longitudinal and hoop stress for seamless and seam shells; Related numerical Problems for safe thickness and safe working pressure.

Reference Books:


Course outcomes:
At the end of the course, the student will be able to:

| CO1 | Compute stress and strain values and find the changes in axial, lateral and volumetric dimensions of bodies of uniform section and of composite section under the influence of normal forces. |
| CO2 | Calculate thermal stresses, in bodies of uniform section and composite sections. |
| CO3 | Define resilience, proof – resilience and modulus of resilience and obtain expressions for instantaneous stress developed in bodies subjected to different loads. |
| CO4 | Compute shear force and bending moment at any section of beam and draw the S.F. & B.M diagrams of for UDL and Point loads. |
| CO5 | Calculate the safe load, safe span and dimensions of cross section. |
| CO6 | Compare strength and weight of solid and hollow shafts of the same length and material and compute the stress and deflection of the closed coil helical spring. |

Course Code : PEPC206
Course Title : THEORY OF MACHINES AND MECHANISMS
Number of Credits : 3
Prerequisites (Course code) : Engineering Mechanics (ESC201)
Course Category : PC

Course Learning Objectives
- To understand different types of cams and their motions and also to draw cam profiles for various motions.
- To understand the mechanism of various types of drives available for transmission of power.
- To understand the design of Brakes, Dynamometers, Bearings and Clutches and their function and working.
- To understand the need for balancing of masses in the same plane
- To Know different types of governors.

Course Content
UNIT I: Cams and Followers: Concept; Definition and application of Cams and Followers; Classification of Cams and Followers; Different follower motions and their displacement diagrams like uniform velocity, SHM, uniform acceleration and Retardation; Drawing of profile of radial cam with knife-edge and roller follower with and without offset with reciprocating motion (graphical method).

UNIT II: Power Transmission: Types of Drives – Belt, Chain, Rope, Gear drives & their comparison; Belt Drives - flat belt, V- belt & its applications; Material for flat and V-belt; Angle of lap, Belt length. Slip and Creep; Determination of Velocity Ratio, Ratio of tight side and slack side tension; Centrifugal tension and Initial tension; Condition for maximum power transmission (Simple numericals); Chain Drives – Advantages & Disadvantages; Selection of Chain & Sprocket wheels; Methods of lubrication; Gear Drives – Spur gear terminology; Types of gears and gear trains, their selection for different applications; Train value & Velocity ratio for compound, reverted and simple epicyclic gear train; Methods of lubrication; Law of gearing; Rope Drives – Types, applications, advantages & limitations of Steel ropes.
UNIT III: Flywheel and Governors: Flywheel - Concept, function and application of flywheel with the help of turning moment diagram for single cylinder 4-Stroke I.C. Engine (no Numericals); Coefficient of fluctuation of energy, Coefficient of fluctuation of speed and its significance; Governors - Types and explanation with neat sketches (Centrifugal, Watt and Porter); Concept, function and applications & Terminology of Governors; Comparison between Flywheel and Governor.

UNIT IV: Brakes, Dynamometers, Clutches & Bearings: Function of brakes and dynamometers; Types of brakes and Dynamometers; Comparison between brakes and dynamometers; Construction and working of i) shoe brake, ii) Band Brake, iii) Internal expanding shoe brake iv) Disc Brake; Concept of Self Locking & Self energizing brakes; Numerical problems to find braking force and braking torque for shoe & band brakes; Construction and working of i) Rope Brake Dynamometer, ii) Hydraulic Dynamometer, iii) Eddy current Dynamometers; Clutches- Uniform pressure and Uniform Wear theories; Function of Clutch and its application; Construction and working of i) Single plate clutch, ii) Multiplate clutch, iii) Centrifugal Clutch iv) Cone clutch and v) Diaphragm clutch. (Simple numericals on single and Multiplate clutch); Bearings – i) Simple Pivot, ii) Collar Bearing, iii) Conical pivot. Torque & power lost in friction (no derivation). Simple numericals.

UNIT V: Balancing & Vibrations: Concept of balancing; Balancing of single rotating mass; Graphical method for balancing of several masses revolving in same plane; Concept and terminology used in vibrations, Causes of vibrations in machines; their harmful effects and remedies.

Reference Books:

Course outcomes
At the end of the course, the student will be able to:

| CO1 | Know different machine elements and mechanisms. |
| CO2 | Understand Kinematics and Dynamics of different machines and mechanisms. |
| CO3 | Select Suitable Drives and Mechanisms for a particular application. |
| CO4 | Appreciate concept of balancing and Vibration. |
| CO5 | Develop ability to come up with innovative ideas. |
| CO6 | Understand different types of cams and their motions and also draw cam profiles for various motions |

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| Course Code | PEPC208 |
| Course Title | INDUSTRIAL PRODUCTION TECHNOLOGY LAB-II |
| Number of Credits | 1.5  (L: 0, T: 0, P: 3) |
| Prerequisites | Industrial Production Technology-II (PEPC202) |
| Course Category | PC |
Course Learning Objectives:

• Operate various machines like lathe, shaper etc.
• Perform plain turning, taper turning, and screw cutting etc. on lathe machine.
• Perform machining operations on shaper.
• Perform shaping operations

Course Content:

1.0 DRILLING EXERCISE (Three models)
   1.1 Preparation of model with two or three different sizes holes for different materials
   1.2 Preparation models of different holes by maintain minimum distance between them

2.0 SHAPING SQUARE (Three models)
   2.1 Hexagon on a round bar; key ways, grooves splines,
   2.2 Shaping step block cut dovetail to angles 60, 90, 120 degrees.

3.0 SIMPLE PLANNING EXERCISE CUTTING 'T' SLOTS (One model)

4.0 PRACTICES ON MILLING MACHINE (Three models)
   4.1 Milling-square-hexagon from round bars with indexing and without indexing
   4.2 Milling key ways of different types
   4.3 Generation of spur gear teeth on a round bar.
   4.4 Milling flutes of a twist drill
   4.5 Milling splines and T-slots

5.0 MOUNTING BALANCING AND DRESSING OF GRINDING WHEELS
   5.1 Grinding flat surface on a surface grinder using magnetic chuck and clamping devices
   5.2 Cylindrical grinding of external surface and internal surface using universal grinding machines
   5.3 Grinding Cutting tools to the required angles
   5.4 Grinding of milling cutters etc, on a tool and cutter grinder

6.0 LATHE OPERATIONS
   6.1 Facing, Step turning & Chamfering
   6.2 Step turning & Groove cutting
   6.3 Step turning & Taper turning
   6.4 Step turning & Knurling
   6.5 Step turning &Thread cutting (L.H)
   6.6 Bush: Turning & Drilling

Reference Books:

Course outcomes:

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

<p>| CO1 | Identify the parts of a center lathe and types of tools used. |</p>
<table>
<thead>
<tr>
<th>CO2</th>
<th>Make use of lathe for machining various cylindrical components</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO3</td>
<td>Identify the parts of a drilling machine and types of tools used.</td>
</tr>
<tr>
<td>CO4</td>
<td>Make use of drilling machine for drilling, reaming and tapping operations</td>
</tr>
<tr>
<td>CO5</td>
<td>Make use of drilling machine for counter sink and counter bore operations</td>
</tr>
</tbody>
</table>

**Course Code**: PEPC210  
**Course Title**: CAD/CAM LAB  
**Number of Credits**: 1 (L: 0, T: 0, P: 2)  
**Prerequisites**: Computer Aided Machine Drawing (MEPC104)  
**Course Category**: PC

**Course Learning Objectives:**
- To understand the fundamentals and use CAD.
- To conceptualize drafting and modeling in CAD.
- To interpret the various features in the menu of solid modeling package.
- To synthesize various parts or components in an assembly.
- To prepare CNC programmes for various jobs.

**Course Content:**

**PART A: Solid modelling**

*Introduction*

*Exercises*
3D Drawing
1. Geneva Wheel  
2. Bearing Block  
3. Bushed bearing  
4. Gib and Cotter joint  
5. Screw Jack  
6. Connecting Rod

*Note*: Print the orthographic view and sectional view from the above assembled 3D drawing.

**PART B: CNC Programming and Machining**

*Introduction:*
1. Study of CNC lathe, milling.  
2. Study of international standard codes: G-Codes and M-Codes  
5. Editing the program in the CNC machines.  
6. Execute the program in the CNC machines.

*Exercises*
Production Engineering Curriculum Structure

Note: Print the Program from the Simulation Software and make the Component in the CNC Machine.

PART C: CNC Turning Machine Material: Aluminium/Acrylic/Plastic rod

1. Using Linear and Circular interpolation - Create a part program and produce component in the Machine.
2. Using Stock removal cycle – Create a part program for multiple turning operations and produce component in the Machine.
3. Using canned cycle - Create a part program for thread cutting, grooving and produce component in the Machine.

PART D: CNC Milling Machine Material: Aluminium/ Acrylic/ Plastic

1. Using Linear interpolation and Circular interpolation – Create a part program for grooving and produce component in the Machine.
2. Using canned cycle - Create a part program for drilling, tapping, counter sinking and produce component in the Machine.
3. Using subprogram - Create a part program for mirroring and produce component in the Machine.

Reference Books:

2. Mechanical Draughtsmanship, G.L. Tamta Dhanpat Rai & Sons, Delhi, 1992

Course outcomes:

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

| CO1 | Explain the 3D commands and features of a CAD software |
| CO2 | Create 3D solid model and find the mass properties of simples solids |
| CO3 | Demonstrate the working of CNC turning and milling machine |
| CO4 | Develop the part program using simulation software for Lathe and Milling |
| CO5 | Assess the part program, edit and execute in CNC turning and machining centre |

Course Code : PEPC212
Course Title : STRENGTH OF MATERIALS & HYDRAULIC MACHINERY LAB
Number of Credits : 1.5 (L: 0, T: 0, P: 3)
Prerequisites : Strength of Materials (PEPC204) and Fluid Mechanics & Hydraulic Machinery (PEPC203)
Course Category : PC

Course Learning Objectives

- Define the various properties of materials such as: Yield stress, Ultimate stress, percentage elongation, Young's Modulus.
- Appreciate the importance of various mechanical properties such as hardness, impact strength.
- Appreciate the practical applications of orifice meter and venturi meter.
- Understand flow through pipes and the importance of pipe friction in practical environment.
- Understand the method of evaluating the performance characteristics of turbine, for a given set of input data.
Course Content:

**Strength of Materials Laboratory Exercises**

1. **Test on Ductile Materials:**
   Finding Young’s Modulus of Elasticity, yield points, percentage elongation and percentage reduction in area, stress strain diagram plotting, tests on mild steel.

2. **Hardness Test:**
   Determination of Rockwell’s Hardness Number for various materials like mild steel, high carbon steel, brass, copper and aluminum

3. **Torsion test:**
   Torsion test on mild steel – relation between torque and angle of twist – determination of shear modulus and shear stress

4. **Impact test:**
   Finding the resistance of materials to impact loads by Izod test and Charpy test

5. **Tests on springs of circular section:**
   Determination of modulus of rigidity, strain energy, shear stress and stiffness by load deflection method (Open / Closed coil spring)

6. **Shear test:**
   Single or double shear test on M.S. bar to finding the resistance of material to shear load

**Fluid Mechanics Laboratory Exercises**

1. Verify the Bernoulli’s Theorem.
2. Determination of co-efficient of discharge of a mouth piece / orifice by variable head method.
3. Determination of co-efficient of discharge of a venturimeter / orifice meter.
4. Determination of the friction factor in a pipe.
5. Performance test on reciprocating pump / centrifugal pump and to draw the characteristics curves.
6. Performance test on impulse turbine / reaction turbine and to find out the Efficiency.

**Reference Books:**

5. Fluid Power with Applications by Anthony Esposito.

**Course outcomes:**

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

<table>
<thead>
<tr>
<th>CO1</th>
<th>Determine the various types of stress and plot the stress strain diagram for mild steel.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Determine the Rockwell hardness for various materials.</td>
</tr>
<tr>
<td>CO3</td>
<td>Determine the torsion, bending, impact and shear values of given materials</td>
</tr>
<tr>
<td>CO4</td>
<td>Determine the Cd of orifice meter, venturi meter, orifice, mouth piece and pipe friction factor</td>
</tr>
<tr>
<td>CO5</td>
<td>Determine performance of pumps and turbines</td>
</tr>
</tbody>
</table>

******
SEMESTER V

<table>
<thead>
<tr>
<th>Course Code</th>
<th>PEPC301</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>MECHATRONICS AND ROBOTICS</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3 (L: 3, T: 0, P: 0)</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>NIL</td>
</tr>
<tr>
<td>Course Category</td>
<td>PC</td>
</tr>
</tbody>
</table>

**Course Learning Objectives**

- To understand the basic concepts and characteristics of measurement systems.
- To learn various types of sensors and transducers, various mechanical, electrical, and pneumatic actuation systems.
- To learn the concepts of digital communications and develop PLC programs.
- To introduce the basic concepts, parts of robots, and types of robots.
- To make the student familiar with the various drive systems for robots, sensors, and their applications in robots and programming of robots.

**Course Content:**

**UNIT-I: Introduction**

Mechatronic systems, closed and open loop measurement systems, The Mechatronics approach, Sensors, microprocessors, and transducers, displacement, position, and proximity pickups. Mechanical and Electrical activation systems.

**Measurement Systems:**

Measurement errors, modelling measurement systems, system reliability, signal conditioning & processing, Data acquisition and processing systems, Data presentation.

**Applied Instrumentation:**


**UNIT-II: Programmable Logic Controller (PLC)**

Definition – Basic block diagram and structure of PLC – Input/Output processing – PLC Programming: Ladder diagram, its logic functions, latching and sequencing – PLC mnemonics – Timers, internal relays, and counters – Shift registers – Master and jump controls – Data handling – Analog input/output – Selection of PLC.

**UNIT-III: Fundamentals of Robot**


**UNIT-IV: Sensors and Machine Vision**

UNIT-V: Robot kinematics and Robot Programming: Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two Degrees of Freedom (In 2 Dimensional) – Deviations and Problems. Teach Pendant Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End effector commands, and Simple Programs Industrial Applications: Application of robots in machining, welding, assembly, and material handling.

Reference Books:
8. Elements of Robotics Process Automation, Mukherjee, Khanna Publishing House, Delhi, 2018

Course outcomes:
At the end of the course, the student will be able to:

| CO1 | Describe about various types of sensors and transducers. |
| CO2 | Explain the various mechanical, electrical and pneumatic actuation systems. |
| CO3 | Explain the basic PLC architecture and PLC programming concepts. |
| CO4 | Explain the robot anatomy, classification, characteristics of robot, advantages and disadvantages. |
| CO5 | Explain about various types of sensors and concepts on robot vision system. |

Course Code: PEPC303
Course Title: INDUSTRIAL ENGINEERING & MANAGEMENT
Number of Credits: 3 (L: 3, T: 0, P: 0)
Prerequisites: NIL
Course Category: PC

Course Learning Objectives:
• To take the right decisions to optimize resources utilization by improving productivity of the Lands, Buildings, People, Materials, Machines, Money, Methods and Management effectively.
• To eliminate unproductive activities under the control of the Management, Supervisor, worker and the Design of Products and Processes.
• To use the Charts to record the Activities of the people, materials and Equipment to find alternative methods which minimize waste and to implement the best method.

Course Content:
UNIT-I: Plant Engineering: Plant; Selection of site of industry; Plant layout; Principles of a good layout; Types; Process; Product and Fixed position; Techniques to improve Layout; Principles of Ma-
Material handling equipment; Plant maintenance; Importance; Break down maintenance; Preventive maintenance and Scheduled maintenance.

**Plant Safety:** Importance; Accident: Causes and Cost of an Accident, Accident Proneness, Prevention of Accidents; Industrial disputes; Settlement of Industrial disputes; Collective bargaining; Conciliation; Mediation; Arbitration; Indian Factories Act 1948 and its provisions related to health, welfare and safety.

**UNIT-II: Work Study:** Productivity; Standard of living; Method of improving Productivity; Objectives; Importance of good working conditions.

**Method Study:** Definition; Objectives; Selection of a job for method study; Basic procedure for conduct of Method study; Tools used; Operation process chart; Flow process chart; Two handed process chart; Man Machine chart; String diagram and flow diagram.

**Work Measurement:** Definition; Basic procedure in making a time study; Employees rating factor; Application of time allowances: Rest, Personal, Process, Special and Policy allowances; Calculation of standard time; Numerical Problems; Basic concept of production study; Techniques of Work Measurement; Ratio delay study; Synthesis from standard data; Analytical estimating and Pre determined Motion Time System (PMTS).

**UNIT-III: Production Planning and Control:** Introduction; Major functions of Production Planning and Control; Pre planning; Methods of forecasting; Routing and Scheduling; Dispatching and Controlling; Concept of Critical Path Method (CPM); Types of Production: Mass Production, Batch Production and Job Order Production; Characteristics; Economic Batch Quantity (EBQ); Principles of Product and Process Planning; Make or Buy decision; Numerical problems.

**Quality Control:** Definition; Objectives; Types of Inspection: First piece, Floor and Centralized Inspection; Advantages and Disadvantages; Statistical Quality Control; Types of Measurements; Method of Variables; Method of Attributes; Uses of X, R, p and c charts; Operating Characteristics curve (O.C. curve); Sampling Inspection; Single and Double Sampling plan; Concept of ISO 9001:2008 Quality Management System Registration/Certification procedure; Benefits of ISO to the organization.

**UNIT-IV: Principles of Management:** Definition of Management; Administration; Organization; F.W. Taylor’s and Henry Fayol’s Principles of Management; Functions of Manager; Types of Organization: Line, Staff, Taylor’s Pure functional types; Line and staff and committee type; Directing; Leadership; Styles of Leadership; Qualities of a good leader; Motivation; Positive and Negative Motivation; Modern Management Techniques; Just In Time; Total Quality Management (TQM); Quality circle; Zero defect concept; 5S Concept; Management Information Systems.

**Personnel Management:** Responsibility of Human Resource Management; Selection Procedure; Training of Workers; Apprentice Training; On the Job training and Vestibule School Training; Job Evaluation and Merit Rating; Objectives and Importance; Wages and Salary Administration; Components of Wages; Wage Fixation; Type of Wage Payment: Halsey’s 50% Plan, Rowan’s Plan and Emerson’s efficiency plan; Numerical Problems.

**UNIT-V: Financial Management:** Fixed and Working Capital; Resources of Capital; Shares Preference and Equity Shares; Debentures; Type of debentures; Public Deposits; Factory Costing: Direct Cost; Indirect Cost; Factory Overhead; Selling Price of a product; Profit; Numerical Problems; Depreciation; Causes; Methods: Straight line, sinking fund and percentage on Diminishing Value Method; Numerical Problems.

**Material Management:** Objectives of good stock control system; ABC analysis of Inventory; Procurement and Consumption cycle; Minimum Stock, Lead Time, Reorder Level-Economic Order Quantity problems; Supply Chain.
Reference Books:

Course outcomes:
At the end of the course, the student will be able to:

| CO1 | Explain the different types of layout and plant maintenance with safety |
| CO2 | List and explain the need of method study and work measurements |
| CO3 | Explain the production planning and quality control, and its functions |
| CO4 | Define the principles of personnel management and organizational behavior |
| CO5 | List and explain the different financial and material management |

Course Code : PEPC305
Course Title : AUTOMATION & CNC MACHINES
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : Basic Mechanical Engineering (PEPC102) Industrial Production Technology-I (PEPC205)
Course Category : PC

Course Learning Objectives:
- To understand basics of industrial automation
- To identify various types of automation
- To create CAM Tool path and NC-G code output.

Course Content:
UNIT-I: Introduction: Basic concept of Automation, Types of Automation, Feasibility etc, Industrial Hydraulics: Introduction, basic concepts, Hydraulic fluids, Classification and properties of hydraulic fluids, Contaminates in hydraulic system, control and cleanliness standards, Fluid power generators, i.e. Gear, Vane, Piston pumps, linear and Rotary Actuators, Direction Control Valves, types, actuation methods, pressure control valves; pressure reducing valves, pressure relief valve, Unloading valve, Sequence valve, Counterbalance valve, Flow control valves simple and pressure compensated type.

UNIT-II: Pneumatics: Introduction, Basic components, Source, storage and distribution, treatment of compressed air; linear and Rotary actuators, Direction control valves – types, actuation methods, pressure control valves, logic devices – twin pressure valve, shutter valve, time delay valve, Pneumatic circuit design and analysis, conventional as well as computer aided design. Robotics: Basic concepts, classification based on Geometry, programming, drives, work volume of robots world and joint coordinates various joints, DOF, end effectors – Types and uses, Sensors in Robots, programming – Teach pendant and Computer programming

UNIT-III: Automatic Assembly System: Development of Automatic Assembly process, Transfer de-
vices – continuous, Intermittent, synchronous and asynchronous, Vibratory feeders – Mechanics, effect of frequency, acceleration, track angle, friction, load sensitivity, orientation of parts – active and passive devices, Mechanical feeders – computation and operational details, feed tracks, Escapement devices. Product design for high-speed automatic assembly, examples of design modifications.


Reference Books:

Course outcomes:
At the end of the course, the student will be able to:

| CO1 | Demonstrate basics of industrial automation |
| CO2 | Demonstrate use of automated controls using pneumatic and hydraulic systems |
| CO3 | Identify various types of automation |
| CO4 | Explain the concept of CNC machines and controls |
| CO5 | Prepare CNC part programming for various jobs |

******
Course Code : PEPC302
Course Title : TOOL ENGINEERING
Number of Credits : 3  (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : PC

Course Learning Objectives:

- To understand the concepts of cutting tools and cutting forces involved in metal cutting process.
- To understand tool angles of various cutting tools & their importance.
- To understand and evaluate the tool wear and tool life with the help of Taylors tool life equation.
- To understand the types of press, forming dies and their constructions.
- To understand the designing of strip layout for given component.

Course Content:

UNIT-I: Jigs and fixtures: – Necessity for jigs and fixtures - Elements of fixtures, design considerations, locators, types of locators, clamping and guiding devices, swarf disposal methods

UNIT-II: Work holding devices for flat, round and irregular surface: Design of drill jigs, bush specifications. Fixture for lathe operations, milling, broaching and welding fixtures, fixtures for CNC machines, modular fixtures.


UNIT-IV: Tool for forging, Design of drop forging dies: - Rolling, strip rolling theory, stress distribution in rolling, Roll separation force and torque. Forces acting on single point and multiple point cutting tools


Reference Books:
1. Tool Design – Cysil Donaldson TMH
2. Tool Design – Cole G.B.
3. Die Design Hand Book – ASTME
4. Jigs and Fixtures – Calving-Hoose
5. Jig and Fixture Design Hand Book – William and Boyes
7. Fundamentals of Fixture Design – V. Koraskove Mir.
8. Metal Hand Book- ASM

Course outcomes:
At the end of the course, the student will be able to:

<table>
<thead>
<tr>
<th>CO</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Select cutting tools and its material using data book and manufacturer's catalogue.</td>
</tr>
<tr>
<td>CO2</td>
<td>Estimate tool wear and tool life.</td>
</tr>
<tr>
<td>CO3</td>
<td>Use press tools and dies effectively.</td>
</tr>
<tr>
<td>CO4</td>
<td>Design strip layout for given component.</td>
</tr>
<tr>
<td>CO5</td>
<td>Decide appropriate cutting fluid for machining process improvement.</td>
</tr>
</tbody>
</table>

Course Code: PEPC304
Course Title: INDUSTRIAL EQUIPMENT MAINTENANCE
Number of Credits: 3 (L: 3, T: 0, P: 0)
Prerequisites: NIL
Course Category: PC

Course Learning Objectives:
- To achieve minimum breakdown and to keep the plant in good working condition at the lowest possible cost.
- Machines and other facilities should be kept in such a condition which permits them to be used at their optimum (profit making) capacity without any interruption or hindrance.
- Maintenance division of the factory ensures the availability of the machines, buildings and services required by other sections of the factory for the performance of their functions at optimum return on investment whether this investment be in material, machinery or personnel.

Course Content:

UNIT-II: Maintenance Organizations: Prerequisites, factors determining effectiveness of a Maintenance organization, objectives of organization design, types of organization. Maintenance Planning and Control: Establishing a Maintenance Plan-Preliminary consideration, Systematic method of Maintenance Plan and schedule planning and schedule of Plant shut downs.


UNIT-IV: Spare Parts Management: Capacity utilization, cost reduction approach to spares, reliability and quality of spares, spare parts procurement, inventory control of spare parts.

UNIT-V: Introduction: friction, wear and lubrication, Historical background, Purpose of lubrication, Lubrication regimes, Characteristics of lubricants - viscosity, viscosity index, oxidation stability, flash
point and fire point, pour point and cloud point, carbon residue, ash content, iodine value, neutralization number, dielectric strength, Composition and classification of lubricants, Lubricating oils – oil refining, types, categories, grading, Grease - composition, function, characteristics, thickeners and additives, soap and its complexes, selection and its practices, solid lubricants, Functional additives – surface, performance enhancing, lubricant protective, Lubricants applications – tribological components and industrial machinery, Lubricants testing and test methods, Organization and management of lubrication, lubricant storage and handling, Safety and health hazards, Environmental regulations.

Reference Books:
3. Hand Book of Reliability Engineering & Management: W. Grant Ireson and Clyde F McGraw Hill

Course outcomes:
At the end of the course, the student will be able to:

| CO1 | Demonstrates the proper use of safety equipment, devices, and procedures in classroom and lab environments |
| CO2 | Understanding of the Industrial Equipment Maintenance and practical laboratory experience to set up and repair industrial equipment and facilities |
| CO3 | Compares and contrasts the operations of various industrial machines |
| CO4 | Applies theoretical study and the knowledge of metering tools to troubleshoot mechanical, electrical, and electromechanical systems and repair them |
| CO5 | Understand the friction, wear and lubrication properties at mating parts of machines and its tribological characteristics |

Course Learning Objectives:
- To provide an overview of how computers are being used in design, development of manufacturing plans and manufacture.
- To understand concepts of drafting and modelling using CAD.
- To understand the need for integration of CAD and CAM.
- To understand the concepts of flexible manufacturing system.

Course Content:
UNIT-I: Fundamentals of CAD/CAM: Automation; Design process; Application of computers for design; Benefits of CAD; Computer configuration for CAD applications; Design workstation; Graphic terminal; CAD Software: Definition of system software and application software; CAD database and structure.
Geometric Modeling: 3D-Wire frame modeling; Wire frame entities and their definitions; Interpolation and Approximation of curves; Concept of Parametric and Non-parametric representation of curves; Curve fitting techniques.

Unit-II: Surface Modeling: Algebraic and Geometric form; Parametric space of surface; Blending functions; Parametrization of surface patch; Subdividing; Cylindrical surface; Ruled surface; Surface of revolution; Spherical surface; Composite surface; Bezier surface; Solid Modelling: Definition of cell composition and spatial occupancy enumeration; Sweep representation; Constructive solid geometry; Boundary representations.

Unit-III: NC Control Production Systems: Numerical control; Elements of NC system; NC part programming; Methods of NC part programming; Manual part programming, Computer assisted part programming; Post processor; Computerized part program.

Unit-IV: Group Technology: Part families; Parts classification and coding; Production analysis; Machine cell design; Computer aided process planning; Retrieval type and Generative type; Machinability data systems; MRP and its Benefits.

Unit-V: Flexible manufacturing system: F.M.S equipment; Layouts; Analysis methods and benefits; Computer aided quality control; Automated inspection: Off-line, On-line, Contact, Non-contact; Coordinate measuring machines; Machine vision; CIM system and Benefits.

Reference Books:
1. CAD/CAM Principles and Applications, P.N. Rao, Tata McGraw-Hill
3. CAD/CAM/CIM, Radha Krishna P. & Subramanyam, Wiley Eastern Ltd

Course outcomes:
At the end of the course, the student will be able to:

| CO1 | Develop mathematical models to represent curves and surfaces and Model engineering components using solid modeling techniques. |
| CO2 | Understand geometric transformation techniques in CAD. |
| CO3 | Develop programs for CNC to manufacture industrial components. |
| CO4 | Understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system. |
| CO5 | Utilize Flexible manufacturing system tools. |

******
Course Code : PEPE###
Course Title : Advanced Sensors for Engineering Application and NDT
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : PE

Course Learning Objectives:
- To learn the latest developments in the field of Sensor technology and instrumentation.
- To understand the concept of non-destructive testing and to describe the various types of NDT tests carried out on components.
- To apply newly introduced techniques to sensor design and fabrication.

Course Content:

UNIT-I: Advanced Sensors: Introduction, semiconductor sensors: metal oxide semiconductors, Hall elements; Silicon sensors: Silicon Planar Technology, Silicon sensors for sensing radiation, mechanical, magnetic and chemical signals.

UNIT-II: IC sensors, membrane types of sensors; Optical sensors: Lasers, photo-detectors, optical fibre; Microsensors for sensing thermal, radiation, mechanical, magnetic and chemical signals; Smart sensors.


UNIT-V: Thermography: Infrared theory, contact, non-contact methods; Acoustic emission testing, eddy current testing; Leak testing: Bubble emission testing, Air leak testing; Case studies on defects in casting, welding.

Reference Books:
2. Non-Destructive Testing by Baldev Raj et al.
3. Sensors & Transducers by D. Patranobis, TMH

Course outcomes:

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

| CO1 | Select the right sensor for a given application |
| CO2 | Design basic circuit building blocks and Simulate, synthesize, and layout a complete sensor or sensor system |
| CO3 | Understand the theory of non-destructive testing methods is used |
| CO4 | Determine the type of requirement of non-destructive test |
| CO5 | Distinguish between the various NDT test as Ultrasonic and Eddy current methods |

*****
Course Code : PEPE###
Course Title : FLEXIBLE MANUFACTURING SYSTEM
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : PE

Course Learning Objectives:
- To understand the role of Flexible Manufacturing Systems (FMS) in manufacturing,
- Be familiar with organization and information processing in manufacturing,
- Have a basic knowledge of automation equipment,
- Understand logic control and associated technologies

Course Content:


UNIT-II: Classification of FMS Layout: FMS: Layouts and their salient features, Single line, dual line, loop, ladder, robot centre, Salient features of processing stations: Processing stations- Machining Centers, Turning centre, Coordinate measuring machine (CMM), Washing/ Deburring station.


UNIT-V: Design of FMS: FMS Performance Evaluation introduction, Analytical model of FMS, Simulation model of FMS; Case studies: Typical examples /case studies of FMS.

Reference Books:

Course outcomes:
At the end of the course, the student will be able to:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Classify and distinguish FMS and other manufacturing systems.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Analyze processing stations and material handling systems used in FMS environments.</td>
</tr>
<tr>
<td>CO3</td>
<td>Design and analyze FMS using simulation and analytical techniques.</td>
</tr>
<tr>
<td>CO4</td>
<td>Develop management and control systems for tools, material handling and configurations in FMS</td>
</tr>
<tr>
<td>CO5</td>
<td>Analyze the production management problems in planning, loading, scheduling, routing and breakdown in a typical FMS.</td>
</tr>
</tbody>
</table>

******
Course Code : PEPE###
Course Title : MATERIAL HANDLING SYSTEM
Number of Credits : 3   (L: 3, T: 0, P: 0)
Prerequisites : Basic Mechanical Engineering (PEPC102)
Course Category : PC

Course Learning Objectives:
- To know the operational features of the material handling equipment & its practical applications.
- To understand, select, operate and maintain the material handling equipments.
- To understand different material handling processes used in industries.
- To understand & appreciate safety instrumentation for equipment.

Course Content:

UNIT-I: Introduction to Material Handling System: Main types of Material handling equipments & their applications; Types of load to be handled; Types of Movements; Methods of stacking, loading & unloading systems; Principles of Material Handling Systems; Modern trends in Materials handling.

UNIT-II: Hoisting Machinery & Equipments: Construction, Working & Maintenance of different types of hoists such as Lever operated hoist, Portable hand chain hoist, Differential hoists, Worm geared and Spur geared hoists, Electric & Pneumatic hoists, Jumper; Construction, Working & Maintenance of different types of cranes such as Rotary cranes, Trackless cranes, Mobile cranes, Bridge cranes, Crane traveling on guide rails; Construction, Working & Maintenance of Elevating equipments such as Stackers, Industrial lifts, Freight elevators, Passenger lifts, and Mast type's elevators, Vertical skip hoist elevators.

UNIT-III: Conveying Machinery: Construction, Working & Maintenance of Traction type conveyors such as Belt conveyors, Chain conveyors, Bucket elevators, Escalators; Construction, Working & Maintenance of Traction less type conveyors such as Gravity type conveyors, Vibrating & Oscillating conveyors, Screw conveyors, Pneumatic & Hydraulic conveyors, Hoppers gates & Feeders.

Surface Transportation Equipment: Construction, Function, Working of Trackless equipment such as Hand operated trucks, Powered trucks, Tractors, Automatic Guided vehicle, Industrial Trailers; Construction, Function, Working of Cross handling equipment such as Winches, Capstans, Turntables, Transfer tables, Monorail conveyors.

UNIT-IV: Components of Material Handling Systems: Flexible hoisting appliances such as Welded load chains, Roller chains, Hemp ropes, Steel wire ropes, Fastening methods of wire & chains, Eye bolts, Lifting tackles, Lifting & Rigging practices; Load handling attachments: a) Various types of hooks-Forged, Triangular eye hooks, Appliances for suspending hooks b) Crane grab for unit & piece loads c) Electric lifting magnet, vacuum lifter, d) Grabbing attachment for loose materials e) Crane attachment for handling liquids/molten metals; Construction & Working of Arresting gear & Brakes; Construction & use of electromagnetic shoe brakes, Thruster operated shoe brakes, Control brakes.

UNIT-V: Mechanism used in Material Handling Equipment: Steady state motion; Starting & stopping of motion in following mechanisms: Hoisting mechanism, Lifting Mechanism, Traveling Mechanism, Rope & chain operated Cross Traverse Mechanism.

Selection of Material Handling Equipment: Factors affecting choice of material handling equipment such as Type of loads, Hourly capacity of the unit, Direction & length of travel, Methods of stocking at initial, final & intermediate points, Nature of production process involved, Specific load conditions & Economics of material handling system.
Reference Books:
1. Material Handling (Principles & Practice) – Allegri T. H., CBS Publisher, New Delhi.
5. Material Handling Equipment – Y. I. Oberman, MIR Publisher, Moscow.

Course outcomes:
At the end of the course, the student will be able to:

<table>
<thead>
<tr>
<th>CO</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Understand constructional &amp; operational features of various materials handling systems.</td>
</tr>
<tr>
<td>CO2</td>
<td>Identify, compare &amp; select proper material handling equipment for specified applications.</td>
</tr>
<tr>
<td>CO3</td>
<td>Know the controls &amp; safety measures incorporated on material handling equipment.</td>
</tr>
<tr>
<td>CO4</td>
<td>Appreciate the role of material handling devices in mechanization &amp; automation of industrial process.</td>
</tr>
<tr>
<td>CO5</td>
<td>Understand &amp; appreciate safety instrumentation for equipment</td>
</tr>
</tbody>
</table>

Course Code : PEPE####
Course Title : SUPPLY CHAIN MANAGEMENT
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : PE

Course Learning Objectives:
- To understand the individual processes of supply chain management and their interrelationships within individual companies and across the supply chain
- To understand of the management components of supply chain management
- To understand the tools and techniques useful in implementing supply chain management

Course Content:
UNIT-II: Supply Chain Drivers and Metrics: Drivers of supply chain performance, Framework for structuring Drivers, Obstacles to achieving strategic fit.
UNIT-IV: Forecasting in SC: Role of forecasting in a supply chain, Components of a forecast and forecasting methods, Risk management in forecasting.
Reference Books:


Course outcomes:

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

<table>
<thead>
<tr>
<th>CO1</th>
<th>Understand the decision phases and apply competitive and supply chain strategies.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Understand individual processes and drivers of supply chain performance.</td>
</tr>
<tr>
<td>CO3</td>
<td>Analyze factors influencing network design.</td>
</tr>
<tr>
<td>CO4</td>
<td>Analyze the role of forecasting in a supply chain.</td>
</tr>
<tr>
<td>CO5</td>
<td>Understand the role of aggregate planning, inventory, IT and coordination in a supply chain.</td>
</tr>
</tbody>
</table>

Course Code : PEPE###
Course Title : COMPUTER INTEGRATED MANUFACTURING
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : PE

Course Learning Objectives:

- To understand different types of manufacturing available today such as the Special manufacturing System, the Manufacturing Cell, and the Flexible Manufacturing System (FMS).
- To learn the fundamentals of computer assisted numerical control programming and programming languages.
- To learn the concepts of Computer Integrated Manufacturing and Management System and automated flow lines.
- To learn the guidelines and criteria for implementing CAD/CAM Systems and associated software for design, Manufacturing, and a common CAD/CAM data base organized to serve both design and manufacturing.

Course Content:

UNIT-I: Concept of Computer Integrated Manufacturing (CIM); Basic components of CIM; Distributed database system; distributed communication system, computer networks for manufacturing; future automated factory; social and economic factors.

UNIT-II: Computer Aided Design (CAD); CAD hardware and software; product modelling, automatic drafting; engineering analysis; FEM design review and evaluation; Group Technology Centre.

UNIT-III: Computer Aided Manufacturing (CAM), Computer assisted NC part programming; Computer assisted robot programming; computer aided process planning (CAPP); computer aided material requirements planning (MRP)

UNIT-IV: Computer aided production scheduling; computer aided inspection planning; computer aided inventory planning, Flexible manufacturing system (FMS); concept of flexible manufacturing.
Unit-V: **Integrating NC machines, robots, AGVs, and other NC equipment**; Computer aided quality control; business functions, computer aided forecasting; office automation

**Reference Books:**

**Course outcomes:**
At the end of the course, the student will be able to:

| CO1 | Understand basic components and networks involved in CIM. |
| CO2 | Understand hardware, software and product modeling at industry level |
| CO3 | Understand process planning and program coding of task. |
| CO4 | Design a manufacturing cell and cellular manufacturing system. |
| CO5 | Design automated material handling and storage systems for a typical production system. |

******

| Course Code | PEPE### |
| Course Title | ADVANCED MANUFACTURING PROCESSES |
| Number of Credits | 3 (L: 3, T: 0, P: 0) |
| Prerequisites | Basic Mechanical Engineering (PEPC102)Industrial Production Technology-I (PEPC205) |
| Course Category | PE |

**Course Learning Objectives:**
- To learn about various unconventional machining processes, the various process parameters and their influence on performance and their applications.

**Course Content:**


**UNIT V: Thermal Energy Based Processes:** Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types - Beam control techniques – Applications. Introduction to manufacturing; Fundamental properties of materials including metals, polymers, ceramics and composites.

**Reference Books:**
Course outcomes:
At the end of the course, the student will be able to:

<table>
<thead>
<tr>
<th>CO</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Understand various classifications of manufacturing processes</td>
</tr>
<tr>
<td>CO2</td>
<td>Understand working principles of mechanical energy based processes</td>
</tr>
<tr>
<td>CO3</td>
<td>Understand working principles of electrical energy based processes</td>
</tr>
<tr>
<td>CO4</td>
<td>Understand working principles of chemical and electro-chemical energy based processes</td>
</tr>
<tr>
<td>CO5</td>
<td>Understand working principles of thermal energy based processes</td>
</tr>
</tbody>
</table>

Course Code: PEPE###
Course Title: TOTAL QUALITY MANAGEMENT
Number of Credits: 3 (L: 3, T: 0, P: 0)
Prerequisites: NIL
Course Category: PE

Course Learning Objectives:
- To introduce the main principles of business and social excellence, to generate knowledge and skills of students to use models and quality management methodology for the implementation of total quality management in any sphere of business and public sector.

Course Content:
**UNIT-I: Basic concepts:** Definitions and history of quality control; Quality function and concept of quality cycle; Quality policy and objectives. Economics of quality and measurement of the cost of quality. Quality considerations in design.

**Unit-II: Process control:** Machine and process capability analysis; Use of control charts and process engineering techniques for implementing the quality plan.

**Unit-III: Acceptance Sampling:** Single, double and multiple sampling, lot quality protection, features and types of acceptance sampling tables, acceptance sampling of variables and statistical tolerance analysis.

**Unit-IV: Quality education:** principles of participation and participative approaches to quality commitment.

**Unit-V: Emerging concepts of quality management:** Taguchi’s concept of off-line quality control and Ishikawa’s cause and effect diagram.

Reference Books:
2. Total Quality Management – An Introductory Text by Paul James, Prentice Hall
3. Quality Control and Applications by Housen & Ghose
4. Industrial Engineering Management by O.P. Khanna

Course outcomes:
At the end of the course, the student will be able to:
CO1: Develop an understanding on quality management philosophies and frameworks

CO2: Develop in-depth knowledge on various tools and techniques of quality management

CO3: Learn the applications of quality tools and techniques in both manufacturing and service industry

CO4: Develop analytical skills for investigating and analysing quality management issues in the industry and suggest implementable solutions to those.

CO5: Emerging concepts for quality and Taguchi optimization technique for offline operations

Course Code: PEPE###

Course Title: POWER PLANT ENGINEERING

Number of Credits: 3 (L: 3, T: 0, P: 0)

Prerequisites: Heat Power Engineering - I (PEPC207)

Course Category: PE

Course Learning Objectives:
- To introduce students to different aspects of power plant engineering.
- To familiarize the students to the working of power plants based on different fuels.
- To expose the students to the principles of safety and environmental issues.

Course Content:

UNIT-I: Introduction to power plant, classifications of power plant, terminology used in power plant, various factors affecting the operation of power plant; Load sharing: cost of power, tariff methods

UNIT-II: Role of thermal power plant in current power generation scenario, selection of site and plant layout; Fuels, handling layout and its methods, stages in coal handling storage.

UNIT-III: Hydro power plant Introduction, working, advantages and disadvantages; Diesel and Gas turbine plant layouts, components, working, advantages and disadvantages of diesel power plant; combined cycle power generation, combined gas and steam turbine power plant operation (only flow diagram).

UNIT-IV: Nuclear power plant Introduction, Working principle; Thermal fission Reactors: PWR, BWR and gas cooled reactors, advantages and Disadvantages; Environmental impact of power plant: Social and Economical issues of power plant, Green house effect, Acid rain, Acid snow, Dry deposition, Acid fog, Air, water; Thermal pollution from power plants: Radiations.

UNIT-V: Power plant safety concept, safety practices to be observed in boiler operation, safety in oil handling system, chemical handling system, statutory provision related to boiler operation.

Reference Books:

Course outcomes:
At the end of the course, the student will be able to:

CO1: Understand power plant engineering and its classification

CO2: Understand the working of thermal power plant and Know the importance of thermal power plant

CO3: Understand the components, working of hydro-electric, diesel and gas turbine power plants and its importance
Course Code: PEPE###
Course Title: FARM EQUIPMENT AND FARM MACHINERY
Number of Credits: 3 (L: 3, T: 0, P: 0)
Prerequisites: NIL
Course Category: PE

Course Learning Objectives:
- Able to find and characterize the machinery based on crop production.
- Able to find the field efficiency and capacities to calculate the economics of machinery.
- Able to find the machines usages for different tillage, and its power requirement calculations.
- Able to understand sowing, planting & transplanting equipment based on crop.
- Able to understand machinery materials and heat effects for different farm machinery equipment.

Course Content:

UNIT-I: Introduction to farm mechanization; Classification of farm machines; Unit operations in crop production; Identification and selection of machines for various operations on the farm; Hitching systems and controls of farm machinery.

UNIT-II: Calculation of field capacities and field efficiency; Calculations for economics of machinery usage, comparison of ownership with hiring of machines; Introduction to seed-bed preparation and its classification. Familiarization with land reclamation and earth moving equipment.

UNIT-III: Introduction to machines used for primary tillage, secondary tillage, rotary tillage, deep tillage and minimum tillage; Measurement of draft of tillage tools and calculations for power requirement for the tillage machines; Introduction to tillage machines like mould-board plough, disc plough, chisel plough, sub-soiler, harrows, puddler, cultivators, identification of major functional components; Attachments with tillage machinery.

UNIT-IV: Introduction to sowing, planting & transplanting equipment; Introduction to seed drills, no-till drills, and strip-till drills; Introduction to planters, bed planters and other planting equipment like sugarcane, potato; Study of types of furrow openers and metering systems in drills and planters; Calibration of seed-drills/planters; Adjustments during operation.

UNIT-V: Introduction to materials used in construction of farm machines; Heat treatment processes and their requirement in farm machines; Properties of materials used for critical and functional components of agricultural machines; Introduction to steels and alloys for agricultural application; Identification of heat treatment processes specially for the agricultural machinery components.

Reference Books:
1. Principles of Farm Machinery by R.A. Kepner, Roy Bainer, and E. L. Berger
2. Farm Machinery and Equipment by H. P. Smith
3. Farm Machinery and equipment by C. P. Nakra
5. Farm Machinery – an Approach by S. C Jain & Grace Phillips
6. Agril. Engineering through worked out examples by Dr. R. Lal and Dr. A.C. Dutta
7. Farm Power and Machinery Engineering by Dr. R. Suresh and Sanjay Kumar
Course outcomes:
At the end of the course, the student will be able to:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Describe the objectives of Farm mechanization.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Classify the Farm Machineries, equipment and materials.</td>
</tr>
<tr>
<td>CO3</td>
<td>Explain selection of the machineries.</td>
</tr>
<tr>
<td>CO4</td>
<td>Discuss the forces acting on tillage tools and hitching systems.</td>
</tr>
<tr>
<td>CO5</td>
<td>Understand the calibration, constructional features and working of various farm equipment.</td>
</tr>
</tbody>
</table>

********

Course Code : PEPE###
Course Title : PRODUCTION PLANNING AND CONTROL
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : PE

Course Learning Objectives:
- To provide students with information on the design and management of operations and production planning/control systems including capacity planning, materials requirements planning, inventory models, scheduling and sequencing, and line balancing for various aspects of the manufacturing and service industry.

Course Content:
UNIT-I: Demand forecasting: Long and short term demand forecasting methods, Regression analysis and Smoothing methods; Estimation of trend, cycle, seasonality components; Analysis of forecast error and computer control of forecasting systems.
UNIT-II: Plant location, capacity scheduling, Warehouse location and capacity scheduling; Multiple Plant Production Facility Design; Aggregate Planning and Master Production Planning and Scheduling.
UNIT-III: Operations scheduling and Control: Basic Sequencing and scheduling techniques, Despatching rules; Chasing and updating of Production Schedules.
UNIT-V: Diagnostic Analysis of Production Planning and Control Systems: Techniques of analysis and evaluation of system performance.

Reference Books:
1. Production Systems Planning Analysis & Control by James L. Riggs, John Wiley & Sons
3. Production / Operations Management: Concept, Structure & Analysis by Tersine R.J., North Holland

Course outcomes:
At the end of the course, the student will be able to:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Ability to use and compare various statistical forecasting models</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Understand the plant layout and material handling from plant to warehouse.</td>
</tr>
</tbody>
</table>


**Course Learning Objectives:**

- To provide a broad and in depth knowledge of a range of operation research models and techniques, which can be applied to a variety of industrial applications.

**Course Content:**

**UNIT-I:** Development, Definition, Characteristics and phase of Scientific Method, Types of models; General methods for solving operations research models.

**UNIT-II:** Allocation: Introduction to linear programming formulation, graphical solution, Simplex Method, artificial variable technique, Duality principle. Sensitivity analysis.


**UNIT-IV:** Sequencing: Introduction, Terminology, notations and assumptions, problems with n-jobs and two machines, optimal sequence algorithm, problems with n-jobs and three machines.

**UNIT-V:** Theory of games: introduction, Two-person zero-sum games, The Maximum –Minimax principle, Games without saddle points – Mixed Strategies, 2 x n and m x 2 Games – Graphical solutions, Dominance property, Use of L.P. to games.

**Reference Books:**


**Course outcomes:**

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

| CO1 | Understand the formulation of Liner Programming |
| CO2 | Analyze and Convert the problem into a mathematical model. |
| CO3 | Understand and implement the transportation problems at workplace |
| CO4 | Understand sequencing to optimize the process time for n-job and m-machine |
| CO5 | Identify and select suitable methods for various games and apply the LP |

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**Production Engineering Curriculum Structure**

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**Course Code** : PEPE###

**Course Title** : OPERATIONS RESEARCH

**Number of Credits** : 3 (L: 3, T: 0, P: 0)

**Prerequisites** : NIL

**Course Category** : PE
Computer Engineering
Curriculum Structure
(III to VI Semesters)
### 7.1 List of Programme Core Courses [PC]

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Code No.</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>COPC201</td>
<td>Computer Programming</td>
<td>2 0 0</td>
<td>III</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>COPC203</td>
<td>Scripting Languages (Python, Perl, etc – any one)</td>
<td>2 0 0</td>
<td>III</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>COPC205</td>
<td>Data Structures</td>
<td>2 0 0</td>
<td>III</td>
<td>2</td>
</tr>
<tr>
<td>4.</td>
<td>COPC207</td>
<td>Computer System Organisation</td>
<td>3 1 0</td>
<td>III</td>
<td>4</td>
</tr>
<tr>
<td>5.</td>
<td>COPC209</td>
<td>Algorithms</td>
<td>3 1 0</td>
<td>III</td>
<td>4</td>
</tr>
<tr>
<td>6.</td>
<td>COPC211</td>
<td>Computer Programming Lab</td>
<td>0 0 4</td>
<td>III</td>
<td>2</td>
</tr>
<tr>
<td>7.</td>
<td>COPC213</td>
<td>Scripting Languages Lab</td>
<td>0 0 4</td>
<td>III</td>
<td>2</td>
</tr>
<tr>
<td>8.</td>
<td>COPC215</td>
<td>Data Structures Lab</td>
<td>0 0 2</td>
<td>III</td>
<td>1</td>
</tr>
<tr>
<td>9.</td>
<td>COPC202</td>
<td>Operating Systems</td>
<td>2 0 0</td>
<td>IV</td>
<td>2</td>
</tr>
<tr>
<td>10.</td>
<td>COPC204</td>
<td>Introduction to DBMS</td>
<td>2 0 0</td>
<td>IV</td>
<td>2</td>
</tr>
<tr>
<td>11.</td>
<td>COPC206</td>
<td>Computer Networks</td>
<td>2 0 0</td>
<td>IV</td>
<td>2</td>
</tr>
<tr>
<td>12.</td>
<td>COPC208</td>
<td>SSAD/Software Engineering</td>
<td>3 0 0</td>
<td>IV</td>
<td>3</td>
</tr>
<tr>
<td>13.</td>
<td>COPC210</td>
<td>Web Technologies</td>
<td>2 0 0</td>
<td>IV</td>
<td>2</td>
</tr>
<tr>
<td>14.</td>
<td>COPC212</td>
<td>Operating Systems Lab</td>
<td>0 0 2</td>
<td>IV</td>
<td>1</td>
</tr>
<tr>
<td>15.</td>
<td>COPC214</td>
<td>Introduction to DBMS Lab</td>
<td>0 0 2</td>
<td>IV</td>
<td>1</td>
</tr>
<tr>
<td>16.</td>
<td>COPC216</td>
<td>Computer Networks Lab</td>
<td>0 0 2</td>
<td>IV</td>
<td>1</td>
</tr>
<tr>
<td>17.</td>
<td>COPC218</td>
<td>Web Technologies Lab</td>
<td>0 0 2</td>
<td>IV</td>
<td>1</td>
</tr>
<tr>
<td>18.</td>
<td>COPC301</td>
<td>Introduction to e-Governance</td>
<td>2 1 0</td>
<td>V</td>
<td>3</td>
</tr>
<tr>
<td>19.</td>
<td>COPC303</td>
<td>IoT</td>
<td>2 1 0</td>
<td>V</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total Credits**: 40
7.2 List of Program Elective Courses [PE]

<table>
<thead>
<tr>
<th>S.No</th>
<th>Code No.</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>COPE301/302</td>
<td>Mobile Computing (3-0-2-4)</td>
</tr>
<tr>
<td>2</td>
<td>COPE303/304</td>
<td>Multimedia Technologies (3-0-2-4)</td>
</tr>
<tr>
<td>3</td>
<td>COPE305/306</td>
<td>Fundamentals of AI (3-1-0-4)</td>
</tr>
<tr>
<td>4</td>
<td>COPE307/308</td>
<td>Advance Computer Networks (3-0-2-4)</td>
</tr>
<tr>
<td>5</td>
<td>COPE309/310</td>
<td>Information Security (3-0-2-4)</td>
</tr>
<tr>
<td>6</td>
<td>COPE311/312</td>
<td>Network Forensics (3-0-2-4)</td>
</tr>
<tr>
<td>7</td>
<td>COPE313/314</td>
<td>Data Sciences: Data Warehousing and Data Mining (3-1-0-4)</td>
</tr>
<tr>
<td>8</td>
<td>COPE315/316</td>
<td>FOSS (Free and Open Source Software) (3-0-2-4)</td>
</tr>
<tr>
<td>9</td>
<td>COPE317/318</td>
<td>Software Testing (3-0-2-4)</td>
</tr>
</tbody>
</table>

More courses may be added to the list above.
### 7.3 Semester-wise Detailed Curriculum

#### Semester III

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Category</th>
<th>Code No.</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Total contact hrs/week</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Program core course</td>
<td>COPC201</td>
<td>Computer Programming</td>
<td>2 0 0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>Program core course</td>
<td>COPC203</td>
<td>Scripting Languages (Python, Perl, etc - any one)</td>
<td>2 0 0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>Program core course</td>
<td>COPC205</td>
<td>Data Structures</td>
<td>2 0 0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4.</td>
<td>Program core course</td>
<td>COPC207</td>
<td>Computer System Organisation</td>
<td>3 1 0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5.</td>
<td>Program core course</td>
<td>COPC209</td>
<td>Algorithms</td>
<td>3 1 0</td>
<td>4</td>
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<td>6.</td>
<td>Summer Internship-I (4 weeks) after IInd Sem</td>
<td>SI201</td>
<td>Summer Internship-1</td>
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<td>7.</td>
<td>Program core course</td>
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<td>Computer Programming Lab</td>
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<tr>
<td>8.</td>
<td>Program core course</td>
<td>COPC213</td>
<td>Scripting Languages Lab</td>
<td>0 0 4</td>
<td>4</td>
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<tr>
<td>9.</td>
<td>Program core course</td>
<td>COPC215</td>
<td>Data Structures Lab</td>
<td>0 0 2</td>
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<td><strong>Total Credits</strong></td>
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</table>
## Semester IV

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Category</th>
<th>Code No.</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Total contact hrs/week</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Program core course</td>
<td>COPC202</td>
<td>Operating Systems</td>
<td>2 T 0 P</td>
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</tr>
<tr>
<td>2.</td>
<td>Program core course</td>
<td>COPC204</td>
<td>Introduction to DBMS</td>
<td>2 T 0 P</td>
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</tr>
<tr>
<td>3.</td>
<td>Program core course</td>
<td>COPC206</td>
<td>Computer Networks</td>
<td>2 T 0 P</td>
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<td>4.</td>
<td>Program core course</td>
<td>COPC208</td>
<td>SSAD/Software Engineering</td>
<td>3 T 0 P</td>
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<td>5.</td>
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<td>COPC210</td>
<td>Web Technologies</td>
<td>2 T 0 P</td>
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<tr>
<td>6.</td>
<td>Open Elective</td>
<td>**OE202</td>
<td>Open Elective-1</td>
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<td>7.</td>
<td>Minor Project</td>
<td>Proj.202</td>
<td>Minor Project</td>
<td>0 T 0 P</td>
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<tr>
<td>8.</td>
<td>Program core course</td>
<td>COPC212</td>
<td>Operating Systems Lab</td>
<td>0 T 2 P</td>
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<tr>
<td>9.</td>
<td>Program core course</td>
<td>COPC214</td>
<td>Introduction to DBMS Lab</td>
<td>0 T 2 P</td>
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<tr>
<td>10.</td>
<td>Program core course</td>
<td>COPC216</td>
<td>Computer Networks Lab</td>
<td>0 T 2 P</td>
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<tr>
<td>11.</td>
<td>Program core course</td>
<td>COPC218</td>
<td>Web Technologies Lab</td>
<td>0 T 2 P</td>
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<td>1</td>
</tr>
<tr>
<td>12.</td>
<td>Mandatory Course</td>
<td>AU202</td>
<td>Essence of Indian Knowledge and Tradition</td>
<td>2 T 0 P</td>
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</table>

**Total Credits** 21
### Semester V

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Category</th>
<th>Code No.</th>
<th>Course Title</th>
<th>Hours per week</th>
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<th>Credits</th>
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<tbody>
<tr>
<td>1.</td>
<td>Program core course</td>
<td>COPC301</td>
<td>Introduction to e-Governance</td>
<td>2 L, 1 T, 0 P</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>Program core course</td>
<td>COPC303</td>
<td>IoT</td>
<td>2 L, 1 T, 0 P</td>
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<td>3.</td>
<td>Program Elective course</td>
<td>COPE###</td>
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<tr>
<td>4.</td>
<td>Program Elective course</td>
<td>COPE###</td>
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<tr>
<td>5.</td>
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<td>**OE301</td>
<td>Open Elective-2</td>
<td>3 L, 0 T, 0 P</td>
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<tr>
<td>6.</td>
<td>Summer Internship-II (6 weeks)</td>
<td>SI301</td>
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<tr>
<td>7.</td>
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<td>0 L, 0 T, 2 P</td>
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**Total Credits: 20**

### Semester VI

<table>
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<tr>
<th>Sl. No</th>
<th>Category</th>
<th>Code No.</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Total contact hrs/week</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Program Elective course</td>
<td>COPE###</td>
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<td>2.</td>
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<tr>
<td>3.</td>
<td>Humanities and Social Science course</td>
<td>HS302</td>
<td>Entrepreneurship and Start-ups</td>
<td>3 L, 1 T, 0 P</td>
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<tr>
<td>4.</td>
<td>Open Elective</td>
<td>**OE###</td>
<td>Open Elective-3</td>
<td>3 L, 0 T, 0 P</td>
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<td>5.</td>
<td>Mandatory Course</td>
<td>AU302</td>
<td>Indian Constitution</td>
<td>2 L, 0 T, 0 P</td>
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<td>6.</td>
<td>Major Project</td>
<td>PR302</td>
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<td>0 L, 0 T, 6 P</td>
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<td>7.</td>
<td>Seminar</td>
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<td>1 L, 0 T, 0 P</td>
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</table>

**Total Credits: 20**

^1 credit is carried forward from the V<sup>th</sup> semester major project evaluation.
Semester III

<table>
<thead>
<tr>
<th>Course Code</th>
<th>COPC201</th>
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</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Computer Programming</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>2 (L:2; T:0; P:0)</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>-</td>
</tr>
<tr>
<td>Course Category</td>
<td>PC</td>
</tr>
</tbody>
</table>

**Course Learning Objectives:**
To enable student, develop structured solutions to problems and implementing them using computers. This involves two parts: i) Formulating a solution for a given problem as a well-defined sequence of actions, and ii) Expressing solution in a machine readable form or a programming language. For the second part, we will learn the common units of programming languages. The first part can only be learned through the repeated practice of solving problems.

**Course Content:**
The language of choice will be C. The focus will be on problem solving and problem where these ideas can be applied. The main focus of the class will to take examples of problems where these ideas can be employed.

**UNIT 1:**
Introduction to Problem Solving (computational way of thinking); Variables and Representation

**UNIT 2:**
Arithmetic, Relational, Logical and Bitwise Operators; Input, Output, Formatting and File I/O

**UNIT 3:**
Conditional Statements, Repeat Statements, Loops and Nested Loops

**UNIT 4:**
Arrays and Memory Organization, Strings, Multidimensional Arrays, Functions and Parameter Passing

**UNIT 5:**
Recursion and Recursive solutions

**Suggested Lab Work:**
This is a skill course. Topics/concepts taught in the class should be practiced in the Lab same week and practiced regularly during the semester till student becomes confident about it. Students should work on solved and unsolved problems listed in the text books. Teacher also should formulate problems and give them as assignment. This course is all about some theory and a lot of practice.

**Reference Books:**
1. Let Us C, Yashavant Kanetkar
2. Problem Solving and Programming in C, R.S. Salaria, Khanna Publishing House
4. The C Programming Language, Kernighan and Ritchie, Prentice Hall of India

**Course outcomes:**
Student should be able to computationally formulate basic problems and write code snippets to execute them. The focus of the course as mentioned above should be on example based learning. The basic nitty gritties can be skipped, however, the application part should be clear. For instance, when to use an array, when to use loop and when to use conditional statements.

******
Course Code : COPC203
Course Title : Scripting Languages
Number of Credits : 2 (L: 2, T: 0, P: 0)
Prerequisites : -
Course Category : PC

Course Learning Objectives:
To learn how to work with a scripting language.

Course Content:
UNIT 1: Introduction, Variables and Data Types
History, Features, Setting up path, Installation and Working with Perl/Python, Basic Syntax
Understanding Perl/Python variables, Numeric data types, Using string data type and string operations, Basic Operators, Understanding coding blocks, Defining list and list slicing, Other Data Types (Tuples, List, Dictionary -Python, Arrays, Associative Arrays/Hashes - Perl)

UNIT 2: Control Structures
Conditional blocks using if, else and elif, For loops and iterations, while loops, Loop manipulation using continue, break and else (and pass in Python), Programming using conditional and loops block

UNIT 3: Functions, Modules and Packages
Organizing Perl codes using functions, Organizing Perl projects into modules, Importing own module as well as external modules, Understanding Packages

UNIT 4: File I/O, Text Processing, Regular Expressions
Understanding read functions, Understanding write functions, Programming using file operations, Powerful pattern matching and searching, Power of pattern searching using regex

UNIT 5: Frameworks
Frameworks - Web2Py, Django, Ruby on Rails, Struts (any one of these or any other)

Suggested Lab Work:
This is a skill course. Topics/concepts taught in the class should be practiced in the Lab same week and practiced regularly during the semester till student becomes confident about it. Students should work on solved and unsolved problems listed in the text books. Teacher also should formulate problems and give them as assignment. This course is all about some theory and a lot of practice.

Reference Books:
1. Taming Python by Programming, Jeeva Jose, Khanna Publishing House
2. Starting Out with Python, Tony Gaddis, Pearson
6. Beginning Python using Python 2.6 and Python 3, James Payne, Wrox publishing

Course outcomes:
At the end of the course student will be able to build program with a scripting language and will be able to learn any other scripting language on their own.

*****
<table>
<thead>
<tr>
<th>Course Code</th>
<th>COPC205</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Data Structures</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>2 (L: 2, T: 0, P: 0)</td>
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<tr>
<td>Prerequisites</td>
<td>-</td>
</tr>
<tr>
<td>Course Category</td>
<td>PC</td>
</tr>
</tbody>
</table>

**Course Learning Objectives:**
To provide strong foundation for implementing programming language to formulate, analyze and develop solutions related to various data structures problems.

**Course Content:**

**UNIT 1:**
Introduction to Data Structures: Basic Terminology, Classification of Data Structures, Operations on Data Structures.

**UNIT 2:**
Linear Data Structures - Stacks: Introduction to Stacks, Array Representation of Stacks, Operations on a Stack, Applications of Stacks- Infix-to-Postfix Transformation, evaluating Postfix Expressions.
Queues: Introduction to Queues, Array Representation of Queues, Operations on a Queue, Types of Queues- DeQueue, Circular Queue, Applications of Queues- Round Robin Algorithm.

**UNIT 3:**

**UNIT 4:**
GRAPHS: Graph Terminologies, Representation of Graphs- Set, Linked, Matrix, Graph Traversals

**Suggested Lab Work:**
This is a skill course. Topics/concepts taught in the class should be practiced in the Lab same week and practiced regularly during the semester till student becomes confident about it. Students should work on solved and unsolved problems listed in the text books. Teacher also should formulate problems and give them as assignment. This course is all about some theory and a lot of practice.

This course is linked with a previous course on Computer Programming and a parallel course on Algorithms, hence exercises should not be done in isolation.

**Reference Books:**
1. Data Structures, R.S. Salaria, Khanna Book Publishing, New Delhi

**Course outcomes:**
Have a good understanding of Data Structures and its applications in algorithms.
Course Learning Objectives:
To have a thorough understanding of the basic structure and operation of a digital computer, its architectures and computational designs.

Course Content:

UNIT 1:
Structure of Computers: Computer Functional units, Von-Neumann architecture, Bus structures, Basic Operational Concepts, Data representation (Fixed and Floating point), Error detecting codes.

Register Transfer and Micro Operations: Register transfer, Bus and memory transfers, Arithmetic micro-operations, Logic micro-operations, Shift micro-operations, and Arithmetic logic shift unit.

UNIT 2:
Micro Programmed Control: Control memory, Address sequencing, and design of control unit.

Computer Arithmetic: Addition and Subtraction, Multiplication and Division algorithms, Floating-point arithmetic operation, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline Vector Processing, Array Processors.

UNIT 3:
Introduction to Microprocessor Architecture: Instruction Set Architecture design principles from programmer's perspective. One example microprocessor (Intel, ARM, etc).

UNIT 4:
Assembly Language Programming: Simple programs, Assembly language programs involving logical, branch and call instructions, sorting, evaluation of arithmetic expressions, string manipulation, assembler directives, procedures and macros.

UNIT 5:
Memory and Digital Interfacing: addressing and address decoding, interfacing RAM, ROM, EPROM, programmable peripheral interface, various modes of operation and interfacing to processor, interfacing keyboard, displays, etc.

Reference Books:

Course outcomes:
Have a good understanding of functioning of computer system as such and its various subcomponents. Student will be able to understand computing requirement for a specific purpose, analyse performance bottlenecks of the computing device and choose appropriate computing device for a given use case.

*****
Course Code : COPC209
Course Title : Algorithms
Number of Credits : 4  (L: 3, T: 1, P: 0)
Prerequisites : -
Course Category : PC

Course Learning Objectives:
The objective of this course is to prepare the student with the algorithmic foundations of computing. A sound grasp of algorithms is essential for any computer science engineer. Almost all programming involves algorithms at some level.

Course Content:

UNIT 1: Fundamentals

UNIT 2: Sorting
The sorting problem. Bubble sort, Selection sort, Insertion sort, Mergesort, Quicksort.

UNIT 3: Searching

UNIT 4: Graphs

UNIT 5: Strings

Reference Books:
1. Algorithms, Sedgewick and Wayne, Pearson
2. Introduction to Algorithms, Cormen, Leiserson, Rivest and Stein. MIT Press

Course outcomes:
The student should be able to design basic algorithms for sorting and searching. The student should be able to understand the basic notions of time and space complexity of algorithms. The student should be able to implement sorting, searching, tree and graph algorithms in a modern computer programming language.

******
Course Code: COPC211
Course Title: Computer Programming Lab
Number of Credits: 2 (L: 0, T: 0, P: 4)
Prerequisites: -
Course Category: PC

Course Learning Objectives:
This Lab course is intended to practice what is taught in theory class of ‘Computer Programming’ and become proficient in computer programming. Computer programming is all about regular practice. Students should work on solved and unsolved problems listed in the text books, and the problems given by the teacher. Some of the topics that should necessary be covered in lab are listed below.

Course Content:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Topics for Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Familiarization with programming environment (Editor, Compiler, etc.)</td>
</tr>
<tr>
<td>2</td>
<td>Programs using I/O statements and various operators</td>
</tr>
<tr>
<td>3</td>
<td>Programs using expression evaluation and precedence</td>
</tr>
<tr>
<td>4</td>
<td>Programs using decision making statements and branching statements</td>
</tr>
<tr>
<td>5</td>
<td>Programs using loop statements</td>
</tr>
<tr>
<td>6</td>
<td>Programs to demonstrate applications of n dimensional arrays</td>
</tr>
<tr>
<td>7</td>
<td>Programs to demonstrate use of string manipulation functions</td>
</tr>
<tr>
<td>8</td>
<td>Programs to demonstrate parameter passing mechanism</td>
</tr>
<tr>
<td>9</td>
<td>Programs to demonstrate recursion</td>
</tr>
<tr>
<td>10</td>
<td>Programs to demonstrate use of pointers</td>
</tr>
<tr>
<td>11</td>
<td>Programs to demonstrate command line arguments</td>
</tr>
<tr>
<td>12</td>
<td>Programs to demonstrate dynamic memory allocation</td>
</tr>
<tr>
<td>13</td>
<td>Programs to demonstrate file operations</td>
</tr>
</tbody>
</table>

The language of choice will be C. This is a skill course. More you practice, better it will be.

Reference Books:
1. Let Us C, Yashavant Kanetkar
2. Problem Solving and Programming in C, R.S. Salaria, Khanna Publishing House
4. The C Programming Language, Kernighan and Ritchie, Prentice Hall of India

Course outcomes:
Student should be able to write code snippets, and then compile, debug and execute them.

******
Course Learning Objectives:
This Lab course is intended to practice whatever is taught in theory class of ‘Scripting Languages’ and become proficient in scripting. Computer programming is all about regular practice. Students should work on solved and unsolved problems listed in the text books, and the problems given by the teacher. Some of the topics that should necessary be covered in lab are listed below.

Course Content:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Topics for Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Practice basic coding syntax</td>
</tr>
<tr>
<td>2</td>
<td>Write and execute scripts based on data types</td>
</tr>
<tr>
<td>3</td>
<td>Write and execute Python scripts with conditionals and loops</td>
</tr>
<tr>
<td>4</td>
<td>Write and execute Scripts based on Functions and Modules</td>
</tr>
<tr>
<td>5</td>
<td>File Processing scripts</td>
</tr>
<tr>
<td>6</td>
<td>Write and execute Regular Expressions</td>
</tr>
<tr>
<td>7</td>
<td>Write and execute SQL Queries</td>
</tr>
<tr>
<td>8</td>
<td>Write and execute scripts using DBI</td>
</tr>
<tr>
<td>9</td>
<td>Develop a simple web application</td>
</tr>
</tbody>
</table>

Teacher may choose any one scripting language. This is a skill course. More student practice and try to find solution on their own, better it will be.

Reference Books:
1. Taming Python by Programming, Jeeva Jose, Khanna Publishing House
2. Starting Out with Python, Tony Gaddis, Pearson
6. Beginning Python using Python 2.6 and Python 3, James Payne, Wrox publishing

Course outcomes:
At the end of the course student will be able to build program with a scripting language and will be able to learn any other scripting language on their own.

Course Code  : COPC213
Course Title  : Scripting Languages Lab
Number of Credits  : 2 (L: 0, T: 0, P: 4)
Prerequisites  :
Course Category  : PC
Course Learning Objectives:
This Lab course is intended to practice whatever is taught in theory class of 'Data Structures', 'Algorithms' and is an extension of previous course on 'Computer Programming'. Students should work on problems listed in the text books, and the problems given by the teacher. Some of the topics that should necessary be covered in lab are listed below. This Lab course requires a good coordination between theory course in Data Structures and Algorithms.

Course Content:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Topics for Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Write a program using recursive and non-recursive functions to perform search operation in a given list of integers using linear search technique</td>
</tr>
<tr>
<td>2</td>
<td>Search operation in a given list of integers using binary search technique</td>
</tr>
<tr>
<td>3</td>
<td>Write a program to implement insertion sorting for a given random data</td>
</tr>
<tr>
<td>4</td>
<td>Write a program to implement bubble sorting for a given random data</td>
</tr>
<tr>
<td>5</td>
<td>Write a program to implement quick sorting for a given random data</td>
</tr>
<tr>
<td>6</td>
<td>Write a program to implement selection sorting for a given random data</td>
</tr>
<tr>
<td>7</td>
<td>Write a program to implement heap sorting for a given random data</td>
</tr>
<tr>
<td>8</td>
<td>Write a program to implement Hashing tables</td>
</tr>
<tr>
<td>9</td>
<td>Write a program to implement single linked list</td>
</tr>
<tr>
<td>10</td>
<td>Write a program to implement double linked list</td>
</tr>
<tr>
<td>11</td>
<td>Write a program to implement circular linked list</td>
</tr>
<tr>
<td>12</td>
<td>Write a program to implement Stack operations using array and linked list</td>
</tr>
<tr>
<td>13</td>
<td>Write a program to implement Queue operations using array and linked list.</td>
</tr>
<tr>
<td>14</td>
<td>Write a program to implement Breadth First Search (BFS)</td>
</tr>
<tr>
<td>15</td>
<td>Write a program to implement Depth First Search (DFS)</td>
</tr>
<tr>
<td>16</td>
<td>Write a program to implement a binary tree of integers</td>
</tr>
<tr>
<td>17</td>
<td>Write a program to find the minimum depth of a binary tree</td>
</tr>
</tbody>
</table>

Use 'C' as programming language for the purpose. This is a skill course. More student practice and try to find solution on their own, better it will be.

Reference Books:
1. Data Structures, R.S. Salaria, Khanna Book Publishing

Course outcomes:
Student will be able to write programs for creating and doing different operations on various data structures. Student will be able to use/implement various algorithms learnt in the course on Algorithms. In summary student will have a good command over Data Structures and its applications in Algorithms.

******
SEMESTER IV

<table>
<thead>
<tr>
<th>Course Code</th>
<th>COPC202</th>
</tr>
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<tbody>
<tr>
<td>Course Title</td>
<td>Operating Systems</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>2 (L:2, T:0, P:0)</td>
</tr>
<tr>
<td>Pre-requisites</td>
<td>COPC205</td>
</tr>
<tr>
<td>Course Category</td>
<td>PC</td>
</tr>
</tbody>
</table>

Course Learning Objectives:
A general introduction to various ideas in implementation of operating systems, particularly UNIX. Introduce to various options available so as to develop capacity to compare, contrast, and evaluate the key trade-offs between different design choices.

Course Content:

UNIT 1:
Overview of Operating System, basic concepts, UNIX/LINUX Architecture, Kernel, services and systems calls, system programs.

UNIT 2:
Process Management: Process concepts, operations on processes, IPC, Process Scheduling, Multi-threaded programming
Memory management: Memory allocation, Swapping, Paging, Segmentation, Virtual Memory, various faults.

UNIT 3:
File management: Concept of a file, access methods, directory structure, file system mounting, file sharing and protection, file system structure and implementation, directory implementation, free-space management, efficiency and performance. Different types of file systems

UNIT 4:
I/O System: Mass storage structure - overview, disk structure, disk attachment, disk scheduling algorithms, swap space management, RAID types.

UNIT 5:
OS Security: Authentication, Access Control, Access Rights, System Logs

Reference Books:
1. Operating System Concepts, Silberschatz and Galvin, Wiley India Limited
2. UNIX Concepts and Applications, Sumitabha Das, McGraw-Hill Education
5. Modern Operating Systems, Andrew S. Tanenbaum, Prentice Hall of India
6. Operating systems, Deitel & Deitel, Pearson Education, India

Course outcomes:
Students should be able to demonstrate basic knowledge about Operating System, be able to apply OS concepts such as processes, memory and file systems to system design, able to configure OS in an efficient and secure manner.
Course Code : COPC204
Course Title : Introduction to DBMS
Number of Credits : 2 (L: 2, T: 0, P: 0)
Prerequisites : COPC203
Course Category : PC

Course Learning Objectives:
It covers the development of database-driven applications using the capabilities provided by modern database management system software. The concepts include conceptual modeling, relational database design and database query languages.

Course Content:
As a part of the lab, project work is included.

UNIT 1:
Introduction; Database System Concepts and Architecture

UNIT 2:
Data Modeling using the Entity-Relationship Model; The Enhanced Entity-Relationship (EER) model

UNIT 3:
The Relational Data Model and Relational Database Constraints; ER/EER to Relational Model mapping; Relational Algebra and Relational Calculus

UNIT 4:
SQL-99: Schema definition, Constraints, Queries, and Views; Security; Introduction to SQL programming Techniques

UNIT 5:
Functional dependencies and normalization for relational databases; Relational database design algorithms and further dependencies.

Reference Books:
4. Introduction to Database Systems, C.J.Date, Pearson Education
5. Introduction to SQL, Rick F.Vander Lans, Pearson Education

Course outcomes:
After completing the course, the students will understand (i) how to design a database, database-based applications (ii) How to use a DBMS (iii) the critical role of database system in designing several information system-based software systems or applications.

*****

Course Code : COPC206
Course Title : Computer Networks
Number of Credits : 2 (L: 2, T: 0, P: 0)
Prerequisites : -
Course Category : PC
Course Learning Objectives:
Understand functioning of computer networks and popular networking protocols

Course Content:
UNIT 1:
Introduction to computer networks; Network Models- OSI Reference Model, TCP/IP Model;

UNIT 2:
Transmission Media – principles, issues and examples; Wired Media – Coaxial, UTP, STP, Fiber Optic Cables; Wireless Media – HF, VHF, UHF, Microwave, Ku Band; Network topologies; Data Link Layer – design issues, example protocols (Ethernet, WLAN, Bluetooth); Switching Techniques;

UNIT 3:
Network Layer - design issues, example protocols (IPv4); Routing - principles/issues, algorithms (Distance-vector, Link-state) and protocols (RIP, OSPF);

UNIT 4:
Transport Layer - design issues, example protocols (TCP); Application Layer Protocols (SMTP, DNS).

UNIT 5:
Functioning of Network Devices – NIC, Hub, Switch, Router, WiFi Devices; Network Management System and example protocol (SNMP).

Reference Books:
1. Computer Networks, 4th Edition (or later), Andrew S. Tanenbaum, PHI
2. TCP/IP Illustrated, Volume-1, W. Richard Stevens, Addison Wesley
3. Data and Computer Communications, William Stallings, PHI
4. An Engineering Approach to Computer Networking, S. Keshav, Addison Wesley/Pearson
5. An Integrated Approach to Computer Networks, Bhavneet Sidhu, Khanna Publishing House

Course outcomes:
1. Understanding of computer networks, issues, limitations, options available.
2. Understanding of the care that needs to be taken while developing applications designed to work over computer networks
3. Able to configure basic LAN and connect computers to it.

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<table>
<thead>
<tr>
<th>Course Code</th>
<th>COPC208</th>
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</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>SSAD/Software Engineering</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3 (L: 3, T: 0, P: 0)</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>-</td>
</tr>
<tr>
<td>Course Category</td>
<td>PC</td>
</tr>
</tbody>
</table>

Course Learning Objectives:
Inculcate essential technology and software engineering knowledge and skills essential to build a reasonably complex usable and maintainable software iteratively. 2) Emphasize on structured approach to handle software development. 3) Enhance communication skills.

Course Content:
As per the course design, concepts learned as part of this course will/should be used in the Minor Project (Proj.202). These two courses should go hand in hand to be effective.

UNIT 1:

UNIT 2:
Development Activities - Requirements Gathering and Analysis, Design Concepts, Software architecture and Architectural styles, Basic UI design, Effective Coding and Debugging techniques.

UNIT 3:
Software Testing Basics, Unit, Integration, System and Acceptance Testing, Introduction to various testing techniques (e.g. Stress testing), Writing and executing test cases, Quality Assurance.

UNIT 4:

Reference Books:
2. Software engineering, Ian Sommerville, Pearson Education
3. An Integrated Approach to Software Engineering, Pankaj Jalote, Springer Verlag

Course outcomes:
The proposed course is expected to provide an introduction to software engineering concepts and techniques to undergraduate students, thus enabling them to work in a small team to deliver a software system. The course content and project will introduce various software technologies, process and project management skills that are needed for the delivery of software in a team setting.

********

Course Code : COPC210
Course Title : Web Technologies
Number of Credits : 2      (L: 2, T: 0, P: 0)
Prerequisites : -
Course Category : PC

Course Learning Objectives:
To provide basic skills on tools, languages and technologies related to website development. Learnings from this course may be used in the Mini Project and summer internship.

Course Content:
UNIT 1: Introduction to www
Protocols and programs, secure connections, application and development tools, the web browser, What is server, setting up UNIX and LINUX web servers, Logging users, dynamic IP Web Design: Web site design principles, planning the site and navigation

UNIT 2: Web Systems Architecture
Architecture of Web based systems- client/server (2-tier) architecture, 3-Tier architecture, Building blocks of fast and scalable data access Concepts - Caches-Proxies- Indexes-Load Balancers- Queues, Web Application architecture (WAA)
UNIT 3: Javascript
Client side scripting, What is Javascript, simple Javascript, variables, functions, conditions, loops and repetition

UNIT 4: Advance scripting
Javascript and objects, Javascript own objects, DOM and web browser environments, forms and validations
DHTML: Combining HTML, CSS and Javascript, events and buttons, controlling your browser,
Ajax: Introduction advantages & disadvantages, ajax based web application, alternatives of ajax
XML, XSL and XSLT: Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas, XML with application, XSL and XSLT.
Introduction to Web Services

UNIT 5: PHP
server side scripting, Arrays, function and forms, advance PHP Databases: Basic command with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP myadmin and database bugs.

Reference Books:
1. "Web Technologies--A Computer Science Perspective", Jeffrey C. Jackson,
2. "Internet & World Wide Web How To Program", Deitel, Deitel, Goldberg, Pearson Education
3. "Web programming- Building Internet Application", Chris Bales

Course Outcomes:
Student will be able to develop/build a functional website with full features.

Reference Books:
1. "Web Technologies--A Computer Science Perspective", Jeffrey C. Jackson,
2. "Internet & World Wide Web How To Program", Deitel, Deitel, Goldberg, Pearson Education
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Course Outcomes:
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<table>
<thead>
<tr>
<th>S.No.</th>
<th>Topics for Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Case Study-1: Employee database – ‘Create’ employee table, ‘Select’ and display an employee matching a given condition, ‘Delete’ duplicate records, delete rows using triggers, insert and update records, find net salary, etc.</td>
</tr>
<tr>
<td>2</td>
<td>Case Study-2: Visitor Management database</td>
</tr>
<tr>
<td>3</td>
<td>Case Study-3: Students Academic database</td>
</tr>
<tr>
<td>4</td>
<td>Case Study-4: Inventory Management System database</td>
</tr>
<tr>
<td>5</td>
<td>Case Study-5: Bank Operations database</td>
</tr>
<tr>
<td>6</td>
<td>Case Study-6: Bus Operator (Roadways) – Do related activities such as prepare E-R Model, Relational Model, do Normalisation, Create Tables, Insert data, Delete Data, Query database, create stored procedures, etc.</td>
</tr>
</tbody>
</table>

This is a skill course. More student practice and try to find solution on their own, better it will be.

Reference Books:
4. Introduction to Database Systems, C.J.Date, Pearson Education
5. Introduction to SQL, Rick F.Vander Lans, Pearson Education

Course outcomes:
After completing the course, the students will understand (i) how to design a database, database-based applications (ii) How to use a DBMS (iii) the critical role of database system in designing several information system-based software systems or applications.

Course Code: COPC216
Course Title: Computer Networks Lab
Number of Credits: 1 (L: 0, T: 0, P: 2)
Prerequisites: -----
Course Category: PC

Course Learning Objectives:
This Lab course is intended to practice whatever is taught in theory class of ‘Computer Networks’. Some of the things that should necessary be covered in lab are listed below:

Course Content:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Topics for Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Showing various types of networking cables and connectors, identifying them clearly</td>
</tr>
<tr>
<td>2</td>
<td>Looking at specifications of cables and connectors of various companies on Internet, find out differences.</td>
</tr>
<tr>
<td>3</td>
<td>Making patch cords using different types of cables and connectors - crimping, splicing, etc</td>
</tr>
<tr>
<td>4</td>
<td>Demonstration of different type of cable testers, using them for testing patch cords prepared by the students in Lab and standard cables prepared by professionals</td>
</tr>
<tr>
<td>5</td>
<td>Configuring computing devices (PC, Laptop, Mobile, etc) for network, exploring different options and their impact – IP address, gateway, DNS, security options, etc</td>
</tr>
<tr>
<td>6</td>
<td>Showing various networking devices – NICs, Hub, Switch, Router, WiFi access point, etc.</td>
</tr>
<tr>
<td>7</td>
<td>Looking at specifications of various networking devices various companies on Internet, find out differences.</td>
</tr>
<tr>
<td>8</td>
<td>Network simulation tool (e.g. Cisco Packet Tracer)</td>
</tr>
<tr>
<td>9</td>
<td>Setting up a small wired LAN in the Lab</td>
</tr>
<tr>
<td>10</td>
<td>Setting up a small wireless LAN in the Lab</td>
</tr>
</tbody>
</table>

This is a skill course. More student practice and try to find solution on their own, better it will be.

Reference Books:
1. Cisco press books on CCNA
2. User manual of networking devices available in the lab
3. Wiki pages on networking devices

Course outcomes:
1. Understanding of computer networks, issues, limitations, options available.
2. Able to configure basic small LAN and connect computers to it.

******
### Course Learning Objectives:
This Lab course is intended to practice whatever is taught in theory class of ‘Web Technologies’. Some of the things that should necessary be covered in lab are listed below:

### Course Content:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Topics for Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Coding Server Client Programs</td>
</tr>
<tr>
<td>2</td>
<td>Developing Web Application using HTML, JavaScript</td>
</tr>
<tr>
<td>3</td>
<td>Developing Advanced Web Application Programs using CSS</td>
</tr>
<tr>
<td>4</td>
<td>Practicing PHP: Basics</td>
</tr>
<tr>
<td>5</td>
<td>Practicing PHP: Web Application Development</td>
</tr>
<tr>
<td>6</td>
<td>Practicing PHP: MySql - tiered Applications</td>
</tr>
<tr>
<td>7</td>
<td>Developing a fully functional Web Service Application using all the technologies learned in this course.</td>
</tr>
</tbody>
</table>

This is a skill course. More student practice and try to find solution on their own, better it will be.

### Reference Books:
1. “Web Technologies--A Computer Science Perspective”, Jeffrey C. Jackson,
3. “Web programming- Building Internet Application”, Chris Bales

### Course outcomes:
Student will be able to program web applications using and will be able to do the following:
- Use LAMP Stack for web applications
- Use Tomcat Server for Servlets and JSPs
- Write simple applications with Technologies like HTML, Javascript, AJAX, PHP, Servlets and JSPs
- Connect to Database and get results
- Parse XML files using Java (DOM and SAX parsers)

Student will be able to develop/build a functional website with full features.

******
<table>
<thead>
<tr>
<th>Course Code</th>
<th>COPC301</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Introduction to e-Governance</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3 (L: 2, T: 1, P: 0)</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>-----</td>
</tr>
<tr>
<td>Course Category</td>
<td>PC</td>
</tr>
</tbody>
</table>

**Course Learning Objectives:**
To cover the concepts of e-Governance and to understand how technologies and business models shape the contours of government for improving citizen services and bringing in transparency.

**Course Content:**

**UNIT 1:**
Exposure to emerging trends in ICT for development; Understanding of design and implementation of e-Government projects, e-governance lifecycle.

**UNIT 2:**
Need for Government Process Re-engineering (GPR); National e-Governance Plan (NeGP) for India; SMART Governments & Thumb Rules

**UNIT 3:**
Architecture and models of e-Governance, including Public Private Partnership (PPP); Need for Innovation and Change Management in eGovernance; Critical Success Factors; Major issue including corruption, resistance for change, e-Security and Cyber laws

**UNIT 4:**
Focusing on Indian initiatives and their impact on citizens; Sharing of case studies to highlight best practices in managing e-Governance projects in Indian context. Visits to local e-governance sites (CSC, eSeva, Post Office, Passport Seva Kendra, etc) as part of Tutorials.

**UNIT 5:**
Mini Projects by students in groups – primarily evaluation of various e-governance projects.

**Reference Books:**
2. The State, IT and Development. Kenneth Kenniston, RK Bagga and Rohit Raj Mathur, Sage Publications India Pvt Ltd.
5. [https://negd.gov.in](https://negd.gov.in)

**Course outcomes:**
Through exposure to introductory ideas and practices followed in a selected number of e-Governance initiatives in India, the course will help students to understand and appreciate the essence of e-Governance.
### Course Code: COPC303
#### Course Title: Internet of Things
#### Number of Credits: 3 (L: 2, T: 1, P: 0)
#### Prerequisites: ----
#### Course Category: PC

**Course Learning Objectives:**

Internet of Things (IoT) is presently an important technology with wide ranging interest from Government, academia and industry. IoT cuts across different application domain verticals ranging from civilian to defence sectors which includes agriculture, space, health care, manufacturing, construction, water, mining, etc. Today it is possible to build different IoT solutions such as shopping system, infrastructure management in both urban and rural areas, remote health monitoring and emergency notification systems, and transportation systems. Therefore, it is very important to learn the fundamentals of this emerging technology.

**Course Content:**

**UNIT 1:**
Introduction to IoT; Sensing; Actuation

**UNIT 2:**
Basics of IoT Networking, Communication Protocols, Sensor networks

**UNIT 3:**
Introduction to Arduino programming, Integration of Sensors/Actuators to Arduino

**UNIT 4:**
Implementation of IoT with Raspberry Pi; Data Handling Analytics

**UNIT 5:**
Case Studies: Agriculture, Healthcare, Activity Monitoring

**Reference Books:**

1. [https://nptel.ac.in/noc/individual_course.php?id=noc17-cs22](https://nptel.ac.in/noc/individual_course.php?id=noc17-cs22)
3. Internet of Things by Dr. Jeeva Jose, Khanna Publishing House (Edition 2017)
6. Research papers

**Course outcomes:**

Students will have good understanding of various aspect of IoT, know some tools and have basic implementation skills.

******

### Course Code: COPE301/302
#### Course Title: Mobile Computing
#### Number of Credits: 4 (L: 3, T: 0, P: 2)
#### Prerequisites: COPC203, COPC204, COPC208
#### Course Category: PE
Course Learning Objectives:
To teaches how to build mobile apps for Android. Students are expected to work on a project as part of the course.

Course Content:
UNIT 1:

UNIT 2:
Creating first android application, Anatomy of android application, Deploying Android app on USB connected Android device, Android application components, Activity life cycle, Understanding activities, Exploring Intent objects, Intent Types, Linking activities using intents

UNIT 3:
Fragments life cycle, Interaction between fragments, Understanding the components of a screen (Layouts), Adapting to display orientation, Action Bar, Views(UI Widgets)-Button, Toast, ToggleButton, CheckBox, RadioButton, Spinner, WebView, EditText, DatePicker, TimePicker, ListView, ProgressBar, Analog and Digital clock, Handling UI events, List fragment, Dialog fragment

UNIT 4:
Menus-Option, Context, Popup, Images-ImageView, ImageSwitcher, AlertDialog, Alarm manager, SMS, E-mail, Media Player, Using camera, recording video, Handling Telephony Manager

UNIT 5:
Storing the data persistently-Data Storage Options: preferences, Internal Storage, External Storage, Content Provider, The SQLite database, Connecting with SQLite database and operations-Insert, Delete, Update, Fetch, Publishing android applications, Deploying APK files

Suggested Lab Work:
This is a skill course. Topics/tools taught in the class should be practiced in the Lab same week and practiced regularly during the semester till student becomes confident about it. Students should explore features of various tools/technologies introduced during the course and become comfortable with their use. Teacher should give weekly practice tasks as assignment. Learnings from this course should be used in the project/software built.

Reference Books:
4. Mark L Murphy, “Beginning Android”, Wiley India Pvt Ltd
5. Sayed Y Hashimi and Satya Komatineni(2009), "Pro Android", Wiley India Pvt Ltd
6. Reto Meier, Professional Android 4 Application Development, Wiley India Pvt Ltd

Course outcomes:
Will be able to develop and deploy basic mobile applications.

******
Course Code : COPE303/304
Course Title : Multimedia Technologies
Number of Credits : 4  (L: 3, T: 0, P: 2)
Prerequisites : COPC203, COPC204, COPC208
Course Category : PE

Course Learning Objectives:
To introduce students to the domain of Multimedia Technologies, which explain the technologies underlying digital images, videos and audio contents, including various compression techniques and standards, and the issues to deliver multimedia content over the Internet.

Course Content:

UNIT 1: Introduction to Multimedia
Multimedia Foundation and Concepts: Multimedia Hardware, Multimedia Software, Multimedia operating systems, Multimedia communication system

UNIT 2: Basic Compression Techniques
Video and Audio Data Compression Techniques – Lossy and Lossless. Example algorithms/standards: Huffman, RLE, JPEG, MPEG, MP3, MP4, LZMA, FLAC, ALAC, ITU G.722, H.261, H.265

UNIT 3: Content Development and Distribution
Desktop publishing (Coral Draw, Photoshop, Page maker)
Multimedia Animation & Special effects (2D/3D animation, Flash)

UNIT 4: Introduction to Digital Imaging
Basics of Graphic Design and use of Digital technology, Definition of Digital images, Digital imaging in multimedia

UNIT 5: Introduction to Multimedia Programming and Applications

Suggested Lab Work:
This is a skill course. Topics/tools taught in the class should be practiced in the Lab same week and practiced regularly during the semester till student becomes confident about it. Students should explore features of various tools introduced during the course and become comfortable with their use. Teacher should give weekly tasks as assignment.

Reference Books:
1. An Introduction to Multimedia Authoring, A. Eliens

Course outcomes:
Student will understand various aspects of Multimedia and related standards. Student will be able to build multimedia content and applications and also multimedia enable Web applications and mobile applications.

******
Course Code : COPE305
Course Title : Fundamentals of AI
Number of Credits : 4       (L: 3, T: 1, P: 0)
Prerequisites : COPC207
Course Category : PE

Course Learning Objectives:
To introduce students to the domain of Artificial Intelligence.

Course Content:
UNIT 1: Introduction
Overview and Historical Perspective, Turing test, Physical Symbol Systems and the scope of Symbolic AI, Agents.

UNIT 2: Search
Heuristic Search: Best First Search, Hill Climbing, Beam Search, Tabu Search

UNIT 3:
Game Playing: Minimax Algorithm, AlphaBeta Algorithm, SSS*.

UNIT 4:
Planning and Constraint Satisfaction: Domains, Forward and Backward Search, Goal Stack Planning, Plan Space Planning, Graphplan, Constraint Propagation.

UNIT 5:
Logic and Inferences: Propositional Logic, First Order Logic, Soundness and Completeness, Forward and Backward chaining.

Reference Books:
1. Deepak Khemani. A First Course in Artificial Intelligence, McGraw Hill Education (India)
2. https://nptel.ac.in/courses/106106126/
7. M.C. Trivedi, A classical approach to Artificial Intelligence, Khanna Publishing House

Course outcomes:
Student will have general idea about Artificial Intelligence, will be able to explore AI tools effectively.
Course Code : COPE307/308
Course Title : Advance Computer Networks
Number of Credits : 4 (L: 3, T: 0, P: 2)
Prerequisites : COPC206
Course Category : PE

Course Learning Objectives:
Introduce Advance Networking Concepts, Theories and Tools

Course Content:

UNIT 1:
Review of Networking Basics; Advance Topics in IPv4 – Subnetting, Multicasting, Multicast Routing Protocols (IGMP, PIM, DVMRP); Advance Topics in TCP – flow management, congestion avoidance, protocol spoofing; IPv6

UNIT 2:
Telecom Networks, Switching Techniques; Introduction to Frame Relay, ATM, MPLS;
VSAT Communication – Star and Mesh architectures, bandwidth reservation;
Wireless Networks – WiFi, WiMax, Cellular Phone Technologies – GSM, CDMA, 3G, 4G

UNIT 3:
Network Redundancy, Load Balancers, Caching, Storage Networks; QoS; Network Monitoring – SNMP, RMON;

UNIT 4:
Introduction to Network Security – VLAN, VPN, Firewall, IPS, Proxy Servers

UNIT 5:
Network Simulation, Network design case studies and exercises, IP Addressing schema, Protocol Analysers (Wireshark, etc)

Reference Books:
1. RFCs and Standards Documents (www.ietf.org and other standard body websites)
3. TCP/IP Illustrated (Vol.1,2), Stevens
4. Data Networks, Bertsekas-Gallager
5. An Engineering Approach to Computer Networking, S. Keshav

Course outcomes:
1. Understanding core concepts/theories/algorithms of computer networks
2. Some hands-on capability on various network devices and tools
3. Capability to design and implement a computer network

*****
Course Code: COPE309/310
Course Title: Information Security
Number of Credits: 4 (L: 3, T: 0, P: 2)
Prerequisites: COPC102
Course Category: PE

Course Learning Objectives:
To learn how to evaluate and enhance information security of IT infrastructure and organisations

Course Content:
UNIT 1:

UNIT 2:
Understanding security weaknesses in popular networking protocols – IP, TCP, UDP, RIP, OSPF, HTTP, SMTP, etc.; security weaknesses in common networking devices – Hub, switch, router, WiFi; Security solutions to mitigate security risk of networking protocols (IPSec, HTTPS, etc) and devices (VLAN, VPN, Ingress Filtering, etc)

UNIT 3:
Basics of Cryptography, PKI, Security considerations while developing softwares

UNIT 4:
Network Security Products – Firewall, IDS/IPS, VPN Concentrator, Content Screening Gateways, etc.

UNIT 5:
Introduction to Security Standards – ISO 27001, Indian IT Act, IPR Laws; Security Audit procedures; Developing Security Policies; Disaster Recovery, Business Continuity Planning

Reference Books:
1. Information Security and Cyber Laws, Sarika Gupta, Khanna Publishing House
2. RFCs of protocols listed in content (https://www.ietf.org)
5. https://www.cert-in.org.in/
6. https://www.sans.org/

Course outcomes:
Understanding of security needs and issues of IT infrastructure. Have basic skills on security audit of networks, operating systems and application software.

*******
Course Code : COPE311/312
Course Title : Network Forensics
Number of Credits : 4      (L: 3, T: 0, P: 2)
Prerequisites : COPC202, COPC206
Course Category : PE

Course Learning Objectives:
To understand various network forensic aspects for analysing network security breach

Course Content:

UNIT 1:
Review of Networking concepts and Protocols, Introduction to Network Forensics, various aspects of Network Forensics

UNIT 2:
Introduction to Network Forensic Tools and techniques: Wireshark, TCP Dump, Syslog, NMS, Promiscuous Mode, Network Port Mirroring, snooping, scanning tools, etc.

UNIT 3:
Understanding and Examining Data Link Layer, Physical Layer, Ethernet Switch Logs, MAC Table, ARP Table, etc.
Understanding and Examining Network Layer, Router Logs, WiFi Device logs, Firewall logs,

UNIT 4:
Understanding audit features of OS and applications; Enabling and Examining Server logs, User activity logs, Browser history analysis, Proxy server logs, Antivirus logs, Email logs

UNIT 5:
Limitations and challenges of network forensics due to encryption, spoofing, mobility, storage limitations, privacy laws, etc.

Suggested Lab Work:
This is a skill course. Topics/tools taught in the class should be practiced in the Lab same week and practiced regularly during the semester till student becomes confident about it. Students should explore features of various tools/applications introduced during the course. Teacher should give weekly tasks as assignment.

Reference Books:
1. Manuals of OS, application software, network devices
2. RFCs of various networking protocols (https://www.ietf.org/)
3. https://www.sans.org/
6. Cyber Forensics, Albert Marcella and Doug Menendez, CRC Press
7. Computer Forensics (5 volume Set) mapping to CHFI (Certified Hacking Forensics Investigator), by EC-Council

Course outcomes:
Student will understand basic concepts of network forensics, learn tools, and will be able to do basic forensic investigations and handle security incidents.

******
Course Code : COPE313/314
Course Title : Data Sciences: Data Warehousing and Data Mining
Number of Credits : 4 (L: 3, T: 1, P: 0)
Prerequisites : COPCC 203, COPC204, COPC 207
Course Category : PE

Course Learning Objectives:
Introduce students to the domain of Data Warehousing and Data Mining

Course Content:
UNIT 1: Introduction
Motivation, Importance, Definitions, Kind of Data, Data Mining Functionalities, Kinds of Patterns, Classification of Data Mining Systems, Data Mining Task Primitives, Integration of A Data Mining System with A Database or Data Warehouse System, Major Issues in Data Mining, Types of Data Sets and Attribute Values, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity. PREPROCESSING: Data Quality, Major Tasks in Data Preprocessing, Data Reduction, Data Transformation and Data Discretization, Data Cleaning and Data Integration.

UNIT 2: Data Warehousing and on-line Analytical Processing
Data Warehouse basic concepts, Data Warehouse Modeling - Data Cube and OLAP, Data Warehouse Design and Usage, Data Warehouse Implementation, Data Generalization by Attribute-Oriented Induction, Data Cube Computation.

UNIT 3: Patterns, Associations and Correlations
Mining Frequent Patterns, Associations and Correlations: Basic Concepts, Efficient and Scalable Frequent Itemset Mining Methods, Pattern Evaluation Methods, Applications of frequent pattern and associations.
Frequent Patterns and Association Mining: A Road Map, Mining Various Kinds of Association Rules, Constraint-Based Frequent Pattern Mining, Extended Applications of Frequent Patterns.

UNIT 4: Classification
Basic Concepts, Decision Tree Induction, Bayesian Classification Methods, Rule-Based Classification, Model Evaluation and Selection, Techniques to Improve Classification Accuracy: Ensemble Methods, Handling Different Kinds of Cases in Classification, Classification by Neural Networks, Support Vector Machines, Pattern-Based Classification, Lazy Learners (or Learning from Your Neighbors).

UNIT 5: Cluster Analysis
Basic Concepts of Cluster Analysis, Clustering Structures, Major Clustering Approaches, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Model-Based Clustering, Why outlieranalysis, Identifying and handling of outliers, Outlier Detection Techniques. WEB MINING: Basic concepts of web mining, different types of web mining, PAGE RANK Algorithm, HITS Algorithm

Reference Books:
1. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques, Elsevier
2. Margaret H Dunham, Data Mining Introductory and Advanced Topics, Pearson Education
3. Amitesh Sinha, Data Warehousing, Thomson Learning, India.
4. Xingdong Wu, Vipin Kumar, the Top Ten Algorithms in Data Mining, CRC Press, UK.

Course outcomes:
Student will have general idea about Data Warehousing and Data Mining techniques, will be able to explore further and effectively use related tools.

******
**Course Code**: COPE315/316

**Course Title**: FOSS (Free and Open Source Software)

**Number of Credits**: 4 (L: 3, T: 0, P: 2)

**Prerequisites**: COPC202, COPC204, COPC208

**Course Category**: PE

**Course Learning Objectives:**
Exposure to free and open source software philosophy and tools.

**Course Content:**

**UNIT 1: FOSS PHILOSOPHY**
Understanding the FOSS Community and FOSS Philosophy, Benefits of Community based Software Development, Guidelines for working with FOSS community, Requirements for being open, free software, open source software, FOSS Licensing Models, FOSS examples

**UNIT 2: LINUX**
Linux Installation and Hardware Configuration, Boot Process, Dual-Booting Linux and other Operating Systems, Kernel Options during Boot, X Windows System Configuration, System Administration (Server Administration, Backup and Restore Procedures, Strategies for keeping a Secure Server)

**UNIT 3: Programming Tools and Techniques**
Libreoffice Tools; Samba: Cross platform; Introduction about LAMP; Brief Introduction to Programming using languages like Java /Python / Perl; Database Systems Mysql, PostgreSQL or equivalent; Open Source UML Tools; Introduction to Mobile Programming; Version Control Systems like SVN, Git or equivalent; Project Management Tools; Bug Tracking Systems; Package Management Systems

**UNIT 4: FOSS CASE STUDIES**
Some example case studies of FOSS implementation

**Suggested Lab Work:**
This is a skill course. Topics/tools taught in the class should be practiced in the Lab same week and practiced regularly during the semester till student becomes confident about it. Students should explore features of various FOSS tools/applications on a Linux system. Teacher should give weekly tasks as assignment. Learnings from this course should be used in the major project.

**Reference Books:**

8. Linux in a Nutshell, by Ellen Siever

**Course outcomes:**
Student will be able to work with FOSS tools, find and evaluate FOSS alternatives for any software requirement.

********
Course Code : COPE317/318
Course Title : Software Testing
Number of Credits : 4 (L: 3, T: 0, P: 2)
Prerequisites : COPC208
Course Category : PE

Course Learning Objectives:
Inculcate essential software testing knowledge and skills, required to reasonably test a system under development in a systematic manner.

Course Content:
As per the course design, concepts learned in this course will/should be used in the major project (Proj.202).

UNIT 1: Basics
Introduction to Software Quality basics: Verification and validation, quality perspectives, Testing terminology, Software Testing Life Cycle (STLC), "V" model of Testing, QA process, cost of testing, types of tests,

UNIT 2: Writing Test Cases
Writing test cases, Functional Testing, non-functional testing, (Performance testing), UI testing. Preparing test data, Writing Unit test, Integration test and User Acceptance Tests, preparing test scenarios from Software requirements

UNIT 3: Test Execution and Management
Test execution, Test Oracles, test planning, test strategy including when to stop testing, test-coverage - Traceability matrix, JIRA, Bugzilla and other bug tracking tools. Test data mining, test reporting.

UNIT 4: Test Automation
Why automation, when not to automate, writing simple automated test cases, learn and practice any one automated testing framework like Selenium and ...

UNIT 5: Other quality Assurance
Quality and Defect management - Code reviews, Quality tools, Change management, version control

Suggested Lab Work:
Writing and executing test cases of different types for a sample system, may be for the minor project done earlier; using Bugzilla to report cases; writing performance test cases for different types of test (load, stress, benchmarking, etc.); Writing automated test for UI, writing-executing test scripts for a sample system

Reference Books/Resources:
2. Bugzilla (https://www.bugzilla.org/)
3. JIRA (https://www.atlassian.com/software/jira)

Course outcomes:
Student will develop skills to understand the system, choose suitable testing methods, strategies, tools and technology, execute and report the test. Student will also be able to understand need and usage of test automation and gain expertise in at least 1 test automation tool.

******
Chemical Engineering Curriculum Structure
(III to VI Semesters)
### 8.1 List of Programme Core Courses [PC]

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Code No</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Semester</th>
<th>Credits</th>
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**Total Credits** 48
### 8.2 List of Program Elective Courses [PE]

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#### Plant Operations & Management

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### 8.3 Semester-wise Detailed Curriculum

#### SEMESTER – III

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Total Credits 20

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Total Credits 20

**SI301** Summer Internship – II (6 weeks) after IV Sem 3
## SEMESTER – V

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Total Credits 21

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Total Credits 20

^one credit is carried forward from the Vth semester major project evaluation.
SEMESTER III

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Course Learning Objectives:
- To give a comprehensive knowledge on various aspects practiced in chemical engineering
- To give the sources of information on related topics.

Course Content:

UNIT I
Chemistry, Chemical Engineering and Chemical Technology; Chemical process industries: History and their role in Society; Role of Chemical Engineer; History and Personalities of Chemical Engineering; Greatest achievements of Chemical Engineering.

UNIT II
Components of Chemical Engineering: Role of Mathematics, Physics, Chemistry and Biology; Thermodynamics, Transport Phenomena, Chemical Kinetics and Process dynamics, design and control.

UNIT III
Concept of Unit Processes and Unit Operations; Description of different Unit Processes and Unit Operations; Designing of equipments; Flowsheet representation of process plants.

UNIT IV
Role of Computer in Chemical Engineering; Chemical Engineering Software; Relation between Chemical Engineering and other engineering disciplines; Traditional vs. modern Chemical Engineering; Versatility of Chemical Engineering: Role of Chemical Engineers in the area of Food, Medical, Energy, Environmental, Biochemical, Electronics etc.

UNIT V
Paradigm shifts in Chemical Engineering; Range of scales in Chemical Engineering; Opportunities for Chemical Engineers; Future of Chemical Engineering.

REFERENCE BOOKS:
2. Pushpavanam.S., “Introduction to Chemical Engineering”, PHI Learning Pvt. Ltd., New Delhi,
Course Outcomes:

At the end of the course, the student can able to:

- Appreciate various unit operations and processes followed in transforming raw material into value added materials,
- Understand the various representation of flow processes
- Significance of Chemical Engineering to the society in the areas of health, energy, environment and food.

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<th>Course Code</th>
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<tr>
<td>Course Title</td>
<td>: Industrial Chemistry</td>
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<tr>
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<td>Prerequisites</td>
<td>: BS105</td>
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<tr>
<td>Course Type</td>
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COURSE LEARNING OBJECTIVES:

- To develop the basic knowledge of organic compounds, their preparation, properties and uses.
- To understand the physical principals of chemical systems
- To lay foundation for the understanding other chemical engineering subjects.

COURSE CONTENT:

UNIT-I: Organic Chemistry Nomenclatures of organic compounds, functional groups.


UNIT-III: Aromatic Compounds, alkyl halides, alchohol and phenols. Concept of aromacity, structure of benzene, properties of benzene, reactions of benzene, halogenation, hydrogenation, pyrolysis, Classification of alkyl halides, isomerism in alkyl halides, properties of alkyl halides, substitution reaction, elimination reaction, alcohols. Classification of alcohols, preparation, properties, reaction, phenols Classification, preparation, reaction.

UNIT-IV: Phase rule, Phase rule, phase, component, degrees of freedom, One component system


REFERENCE BOOKS:

4. B.R.Puri, L.R.Sharma and M.S.Pathania, “Principles of physical chemistry” Vikas Publishing House Pvt Ltd.,

COURSE OUTCOMES:
The student can be able to:

- Write the reactions for given organic compounds.
- Describe reaction for alkanes, alkenes.
- Identify the properties of various organic compounds.
- Compare principles of Langmuir and Freudlich isotherm.
- Describe the mechanism of degree of freedom.

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<tr>
<th>Course Code</th>
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<td>Course Title</td>
<td>CHEMICAL PROCESS CALCULATIONS</td>
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COURSE LEARNING OBJECTIVES
- To give students fundamental knowledge on Unit processes and Unit operations, Units and conversions and also the basic laws governing chemical operations.
- To impart knowledge on material and energy balance with and without reactions.

COURSE CONTENT

UNIT-I: Basics of unit operations and unit processes, Units and dimensions.


REFERENCE BOOKS


COURSE OUTCOMES

On completion of the course, the students would have,

• The capability to understand the need for study of unit operations and processes. Convert units and dimensions and also modify equations from system to another.
• The capability to apply the laws of physics and chemistry in solving process industry related applications.
• Proficiency to integrate the data and formulate the mass and energy balance problems
• The capability to use mathematical knowledge for solving mass and energy balance problems with and without chemical reactions.

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COURSE LEARNING OBJECTIVES:

• To impart the fundamental concepts of fluid statics, pressure distribution and dimensional analysis.
• To nurture the students to solve fluid dynamics problems using Newton’s laws of motion.
• To enable students to compute velocity profile, friction factor and head loss in pipes and fittings.
• To impart the knowledge of metering and transportation of fluids and fluid moving machinery performance.

COURSE CONTENT:


UNIT-II: Momentum Balance and their Applications: Kinematics of fluid flow; Newtonian and non-Newtonian fluids - Reynolds number - experiment and significance - Momentum balance - Forces acting on stream tubes - Bernoulli’s equation - Correction for fluid friction

UNIT-III: Flow of incompressible fluids in pipes – laminar and turbulent flow through closed conduits - velocity profile & friction factor for smooth and rough pipes - Head loss due to friction in pipes, fitting etc.


REFERENCE BOOKS

COURSE OUTCOMES
On completion of the course, the students would have,
- The knowledge of fundamental concepts in fluids statics and to use dimensional analysis for scaling experimental results
- The ability to solve hydrostatic and fluid flow problems using Newton's laws of motion
- The ability to analyze frictional flow in pipes and piping networks and to compute the head loss and power requirements for chemical process equipments.
- The ability to select the metering equipments and fluid moving machinery for appropriate chemical engineering operations.

 COURSE LEARNING OBJECTIVES:
To impart knowledge on
- Understand basic principles of particle preparation and their characterization
- Understand the performance of different equipments for separation of solids and size reduction
- Basic principles in various operations such as Size Reduction, Filtration, Sedimentation, Mixing and Agitation etc.
- Study various methods for storage of solids and conveyors available for their transportation.

COURSE CONTENT:
UNIT-II: Introduction to size reduction equipment, energy and power requirement in milling operations


UNIT-IV: Particulate Processes: Solid-Liquid and Gas-Solid separation methods, Equipments Classification by size, agitation and mixing of solids and liquids,

UNIT-V: Handling of Particulate Material: Conveying methods, Storage methods, Feeders and elevators.

REFERENCE BOOKS

COURSE OUTCOMES
On completion of the course, students are expected to
- understand the basic principles of particles preparation and their characterization.
- have knowledge about different size reducing equipment and power requirements during size reduction.
- have an understanding on solid fluid separation equipment.
- have an understanding of solid storage and their conveying in chemical process industries.

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<tr>
<th>Course Code</th>
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<tr>
<td>Course Title</td>
<td>Engineering Thermodynamics</td>
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<td>Prerequisites</td>
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<td>Course Type</td>
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</table>

COURSE LEARNING OBJECTIVES:
To impart knowledge on
- To understand the basic knowledge of thermodynamic systems used in Chemical Engineering operations.
- To understand basic working principles of boilers.
- To understand the Energy conservation opportunities in steam systems

COURSE CONTENT:
UNIT-I: Basic Concepts and Definitions: Energy conversion and efficiencies - System, property and state - Thermal equilibrium - Temperature - Zeroth law of Thermodynamics.
UNIT-II: First Law of Thermodynamics: The concept of work and adiabatic process - First law of thermodynamics - Conservation of Energy principle for closed and open systems - Calculation of work for different processes of expansion of gases


UNIT-IV: Gas Power Cycles: Air standard cycles: - Air standard Otto cycle, diesel cycle, dual cycle and Bryton cycles and their efficiencies

UNIT-V: Refrigeration Cycles and Systems: Reverse Carnot cycle - COP - Vapor compression refrigeration cycle and systems (only theory) - Gas refrigeration cycle - Absorption refrigeration system (only theory) - Liquification and solidification of gases

REFERENCE BOOKS

COURSE OUTCOMES
On completion of the course, the students will be able to

- understand the conceptual laws of thermodynamics for application in thermodynamic cycles.
- understand and analyze different thermodynamic cycles and calculate their thermal efficiencies.
- understand the basics of boilers and perform simple calculations of boiler efficiencies.
- understand the steam distribution and utilization systems to identify the energy conservation opportunities.
- comprehend principles of steam turbines and calculation of turbine efficiencies; understand the basics of vacuum pumps and instruments for measurement of vacuum.

*******
Course Code : CHPC213
Course Title : MOMENTUM TRANSFER LAB
Number of Credits : 1 (L: 0, T: 0, P: 2)
Prerequisites : CHPC205
Course Type : PC

COURSE LEARNING OBJECTIVES:
Understand and application of the principles & concepts of learned in momentum transfer theory course

CONTENTS:
To conduct experiment to study
1. Different types of manometers
2. Major losses in pipe flow
3. Minor Losses (Globe Valve, Bends and Elbows)
4. Major losses in spiral coil flow
5. Major losses in helical coil flow
6. Flow Through Packed Bed
7. Flow Through Fluidized Bed
8. Calibration of orifice meter
9. Calibration of venturi meter
10. Calibration of pitot tube
11. Calibration of channel
12. Characteristics of reciprocating pump
13. Characteristics of centrifugal pump

REFERENCES:
1. Lab Manual

COURSE OUTCOME:
After completion of the course, student can able to
- Understand and application of the concept of manometers
- Understand and analyse the laminar and turbulent flow
- Understand, apply and analyse the friction factor
- Understand the concepts of flow meters, pumps.
Course Code : CHPC215
Course Title : MECHANICAL OPERATIONS LAB
Number of Credits : 1 (L: 0, T: 0, P: 2)
Prerequisites : CHPC 207
Course Type : PC

COURSE LEARNING OBJECTIVES:
- To impart hands on experience on different unit operation equipments.
- Apply principles developed in chemical engineering courses to the analysis of chemical engineering processes and unit operations.

CONTENTS:
1. Different types of density of particle (Bulk, Particle, Repose)
2. Angle of repose
3. Particle size distribution
4. Screen effectiveness
5. Jaw crusher
6. Ball mill
7. Drop weight crushes
8. Drag studies
9. Settling studies
10. Separation of solids using settling characteristics
11. Constant Pressure Filtration
12. Constant Volume Filtration
13. Elutriation
14. Agitated vessel
15. Storage of Solids

REFERENCES:
1. Lab Manual
3. G Chandrasekhar, Laboratory Experiments in Chemical and Allied Engineering, Penram International Publishing (India) Pvt. Ltd.,

COURSE OUTCOME:
After completion of the course, student can able to:
- Understand the fundamentals involved in the Mechanical operations.
- understand and application of the concept of Particulate properties and its measurements.
- understand liquid-solid and gas-solid separations.

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SEMESTER IV

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<tr>
<th>Course Code</th>
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<tr>
<td>Course Title</td>
<td>PROCESS HEAT TRANSFER</td>
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<tr>
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**COURSE LEARNING OBJECTIVES:**

- To study the fundamental concepts of heat transfer viz., conduction, convection, radiation, Boiling and Condensation.
- To use these fundamentals in typical engineering applications (Heat exchanger and Evaporator) and current research.

**COURSE CONTENT:**

**UNIT-I:** Basic modes of heat transfer and the laws governing them. Steady state conduction through plane and composite walls general heat conduction equation, concepts of thermal diffusivity and equivalent thermal conductivity.

**UNIT-II:** Convection – Dimensional analysis and empirical correlations, Critical insulation thickness for cylindrical and spherical surfaces, Physical significance of the dimensionless groups.

**UNIT-III:** Thermal Radiation laws, spectrum of electromagnetic radiation, Black and Gray bodies and configuration factor – typical examples. Boiling and condensation.

**UNIT-IV:** Heat Exchangers – classification, overall and individual film coefficients, mean temperature difference, LMTD correction factor for multiple pass exchanger

**UNIT-V:** Evaporation, single and multiple effect operation, material and Energy balance in evaporators, boiling point elevation, Duhring’s rule, effect of liquid head.

**REFERENCE BOOKS:**


**COURSE OUTCOMES:**

On completion of the course, the student can able

- to estimate steady state heat transfer rates from/to objects
- to use equations for different types of convection and solve for heat transfer rate by convection
- to estimate the rate of radiation heat transfer with and without participating medium, ability to identify the roll of re-radiating surface, radiation shields, boiling and condensation.
- to estimate steam economy, capacity of single and multiple effect evaporators.
Chemical Engineering Curriculum Structure

<table>
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<tr>
<th>Course Code</th>
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<td>Course Title</td>
<td>MASS TRANSFER - I</td>
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<tr>
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**COURSE LEARNING OBJECTIVES:**

- To learn the concept of diffusion in gas, liquid & solid.
- To understand the basics of interphase mass transfer.
- To learn application of gas-liquid operation and simultaneous heat and mass transfer operations.

**COURSE CONTENT:**

**UNIT-I:** Definition- Ficks law, Molecular and eddy diffusion, Diffusion in gaseous mixtures, liquid mixtures and solids, measurement and calculation of diffusivities. Mass transfer coefficients - Individual and overall with relations, Theories of mass transfer, Analogies between momentum, heat and mass transfer to predict mass transfer coefficients.

**UNIT-II:** Absorption – Solubility, theory of gas absorption, Concept of Equilibrium and operating lines. Mass Transfer Equipments- Batch and continuous, Stage wise contactors and Differential contactors, Concept of HTU and NTU, Tower packings and packing characteristics.

**UNIT-III:** Humidification Theory, Psychometric Chart, Adiabatic Saturator, Wet Bulb Theory, Methods of Humidification and dehumidification, Cooling towers.

**UNIT-IV:** Drying Theory and Mechanism, Drying Characteristics, Estimation of Drying time, drying rate curve, Classification of Driers, Description and Application of Driers, Continuous driers.

**UNIT-V:** Crystallization, Solubility curve, Types of crystals, Principles of Crystallization, Supersaturation Theory, Factors governing nucleation and crystal growth. Theory of crystallization, Classification of crystallizers and their applications.

**REFERENCE BOOKS:**


**COURSE OUTCOMES:**

On completion of the course, the student will be:

- familiar with the basic phenomenon of mass transfer involving phases.
- able to apply the concepts of mass transfer in gas-liquid systems like absorption, humidification, drying and crystallization
- Gaining good knowledge of required optimum condition for a gas-liquid system.

*******
Course Code: CHPC206
Course Title: CHEMICAL ENGINEERING THERMODYNAMICS
Number of Credits: 3 (L: 2, T: 1, P: 0)
Prerequisites: CHPC209
Course Type: PC

COURSE LEARNING OBJECTIVES:
This course will impart
- Knowledge on the concepts of thermodynamics.
- Use of thermodynamics concepts in chemical engineering applications and
- Appreciate the relationship between thermodynamics with separation and reactions.

COURSE CONTENT:
UNIT-II: Applications to Laws of Thermodynamics - Flow processes: Flow in pipes, Flow through nozzles, Compression- Refrigeration
UNIT-III: Thermodynamic Properties of Pure Fluids- Classification of Thermodynamic properties -Work function and Gibb’s Free energy-Fundamental Property relations-Maxwell’s equations Clapeyron equation - Differential equations of Entropy Relationship between Cp and Cv- Effect of pressure and volume on Cp and Cv- Gibb’s Helmholtz Equation
UNIT-IV: Thermodynamic Properties of Solutions - Introduction to fugacity and activity, Activity coefficients-Partial molar properties- Lewis Randall rule-Roults and Henry’s law-Gibbs Duhem Equation
UNIT-V: Phase Equilibria and Chemical Reaction Equilibria - Criteria for phase equilibrium, Criterion of stability, Phase equilibria in single and multiple component systems, Duhem’s theorem, VLE for Ideal solutions, Reaction stoichiometry-Equilibrium constant- Feasibility of reaction- Effect of temperature, pressure, volume and other factors

REFERENCE BOOKS:

COURSE OUTCOMES:
- On completion of the course, the students will be familiar with,
- Fundamentals of thermodynamics as applied to various processes
- Thermodynamics Properties as applied to ideal and real gases
- Determination of equilibrium states for mixture of gases, phases and chemical reaction
- Relationship between thermodynamics, separations and reactions.
Course Code : CHPC208
Course Title : CHEMICAL TECHNOLOGY
Number of Credits : 3  (L: 3, T: 0, P: 0)
Prerequisites : -----
Course Type : PC

COURSE LEARNING OBJECTIVES:
- To impart the basic concepts of chemical technology.
- To develop understanding about unit process and unit operations in various industries.
- To learn manufacturing processes of organic and Inorganic Chemicals and its applications and major engineering problems encountered in the process.
- To learn the process flow sheet drawing for the manufacturing chemical processes.

COURSE CONTENT:

UNIT-I: Natural Products Processing: Production of pulp, paper and rayon, Manufacture of sugar, starch and starch derivatives, Gasification of coal and chemicals from coal.

UNIT-II: Industrial Microbial Processes and Edible Oils: Fermentation processes for the production of ethyl alcohol, citric acid and antibiotics, Refining of edible oils and fats, fatty acids, Soaps and detergents.


UNIT-V: Fertilisers: Nitrogen Fertilisers; Synthetic ammonia, nitric acid, Urea, Phosphorous Fertilisers: Phosphate rock, phosphoric acid, super phosphate and Triple Super phosphate

REFERENCE BOOKS:

COURSE OUTCOMES:
On completion of the course, the student can be able to
- Understand the various unit operations and processes with their symbols
- Understand the manufacturing process of natural products processing and industrial microbial processes and edible oils.
- Understand the various chemical reactions involved in the process
- Understand the manufacturing process of inorganic chemicals
- Draw the process flow sheet and understand the major engineering problems encountered in the processes.
Course Code : CHPC210
Course Title : HEAT TRANSFER LAB
Number of Credits : 1  (L: 0, T: 0, P: 2)
Prerequisites : CHPC 202
Course Type : PC

COURSE LEARNING OBJECTIVES:
To provide experience on testing, and analysis of heat transfer equipments in various approaches.

COURSE CONTENT
- Temperature distribution in a metal rod
- Thermal Conductivity of metal rod
- Radiation
- Natural convective heat transfer
- Forced convective heat transfer
- Double pipe heat exchanger
- Shell and Tube Heat exchanger
- Plate Heat Exchanger
- Condenser
- Heat Transfer in Jacketed Kettle
- Open pan evaporator

REFERENCE BOOKS
1. Lab Manual
3. G Chandrasekhar, Laboratory Experiments in Chemical and Allied Engineering; Penram International Publishing (India) Pvt. Ltd.,

COURSE OUTCOMES
The students have understood how heat transfer occurs for different equipments and worked out the parameters studied in theory.

*******
Course Code : CHPC212
Course Title : CHEMICAL ENGINEERING DRAWING
Number of Credits : 2 (L: 0, T: 0, P: 4)
Prerequisites : ES 101
Course Type : PC

COURSE LEARNING OBJECTIVES:
To develop skill to design and install process equipments used widely in the chemical industry.

COURSE CONTENT:

UNIT-II: Drawing of vessels & supports such as bracket, saddle, skirt.

UNIT-III: Storage Tanks, Cyclone separators centrifuges, thickeners and filtration equipments.

UNIT-IV: Crystallizers, agitated vessel, jacketed and coil heated vessels.

UNIT-V: Double Pipe & Shell & Tube Heat Exchangers, Tray Columns & Packed Columns

REFERENCE BOOKS:
2. V.V. Mahajani and S. B. Umarji, "Joshi’s Process Equipment Design", Mac Millan Publishers India Limited, New Delhi,

COURSE OUTCOMES:
On completion of the course, the student can be able to

- Identify different components of vessels
- Draw the components of vessels
- Draw the mechanical operation of equipments
- Draw the heat transfer equipments and
- Draw the packed and tray columns

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### SEMESTER V

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<th>Course Code</th>
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<td>Course Title</td>
<td>MASS TRANSFER - II</td>
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**COURSE LEARNING OBJECTIVES:**

- To impart the basic concept of conventional mass transfer operations.
- To learn the equilibrium characteristics of two phase mass transfer processes.
- To understand the hydrodynamics and operation of mass transfer equipments.
- To develop the skills in the design and analysis of mass transfer equipments in process industries.

**COURSE CONTENT:**

- **UNIT-I:** Principle, theory, Vapour Liquid Equilibria calculations, Effect of Pressure and temperature on VLE, Methods of distillations, batch, continuous, flash, steam distillation.
- **UNIT-II:** Stage-wise and continuous contactors operations, Mc-Cabe Thiele Method, Azeotropic distillation and Extractive distillation, Introduction - Multi component Flash and differential distillation.
- **UNIT-III:** Liquid - Liquid Equilibria, Effect of Pressure and Temperature on LLE, Solubility criteria, Batch and continuous extraction towers for miscible and immiscible systems. Industrial Applications.
- **UNIT-IV:** Theory, Mechanism, Types of leaching, Solid - Liquid equilibria, Batch and continuous extractors. Equipments and industrial applications.
- **UNIT-V:** Types of adsorption, nature of adsorbents, Adsorption isotherms, Operation of adsorption columns. Batch and continuous operations

**REFERENCE BOOKS:**


**COURSE OUTCOMES:**

After completing the course, a student can able to

- Have an ability to apply the concepts of mass transfer in Chemical Process industries.
- Analyse the two phase transfer processes and select the transfer equipments.
- Develop equilibrium characteristics from thermodynamic fundamentals.
- Explain the industrial applications of the mass transfer equipment.

******
**Course Code**: CHPC303  
**Course Title**: CHEMICAL REACTION ENGINEERING  
**Number of Credits**: 4 (L: 2, T: 1, P: 2)  
**Prerequisites**: NIL  
**Course Category**: PC

**COURSE LEARNING OBJECTIVES:**
- Introduce basic concepts of chemical kinetics like homogeneous and heterogeneous reactions, rate of reaction, order and molecularity of reaction, concentration and temperature dependency of rate of reaction.
- Build up the concepts to analyze kinetic data and determine the rate expression for a reaction.
- This course will guide students to make use of key concepts and techniques of chemical kinetics to design single reactor and multiple reactors.
- Analyze multiple reactions to determine selectivity and yield.
- Work together in same-discipline teams to solve engineering problems.

**COURSE CONTENT:**

**UNIT-I:** Basics of Rate process and Chemical Kinetics: Introduction – Rate of a Chemical Reaction, kinetics of homogeneous reactions: Concentration dependent, Temperature dependent term of rate equation, Searching for a mechanism. Interpretation of Batch Reactor data.

**UNIT-II:** Types and Mechanisms of Chemical Reactions, Single Ideal Reactors, Batch, Mixed flow reactors and plug flow reactors – Performance equations.


**UNIT-IV:** Heat Effects: Temperature and pressure effects on single and multiple reactions.

**UNIT-V:** Non-ideal flow: Residence time distribution studies: C, E, F and I curves.

**REFERENCE BOOKS:**

**COURSE OUTCOMES:**
On completion of the course, the students:
- Will understand the classification of chemical reactions, factors affecting the rate of reaction, and the effect of temperature on rate of reaction.
- Will gain the knowledge on analyzing the laboratory data for determining the order of reaction and reaction rate constant Ability to relate rate of reaction with design equation for reactor sizing.
- Will familiar with the comparisons of ideal reactor types (batch, plug flow, mixed flow and select the most suitable one.
- Will familiar with the determining optimal ideal reactor design for multiple reactions for particular yield or selectivity.

******
Course Code : CHPC305
Course Title : PROCESS CONTROL & INSTRUMENTATION
Number of Credits : 3 (L: 2, T: 1, P: 0)
Prerequisites : NIL
Course Category : PC

COURSE LEARNING OBJECTIVES:
• To introduce students to the terminology, concepts and practices of input/output modelling and process control.
• To impart knowledge in the design of control systems for chemical processes.

COURSE CONTENT:
UNIT-I: Laplace transforms - properties of Laplace transform, solution of linear differential equations using Laplace transform techniques, piecewise continuous functions
UNIT-II: Dynamic behaviour of systems - derivation of transfer functions for first and second order systems, liquid level, temperature, pressure, flow and concentration control processes, linearization of nonlinear systems, interacting and non-interacting systems.
UNIT-III: Transient response of first and second order systems, natural frequency, damping factor, overshoot, decay ratio, rise time and settling time.
UNIT-V: Principles of measurements and classification of process instruments, measurement of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity, pH, concentration, electrical and thermal conductivity, humidity of gases.

REFERENCE BOOKS:

COURSE OUTCOMES:
On completion of the course, the student:
• Can construct a model of the chemical processes and other elements used in feedback control systems from first principles leading to the development of transfer function models
• Can compute the response of the developed transfer function for various forcing functions providing an understanding of the transient response of the system
• Can derive transfer function models of controllers and compute the transient response under closed loop conditions.
• Can evaluate the stability of the control system given a mathematical model of a control system including its components.
• Different Instrumentations used in Process Industries.

******
Course Code : CHPC307
Course Title : MASS TRANSFER LAB
Number of Credits : 1 (L: 0, T: 0, P: 2)
Prerequisites : CHPC204 and CHPC301
Course Category : PC

COURSE LEARNING OBJECTIVES:
To provide experience analysis of mass transfer operations.

COURSE CONTENT:
1. Diffusion
2. Wetted wall column
3. Simple Distillation
4. Steam Distillation
5. Surface evaporation
6. Liquid-Liquid Extraction
7. Leaching
8. Adsorption
9. Air drying
10. Packed Column Distillation

REFERENCE BOOKS:
1. Lab manual

COURSE OUTCOMES:
After this Lab course, a student can able to
• Appreciate the concept of diffusion and convection
• Understand the different types of distillation
• Know the contactors used in chemical Process Industries.
• Explain the usage and employability of devices for determining the separation factors and efficiencies of the systems.

*******
Course Code : CHPC309
Course Title : CHEMICAL REACTION ENGINEERING LAB
Number of Credits : 1 (L: 0, T: 0, P: 2)
Prerequisites : CHPC303
Course Category : PC

COURSE LEARNING OBJECTIVES
To provide experience on analysis of process control and reaction engineering.

COURSE CONTENT
1. Batch reactor
2. Plug flow reactor
3. Mixed flow reactor
4. Adiabatic reactor
5. Combined reactor: Mixed flow-plug flow
6. Combined reactor: Plug flow-mixed flow
7. RTD studies
8. Photochemical reactor

REFERENCE BOOKS
1. Lab manual

COURSE OUTCOMES
After this Lab course, a student can able to
1. appreciate the concept of reactions kinetics and rate equations
2. understand the different types of reactions
3. know the types of reactors and its usage
4. conversion and yield.

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SEMESTER VI

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<th>Course Code</th>
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<tr>
<td>Course Title</td>
<td>PROJECT ENGINEERING</td>
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<td>Number of Credits</td>
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</table>

COURSE LEARNING OBJECTIVES:

- To enable the students to gain experience in organization and implementation of a small project and thus acquire the necessary confidence to carry out the main project in the final year.
- To make the students gain all the knowledge in terms of financial analysis for starting up a new chemical industry.
- To gain knowledge on cost analysis when it comes to start up a new industry after undergoing all major subjects of chemical engineering.
- To give a clear linkage between technical knowledge and commercial aspects of the major chemical engineering unit operations and design.

COURSE CONTENT:

UNIT-I: Plant location and site selection, CCOE Clearance, MoEF Clearance, plant layout, factors affecting plant location, project planning and scheduling of projects, project financing, Flow sheeting, Selection of Process Equipment. Process utilities, process water, boiler feed water, steam distribution including appropriate mechanical valves and instrumentation, process pumps, compressors, Refrigeration plant.

UNIT-II: Piping design and piping, Connecting pipes to process equipment, layout, Support for piping insulation, plant constructions, star-up and commissioning.


REFERENCE BOOKS:

3. Industrial Boilers, and Heat recovery Steam Generators Design, Applications and calculations by V.Ganapathy, Marcel Dekker, Inc.

COURSE OUTCOMES:

On completion of the course, the student can
1. understand how a project has to be started, their pre-requirements, flow chart preparation, economic calculation and so on.

2. work out the balance sheet and Income statement for a particular concern.

3. gain a good knowledge on when to run an industry in a profitable or without loss/gain of a particular concern.

4. choose between the equipment/instruments of the same function based on both technical and commercial point of view.

5. draw a complete flowchart of a plant with cost analysis.

******
PROGRAMME ELECTIVE COURSES

Course Code : CHPExxx
Course Title : MATERIAL SCIENCE AND TECHNOLOGY
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : Nil
Course Category : PE

COURSE LEARNING OBJECTIVES:
- To impart the basic concept of material science.
- To understand the various properties, corrosion and heat treatment of engineering materials.
- To understand the engineering requirement and selections of materials based on the properties for various applications.

COURSE CONTENT:
UNIT-II: Structure and Imperfections in Crystals: Crystal structure Crystal geometry, structure of solids, methods of determining structures. Imperfection in crystals - types of imperfection. Point imperfection

REFERENCE BOOKS:
2. R. Balasubramaniam, "Callister's Materials Science and Engineering", Wiley

COURSE OUTCOMES:
- After completion of the course, the students can understand the basics knowledge such as internal structure, crystal geometry, crystal imperfection of the engineering materials
- Understand the various properties and corrosion behavior of the selected materials in chemical industries
- Experience in the metallic and nonmetallic material selection and handling material in chemical engineering in the areas of equipment design.

*******
Course Code: CHPExxx
Course Title: PETROLEUM REFINING & PETROCHEMICAL TECHNOLOGY
Number of Credits: 3 (L: 3, T: 0, P: 0)
Prerequisites: NIL
Course Category: PE

COURSE LEARNING OBJECTIVES:

- To impart introductory knowledge of petroleum refining and corresponding processes.
- To provide an insight into petrochemical industry.

COURSE CONTENT:


UNIT-II: Secondary Processing: FCCU, Hydro cracking, Visbreaking, Coking, Reforming, Alkylation, Isomerisation and polymerization processes.


UNIT-IV: Petrochemical: Building blocks, intermediates, major petrochemicals and their applications,

UNIT-V: Chemicals from methane and synthesis gas, Chemicals from olefins, Chemicals from aromatics, Synthetic fibres, plastics and rubber.

REFERENCE BOOKS
1. B.K. Bhaskarao, Bulk Chemicals from Petroleum, Khanna Publishing House

COURSE OUTCOMES

- On completion of the course, the students will be able to develop overview of petroleum industry and know about origin, formation composition and characterization of crude oil.
- Comprehend primary processing mechanisms of crude to obtain various petroleum cuts.
- Know about secondary conversion techniques and treatment processes in petroleum refinery to get products of desired yield and quality
- Understand manufacturing processes and applications of various petrochemicals
- Grasp environmental and safety aspects in petroleum refinery and petrochemical industries.

******
Course Code : CHPEXXX
Course Title : FOOD TECHNOLOGY
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : Basic understanding of Transfer operations
Course Category : PE

COURSE LEARNING OBJECTIVES:
To impart knowledge to the students about advanced technology in food science and recent trends adapted in food industry.

COURSE CONTENT:
UNIT-II: Fluid Flow, Thermal Process Calculations, Refrigeration, Evaporation and Dehydration operations in Food Processing
UNIT-IV: Preservation by Heat and Cold, Dehydration, Concentration, Drying, Irradiation, Microwave heating, Sterilization and Pasteurization, Fermentation and Pickling, Packaging Methods

REFERENCE BOOKS:
3. R Paul Singh, Dennis R Heldman, ‘Introduction to Food Engineering,’ 4/e, Elsevier,

COURSE OUTCOMES:
Upon successful completion of this course, the student should be able to
- Explain properties of food in relation to its quality.
- Elucidate the theory and applications of unit operations in food processing.
- Describe the various equipments used in food industry.
- Explain the factors affecting the growth and survival of food microorganisms.
- Describe various food preservation techniques.
Course Code : CHPExxx
Course Title : INSTRUMENTAL METHOD OF ANALYSIS
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : PE

COURSE LEARNING OBJECTIVES:
To make the students understand the working principles of different types of instruments and their applications

COURSE CONTENT:


REFERENCE BOOKS:
2. Dr. G.R. Chatwal and Sham Anand, "Instrumental Method of Analysis",Hph.

COURSE OUTCOMES:
Upon completion of this course, the students would have

- Knowledge about the Qualitative and quantitative instrument analysis of different materials.
- Understanding the principle in Instrumentation techniques
- Various Instruments and its applications

******
Course Code : CHPEXXX
Course Title : SAFETY IN CHEMICAL PROCESS INDUSTRIES
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : Basic understanding of Process Industries
Course Category : PE

COURSE LEARNING OBJECTIVES:
Students learn about implementation of safety procedures, risk analysis and assessment, hazard identification.

COURSE CONTENT:
UNIT-I: Hazard identification methodologies, risk assessment methods - PHA, HAZOP, MCA, ETA, FTA, consequence analysis,
UNIT-II: Hazards in work places - nature and type of work places, types of hazards, hazards due to improper house-keeping, hazards due to fire in multi-floor industries and buildings, guidelines and safe methods in the above situations.
UNIT-III: Workers’ exposures to hazardous chemicals, TLVs of chemicals, physical and chemical properties of chemicals leading to accidents like fire explosions, ingestion and inhalation, pollution in work places due to dangerous dusts, fumes and vapours, guidelines and safe methods in chemicals handling, storage and entry into confined spaces.
UNIT-IV: Hazards peculiar to industries like fertilizer, heavy chemicals, petroleum, pulp and paper, tanneries, dyes, paints, pesticides, glass and ceramics, dairy and sugar industries, guidelines for safeguarding personnel and safeguarding against water, land and air pollution in the above industries.

REFERENCE BOOKS:

COURSE OUTCOMES:
On completion of the course the students will
- understand the importance of safety measures
- Know Different types of prevention techniques
- identify the risks in process management in different types of process industries.

*******
Course Code : CHPExxx
Course Title : PLANT UTILITIES
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : Basic understanding of Process Industries
Course Category : PE

COURSE LEARNING OBJECTIVES:
To enable the students to understand the process plant utilities and optimization techniques to optimize various parameters in chemical industries.

COURSE CONTENT:
UNIT-I: IMPORTANT OF UTILITIES: Hard and Soft water, Requisites of Industrial Water and its uses. Methods of water Treatment such as Chemical Softening and Demineralization, Resins used for Water Softening and Reverse Osmosis. Effects of impure Boiler Feed Water.


UNIT-III: REFRIGERATION: Refrigeration Cycles, Methods of Refrigeration used in Industry and Different Types of Refrigerants such as Monochlorodifluoro Methane, Chlorofluoro Carbons and Brins. Refrigerating Effects and Liquefaction Processes.


REFERENCE BOOKS:

COURSE OUTCOMES:
At the end of this course, the students will
- Understand the importance of health, safety and the environment in process industries.
- Steam, power, water, air are extensively used in process industries and their efficient operation is imperative for economic and
- Safe operation is essential for the survival of industries.

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Chemical Engineering Curriculum Structure

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Chemical Engineering Curriculum Structure

Course Code : CHPExxx
Course Title : PETROLEUM ENGINEERING
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : PE

COURSE LEARNING OBJECTIVES:
To provide
• an overview of petroleum industry.
• Petroleum exploration and exploitation techniques,
• oil and gas reserve identification and evaluation.
• Drilling and production of oil and gas. Disposal of effluents.

COURSE CONTENT:
UNIT-I: Earth science - occurrence of petroleum Rocks and traps. Reservoir rocks and properties. Classification of oil and gas reserves Reservoir mechanics and drive mechanism.

UNIT-II: Drilling – introduction to drilling of oil and gas wells. Drilling rigs and equipments. Drilling fluids and cementing.


UNIT-IV: Petroleum exploration – well testing, production potential and well performances. Material balance, Artificial lift, Improved recovery methods.


REFERENCE BOOKS:
3. Introduction to Petroleum Engineering by Geltin

COURSE OUTCOMES
After completing the course, a student can able to understand the various processes involved in the upstream processes of petroleum Engineering.

******
<table>
<thead>
<tr>
<th>Course Code</th>
<th>CHPExxx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>ENERGY ENGINEERING</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3 (L: 3, T: 0, P: 0)</td>
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<tr>
<td>Prerequisites</td>
<td>NIL</td>
</tr>
<tr>
<td>Course Category</td>
<td>PE</td>
</tr>
</tbody>
</table>

**COURSE LEARNING OBJECTIVES:**
- To identify different types of fuel sources for energy production.
- To appreciate the advantages of energy production from renewable energy resources.

**COURSE CONTENT:**

**UNIT-I:** Fuels - Classification, Properties, tests and analysis. Solid Fuels - Coal, origin, classification, storage and handling, carbonization, gasification and briquetting - gasification of biomass.

**UNIT-II:** Liquid fuels - Petroleum based fuels, synthetic fuels, alcohol and blended fuels, storage and handling.

**UNIT-III:** Gaseous fuels - Water gas, carbureted water gas, producer gas, coal gas and natural gas.

**UNIT-IV:** Combustion - Air requirement for solid, liquid and gaseous fuels, Combustion equipment

**UNIT-V:** Solar energy, Wind energy, Tidal energy, Hydropower, Geothermal energy, Nuclear energy.

**REFERENCE BOOKS:**
2. G.D.Rai, “Non-conventional energy sources”, Khanna Publishers, IV edition, New Delhi,

**COURSE OUTCOMES:**
On completion of the course, the students can
1. familiar with energy production from conventional fuels and renewable energy resources,
2. compare the process of energy generation by conventional as well as renewable resources
3. familiar with energy conservation through waste heat recovery.
4. familiar with the challenges associated with the use of various energy sources.
5. familiar with information on renewable energy technologies as a basis for further analysis and evaluation.

******
Course Code : CHPExxx  
Course Title : MODERN SEPARATION TECHNIQUES  
Number of Credits : 3 (L: 3, T: 0, P: 0)  
Prerequisites : CHPC204, CHPC301  
Course Category : PE

COURSE LEARNING OBJECTIVES:
To identify about the kind of separation processes in general and novel separations are integral part of any process chemical industries.

COURSE CONTENT:
UNIT-I: Thermal Diffusion: Basic Rate Law, Theory of Thermal Diffusion Phenomena for gas and liquid mixtures, Equipments design and Applications. Zone Melting
UNIT-II: Chromatographic techniques, Equipment and Commercial processes, Molecular Sieves.
UNIT-III: Cryogenic, Supercritical fluid extraction and Azeotropic separation.
UNIT-IV: Principle of membrane separations process; Classification: Reverse osmosis, Ultra-filtration, Micro-filtration, Nano-filtration and Dialysis; Membrane modules and application; Electro-dialysis; Per-vaporation and gas separation using membranes; Electrophorosis; Liquid membranes.
UNIT-V: Foam and bubble separation: Principle; Classification; Separation techniques; Column operations. Surface Adsorption, Nature of foams.

REFERENCE BOOKS:

COURSE OUTCOMES:
On completion of the course the students will be able to
• Differentiate the conventional techniques and modern techniques
• Understand the principles of modern separation techniques
• Application of this techniques in Industries
• Identify the importance of economics involved in its applications

******
Chemical Engineering Curriculum Structure

Course Code : CHPExxx
Course Title : WASTE MANAGEMENT
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : PE

COURSE LEARNING OBJECTIVES:
- To recognize and learn about waste management, waste treatment and recycling
- To understand the impacts on our environment.
- To learn about pollution, pollutants, waste disposal processes

COURSE CONTENT:
UNIT- I: Types and Sources of Solid and Hazardous Wastes - Need for Solid and Hazardous Waste Management, Waste Generation Rates - Composition – Hazardous Characteristics,


REFERENCE BOOKS:
1. O.P. Gupta, "Elements of Solid Waste Hazardous Management", Khanna Publishing House, New Delhi, 2018

COURSE OUTCOMES:
At the end of the course student will be able
- To explain the various functional elements involved in waste management system
- To quantify and categorize solid wastes for any region
- To prepare concept design for the common functional elements of the waste management systems.
- To select suitable waste processing technologies and disposal methods

******
Chemical Engineering Curriculum Structure

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CHPExxx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>PROCESS EQUIPMENT DESIGN</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3 (L: 3, T: 0, P: 0)</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>CHPC209</td>
</tr>
<tr>
<td>Course Category</td>
<td>PE</td>
</tr>
</tbody>
</table>

COURSE LEARNING OBJECTIVES:
To apply the basic principles/concepts learned in the subjects of Fluid Mechanics, Heat Transfer, Mass Transfer, and Mechanical Operation in the design of chemical process equipment.

To develop the skill to select and design the appropriate process equipment for the required unit or process operation.

To analyses and evaluate the performance of existing equipment.

COURSE CONTENT:
UNIT-I: Design of Pressure Vessels: Design of vessels and its components
UNIT-II: Design of heads/closures, design of supports and design of high pressure vessels.
UNIT-III: Design of Storage tanks, Agitated vessels and Reaction vessels.
UNIT-IV: Design of Phase Separation Equipment - Design of physical separation equipments.
UNIT-V: Design of Heat Transfer Equipments such as heat exchangers without and with phase change. Design of Mass Transfer Equipments: Design of mass transfer equipments such as distillation columns, absorption columns, extraction columns.

REFERENCE BOOKS

COURSE OUTCOMES
On completion of the course, student can

- Perform the mechanical design of vessel and its auxiliaries
- Integrate the knowledge acquired from core chemical engineering subjects for design of chemical process equipment (pressure vessels, storage tanks, reactor vessels, phase separation equipment)
- Identify the process equipment problems and provide suitable alternate solutions.

******
Course Code : CHPEXXX
Course Title : COMPUTER APPLICATIONS IN CHEMICAL ENGINEERING
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : CHPC203
Course Category : PE

COURSE LEARNING OBJECTIVES:
To impart the students, the knowledge of computer and its application in chemical engineering.

COURSE CONTENT:
UNIT-I: INTRODUCTION: Review on Programming languages, Basic, Fortran, Review on operating system commands.

UNIT-II: SPREAD SHEETS: Application in Density, molecular weight, mole and percentage compositions, Empirical and Molecular formula calculations, Heat of mixing, Gas laws, Vapour pressure, Chemical Kinetics calculations.

UNIT-III: SPREAD SHEETS: Application in data processing, Statistical analysis of data, Regression. Analysis of variance, Interpolation, Graphical representations of various Chemical Engineering problem both in laboratory exercise and core subjects such as Mechanical operation, Reaction Engineering, Distillation etc.,


REFERENCE BOOKS:

COURSE OUTCOMES:
On completion of the course the students will be able to know the importance of software to control the process in industries and applications related to mathematical modelling.

******
Electronics and Communication Engineering Curriculum Structure
(III to VI Semesters)
### 9.1 List of Programme Core Courses [PC]

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Code No.</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ECPC201</td>
<td>Principles of Electronic Communication</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>ECPC203</td>
<td>Principles of Electronic Communication Lab</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>ECPC205</td>
<td>Electronic Devices and Circuits</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>ECPC207</td>
<td>Electronic Devices and Circuits Lab</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>ECPC209</td>
<td>Digital Techniques</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td>ECPC211</td>
<td>Digital Techniques Lab</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7.</td>
<td>ECPC213</td>
<td>Electronic Measurements and Instrumentation</td>
<td>3</td>
<td>0</td>
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<tr>
<td>8.</td>
<td>ECPC215</td>
<td>Electronic Measurements and Instrumentation Lab</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9.</td>
<td>ECPC217</td>
<td>Electric circuits and network</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>10.</td>
<td>ECPC202</td>
<td>Microcontroller and Applications</td>
<td>3</td>
<td>0</td>
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<tr>
<td>11.</td>
<td>ECPC204</td>
<td>Microcontroller and Applications Lab</td>
<td>0</td>
<td>0</td>
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<tr>
<td>12.</td>
<td>ECPC206</td>
<td>Consumer Electronics</td>
<td>3</td>
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<tr>
<td>13.</td>
<td>ECPC208</td>
<td>Digital Communication Systems</td>
<td>3</td>
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<tr>
<td>14.</td>
<td>ECPC210</td>
<td>Digital Communication Systems Lab</td>
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<tr>
<td>15.</td>
<td>ECPC301</td>
<td>Embedded Systems</td>
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<tr>
<td>16.</td>
<td>ECPC303</td>
<td>Embedded Systems Lab</td>
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<tr>
<td>17.</td>
<td>ECPC305</td>
<td>Mobile and Wireless Communication</td>
<td>3</td>
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<tr>
<td>18.</td>
<td>ECPC307</td>
<td>Mobile and Wireless Communication Lab</td>
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<td>0</td>
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<tr>
<td>19.</td>
<td>ECPC302</td>
<td>Computer Networking and Data Communication</td>
<td>3</td>
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<tr>
<td>20.</td>
<td>ECPC304</td>
<td>Computer Networking and Data Communication Lab</td>
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**Total Credits** 41
### 9.2 List of Program Elective Courses [PE]

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Code No.</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Total hrs/week</th>
<th>Credits</th>
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<tbody>
<tr>
<td>1.</td>
<td>ECPE201</td>
<td>Electronic Equipment Maintenance Or Simulation Software</td>
<td>0 0 4</td>
<td>4</td>
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<tr>
<td>2.</td>
<td>ECPE202</td>
<td>Linear Integrated Circuits</td>
<td>3 1 0</td>
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<td>3.</td>
<td>ECPE203</td>
<td>Linear Integrated Circuits</td>
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<td>4.</td>
<td>ECPE301</td>
<td>Industrial Automation or Control System and PLC</td>
<td>3 0 0</td>
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<tr>
<td>5.</td>
<td>ECPE302</td>
<td>Industrial Automation Lab or Control System and PLC Lab</td>
<td>0 0 2</td>
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<tr>
<td>6.</td>
<td>ECPE303</td>
<td>Microwave and RADAR or Optical Communication and networking</td>
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<tr>
<td>7.</td>
<td>ECPE304</td>
<td>Microwave and RADAR Lab or Optical Communication and networking Lab</td>
<td>0 0 2</td>
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**Total Credits: 15**
### 9.3 Semester-wise Detailed Curriculum

#### Semester III

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<th>Sl. No</th>
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<th>Course Title</th>
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<th>Total contact hrs/week</th>
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<tbody>
<tr>
<td>1.</td>
<td>Program core course</td>
<td>ECPC201</td>
<td>Principles of Electronic Communication</td>
<td>3 0 0</td>
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<td>2.</td>
<td>Program core course</td>
<td>ECPC203</td>
<td>Principles of Electronic Communication Lab</td>
<td>0 0 2</td>
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<td>3.</td>
<td>Program core course</td>
<td>ECPC205</td>
<td>Electronic Devices and Circuits</td>
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<td>4.</td>
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<td>Electronic Devices and Circuits</td>
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<td>5.</td>
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<td>Digital Electronics</td>
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<td>Digital Electronics Lab</td>
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<td>7.</td>
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<td>ECPC213</td>
<td>Electronic Measurements and Instrumentation</td>
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<td>8.</td>
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<td>Electronic Measurements and Instrumentation Lab</td>
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<td>9.</td>
<td>Program core course</td>
<td>ECPC217</td>
<td>Electric circuits and network</td>
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<td>10.</td>
<td>Summer Internship-I (4 weeks) after II Semester</td>
<td>SI201</td>
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**Total Credits** 20

******
## Semester IV

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<th>Sl. No</th>
<th>Category</th>
<th>Code No.</th>
<th>Course Title</th>
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<td>1.</td>
<td>Program core course</td>
<td>ECPC202</td>
<td>Microcontroller and Applications</td>
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<td>2.</td>
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<td>ECPC204</td>
<td>Microcontroller and Applications Lab</td>
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<td>3.</td>
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<td>ECPC206</td>
<td>Consumer Electronics</td>
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<td>4.</td>
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<td>Digital Communication Systems</td>
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<td>5.</td>
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<td>Digital Communication Systems Lab</td>
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<td>Electronic Equipment Maintenance</td>
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<td>ECPE204</td>
<td>Linear Integrated Circuits</td>
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<td>9.</td>
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<td>10.</td>
<td>Mandatory Course</td>
<td>AU202</td>
<td>Essence of Indian Knowledge and Tradition</td>
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</table>

*****
## Semester V

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Category</th>
<th>Code No.</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Total contact hrs/Week</th>
<th>Credits</th>
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<tbody>
<tr>
<td>1.</td>
<td>Program core course</td>
<td>ECPC301</td>
<td>Embedded Systems</td>
<td>L:3 T:0 P:0</td>
<td>3</td>
<td>3</td>
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<tr>
<td>2.</td>
<td>Program core course</td>
<td>ECPC303</td>
<td>Embedded Systems Lab</td>
<td>L:0 T:0 P:2</td>
<td>2</td>
<td>1</td>
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<tr>
<td>3.</td>
<td>Program core course</td>
<td>ECPC305</td>
<td>Mobile and Wireless Communication</td>
<td>L:3 T:0 P:0</td>
<td>3</td>
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<td>4.</td>
<td>Program core course</td>
<td>ECPC307</td>
<td>Mobile and Wireless Communication Lab</td>
<td>L:0 T:0 P:2</td>
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<td>5.</td>
<td>Program Elective course</td>
<td>ECPE301</td>
<td>Industrial Automation or Control System and PLC</td>
<td>L:3 T:0 P:0</td>
<td>3</td>
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<td>6.</td>
<td>Program Elective course</td>
<td>ECPE303</td>
<td>Industrial Automation Lab or Control System and PLC Lab</td>
<td>L:0 T:0 P:2</td>
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<td>7.</td>
<td>Program Elective course</td>
<td>ECPE305</td>
<td>Microwave and RADAR or Optical Communication and networking</td>
<td>L:3 T:0 P:0</td>
<td>3</td>
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<td>8.</td>
<td>Program Elective course</td>
<td>ECPE307</td>
<td>Microwave and RADAR Lab or Optical Communication and networking Lab</td>
<td>L:0 T:0 P:2</td>
<td>2</td>
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<td>9.</td>
<td>Open Elective</td>
<td>ECOE301</td>
<td>Renewable Energy Technologies or Internet of Things</td>
<td>L:3 T:0 P:0</td>
<td>3</td>
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<tr>
<td>10.</td>
<td>Summer Internship-II(6 weeks) after IV Semester</td>
<td>SI301</td>
<td></td>
<td>L:0 T:0 P:0</td>
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<td>11.</td>
<td>Major Project</td>
<td>PR302</td>
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<td>L:0 T:0 P:2</td>
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**Total Credits**

|   |   |   |   |   | 22 |
### Semester VI

<table>
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<tr>
<th>Sl. No</th>
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<th>Hours per week</th>
<th>Total contact hrs/week</th>
<th>Credits</th>
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<td>1</td>
<td>Program core course</td>
<td>ECPC302</td>
<td>Computer Networking and Data Communication</td>
<td>3 0 0</td>
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<td>2</td>
<td>Program core course</td>
<td>ECPC304</td>
<td>Computer Networking and Data Communication Lab</td>
<td>0 0 2</td>
<td>2</td>
<td>1</td>
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<tr>
<td>3</td>
<td>Humanities and Social Science course</td>
<td>HS302</td>
<td>Entrepreneurship and Start-ups</td>
<td>3 1 0</td>
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<td>4</td>
<td>Open Elective</td>
<td>ECOE302</td>
<td>Robotics or Mechatronics</td>
<td>3 0 0</td>
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<td>5</td>
<td>Open Elective</td>
<td>ECOE303</td>
<td>Artificial Intelligence or Product Design</td>
<td>3 0 0</td>
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<td>6</td>
<td>Mandatory Course</td>
<td>AU302</td>
<td>Indian Constitution</td>
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<td>7</td>
<td>Major Project</td>
<td>PR302</td>
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</table>

Total Credits: **19**

^one credit is carried forward from the V\textsuperscript{th} semester major project evaluation.

****
Course Content:

ANALOG MODULATION: Concept of frequency translation. Amplitude Modulation: Description of full AM, DSBSC, SSB and VSB in time and frequency domains, methods of generation & demodulation, descriptions of FM signal in time and frequency domains.

PULSE ANALOG MODULATION: Ideal sampling, Sampling theorem, aliasing, interpolation, natural and flat top sampling in time and frequency domains.

PCM & DELTA MODULATION SYSTEMS: Uniform and Non-uniform quantization. PCM and delta modulation, Signal to quantization noise ratio in PCM and delta modulation.


SPREAD-SPECTRUM MODULATION: Introduction, Pseudo-Noise sequences, direct sequence spread spectrum (DSSS) with coherent BPSK, processing gain, probability of error, frequency-hop spread spectrum (FHSS). Application of spread spectrum: CDMA.

Books:
1. Principles of communication systems By Taub Schilling, T.M.H.
2. Fundamentals of communication systems By Proakis & Salehi, Pearson education
5. Modern Digital & Analog Communication By B.P. Lathi, Oxford Publications

Course Outcomes:
1. Use of different modulation and demodulation techniques used in analog communication.
2. Identify and solve basic communication problems.
3. Analyse transmitter and receiver circuits.
4. Compare and contrast design issues, advantages, disadvantages and limitations of analog communication systems.

Course Content:
1. Harmonic analysis of a square wave of modulated waveform: measures modulation index.
2. To modulate a high frequency carrier with sinusoidal signal to obtain FM signal.
3. To study and observe the operation of a super heterodyne receiver
4. To modulate a pulse carrier with sinusoidal signal to obtain PWM signal and demodulate it.
5. To modulate a pulse carrier with sinusoidal signal to obtain PPM signal and demodulate it.
6. To observe pulse amplitude modulated waveform and its demodulation.
7. To observe the operation of a PCM encoder and decoder. To consider reason for using digital signal x-missions of analog signals.
8. To study & observe the amplitude response of automatic gain controller (AGC).

**Practical Outcomes (PrOs)**
1. Understanding the different techniques of signal modulation and demodulation.
2. Understanding the variation in amplitude of controllers.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>ECPC 205</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Electronics Devices and Circuits</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3 (L:3, T:0, P:0)</td>
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<tr>
<td>Prerequisites</td>
<td>NIL</td>
</tr>
<tr>
<td>Course Category</td>
<td>PC</td>
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</tbody>
</table>

**Course Content:**

**Unit 1 – Semiconductor and Diodes**
- Definition, Extrinsic/Intrinsic, N-type & p-type
- PN Junction Diode – Forward and Reverse Bias Characteristics
- Zener Diode – Principle, characteristics, construction, working
- Diode Rectifiers – Half Wave and Full Wave
- Filters – C, LC and PI Filters

**Unit 2 – Bipolar Junction Transistor (BJT)**
- NPN and PNP Transistor – Operation and characteristics
- Common Base Configuration – characteristics and working
- Common Emitter Configuration – characteristics and working
- High frequency model of BJT
- Classification of amplifiers, negative feedback

**Unit 3 – Field Effect Transistors**
- FET – Working Principle, Classification
- MOSFET Small Signal model
- N-Channel/ P-Channel MOSFETs – characteristics, enhancement and depletion mode, MOS-FET as a Switch
- Common Source Amplifiers
- Uni-Junction Transistor – equivalent circuit and operation
Unit 4 – SCR DIAC & TRIAC

- SCR – Construction, operation, working, characteristics
- DIAC - Construction, operation, working, characteristics
- TRIAC - Construction, operation, working, characteristics
- SCR and MOSFET as a Switch, DIAC as bidirectional switch
- Comparison of SCR, DIAC, TRIAC, MOSFET

Unit 5 – Amplifiers and Oscillators

- Feedback Amplifiers – Properties of negative Feedback, impact of feedback on different parameters
- Basic Feedback Amplifier Topologies: Voltage Series, Voltage Shunt Current Series, Current Shunt
- Oscillator – Basic Principles, Crystal Oscillator, Non-linear/ Pulse Oscillator

SUGGESTED LEARNING RESOURCES:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Title of Book</th>
<th>Author</th>
<th>Publication</th>
</tr>
</thead>
</table>

SUGGESTED SOFTWARE/LEARNING WEBSITES:

- [b. https://www.youtube.com/watch?v=Rx43l-QpeWQ](https://www.youtube.com/watch?v=Rx43l-QpeWQ)

******

<table>
<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>Electronic Devices and Circuits Lab</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>1 (L: 0, T: 0, P: 2)</td>
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<tr>
<td>Prerequisites</td>
<td>NIL</td>
</tr>
<tr>
<td>Course Category</td>
<td>PC</td>
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</table>

Course Content:

SUGGESTED PRACTICALS/ EXERCISES

The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Practical Outcomes (PrOs)</th>
<th>Unit No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Construct the circuit and plot the VI characteristics of the PN Junction Diode, find the cut in voltage</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>Construct the circuit and plot the characteristics of a Zener Diode. Find the breakdown voltage</td>
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<tr>
<td>3.</td>
<td>Construct a Half Wave Rectifier and obtain regulation characteristics – Without Filters and with Filters Compare the results</td>
<td>1</td>
</tr>
<tr>
<td>4.</td>
<td>Construct a Full Wave Rectifier and obtain regulation characteristics – Without Filters and with Filters Compare the results</td>
<td>1</td>
</tr>
<tr>
<td>5.</td>
<td>Construct a Bridge Rectifier and obtain regulation characteristics – Without Filters and with Filters</td>
<td>1</td>
</tr>
<tr>
<td>6.</td>
<td>Obtain the characteristics of DIAC and TRIAC</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>Simulate half wave, full wave and bridge rectifier using simulation tool like PSpice/ Orcad/ Multisim.</td>
<td>3</td>
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<tr>
<td>8.</td>
<td>Develop a simulation model for Voltage Series and Voltage Shunt Feedback Amplifiers</td>
<td>5</td>
</tr>
<tr>
<td>9.</td>
<td>Develop circuits for Voltage Series and Voltage Shunt Feedback Amplifiers and obtain output plots. Compare the results with the simulation model.</td>
<td>5</td>
</tr>
<tr>
<td>10.</td>
<td>Develop a simulation model for Current Series and Current Shunt Feedback Amplifiers</td>
<td>5</td>
</tr>
<tr>
<td>11.</td>
<td>Develop circuits for Current Series and Current Shunt Feedback Amplifiers and obtain output plots. Compare the results with the simulation model.</td>
<td></td>
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<tr>
<td>12.</td>
<td>Total</td>
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Reference Books:

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<tr>
<th>S. No.</th>
<th>Title of Book</th>
<th>Author</th>
<th>Publication</th>
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*******
**Course Code**: ECPC209

**Course Title**: Digital Electronics

**Number of Credits**: 2 (L: 2, T: 0, P: 0)

**Prerequisites**: NIL

**Course Category**: PC

**Course Content**:

**Unit 1** – Number Systems & Boolean Algebra
- Introduction to different number systems – Binary, Octal, Decimal, Hexadecimal
- Conversion from one number system to another.
- Boolean variables – Rules and laws of Boolean Algebra
- De-Morgan's Theorem
- Karnaugh Maps and their use for simplification of Boolean expressions

**Unit 2** – Logic Gates
- Logic Gates – AND, OR, NOT, NAND, NOR, XOR, XNOR: Symbolic representation and truth table
- Implementation of Boolean expressions and Logic Functions using gates
- Simplification of expressions

**Unit 3** – Combinational Logic Circuits
- Arithmetic Circuits – Addition, Subtraction, 1’s 2’s Complement, Half Adder, Full Adder, Half Subtractor, Full Subtractor, Parallel and Series Adders
- Encoder, Decoder
- Multiplexer – 2 to 1 MUX, 4 to 1 MUX, 8 to 1 MUX. Applications
- Demultiplexer – 1 to 2 DEMUX, 1- 4 DEMUX, 1- 8 DEMUX

**Unit 4** – Sequential Logic Circuits
- Flip Flops – SR,JK, T, D, FF, JK-MS, Triggering
- Counters – 4 bit Up – Down Counters, Asynchronous/ Ripple Counter, Decade Counter- Mod 3, Mod 7 Counter, Johnson Counter, Ring Counter
- Registers – 4bit Shift Register: Serial In Serial Out, Serial in Parallel Out, Parallel In Serial Out, Parallel In Parallel Out

**Unit 5** – Memory Devices
- Classification of Memories – RAM Organization, Address Lines and Memory Sixe,
  - Static RAM, Bipolar RAM, cell Dynamic RAM, D RAM, DDR RAM
- Read Only memory – ROM organization, Expanding memory, PROM, EPROM, EEPROM, Flash memory
- Data Converters – Digital to Analog converters, Analog to Digital Converters
SUGGESTED LEARNING RESOURCES:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Title of Book</th>
<th>Author</th>
<th>Publication</th>
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</table>

Course Code : ESPC211
Course Title : Digital Electronics Lab
Number of Credits : 1 (L: 0, T: 0, P: 2)
Prerequisites : NIL
Course Category : PC

Course Content:

SUGGESTED PRACTICALS/EXERCISES

The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Practical Outcomes (PrOs)</th>
<th>Unit No.</th>
<th>Approx. Hrs. Required</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>To verify the truth tables for all logic gates – NOT OR AND NAND NOR XOR XNOR using CMOS Logic gates and TTL Logic Gates</td>
<td>1</td>
<td>02</td>
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<tr>
<td>2.</td>
<td>Implement and realize Boolean Expressions with Logic Gates</td>
<td>2</td>
<td>02</td>
</tr>
<tr>
<td>3.</td>
<td>Implement Half Adder, Full Adder, Half Subtractor, Full subtractor using ICs</td>
<td>3</td>
<td>02</td>
</tr>
<tr>
<td>4.</td>
<td>Implement parallel and serial full-adder using ICs</td>
<td>3</td>
<td>02</td>
</tr>
<tr>
<td>5.</td>
<td>Design and development of Multiplexer and De-multiplexer using multiplexer ICs</td>
<td>3</td>
<td>02</td>
</tr>
<tr>
<td>6.</td>
<td>Verification of the function of SR,D, JK and T Flip Flops</td>
<td>4</td>
<td>02</td>
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<tr>
<td>7.</td>
<td>Design controlled shift registers</td>
<td>4</td>
<td>02</td>
</tr>
<tr>
<td>8.</td>
<td>Construct a Single digit Decade Counter (0-9) with 7 segment display</td>
<td>4</td>
<td>03</td>
</tr>
<tr>
<td>9.</td>
<td>To design a programmable Up-Down Counter with a 7 segment display.</td>
<td>4</td>
<td>03</td>
</tr>
<tr>
<td>10.</td>
<td>Study of different memory ICs</td>
<td>5</td>
<td>02</td>
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<tr>
<td>S. No.</td>
<td>Practical Outcomes (PrOs)</td>
<td>Unit No.</td>
<td>Approx. Hrs. Required</td>
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<tr>
<td>11.</td>
<td>Study Digital- to – Analog and Analog to Digital Converters</td>
<td>5</td>
<td>02</td>
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<tr>
<td>12.</td>
<td>Simulate in Software (such as PSpice) an Analog to Digital Converter</td>
<td>5</td>
<td>03</td>
</tr>
<tr>
<td>13.</td>
<td>Simulate in Software (such as PSpice) an Analog to Digital Converter</td>
<td>5</td>
<td>03</td>
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<th>Title of Book</th>
<th>Author</th>
<th>Publication</th>
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</table>
Course Code : ECPC213
Course Title : Electronic Measurement and Instrumentation
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : PC

Course Content:

Unit – I Basics of Measurements and Bridges
   Accuracy & precision, Resolution
   Types of Errors
   DC Bridges – Wheatstone and Kelvin Double Bridge
   AC Bridges - Maxwell’s Bridge, Hay’s Bridge, Anderson Bridge, De-Sauty’s Bridge

Unit - II Potentiometer
   Basic DC slide wire Potentiometer
   Crompton’s DC Potentiometer
   Applications of DC Potentiometer
   AC Potentiometers
   Applications of AC Potentiometers

Unit – III Measuring Instruments
   Permanent Magnet Moving Coil Instruments (PMMC)
   Moving Iron type Instruments (MI)
   Electro Dynamo Type Instruments
   Single Phase Energy Meter

Unit – IV Electronic Instruments
   Electronic Voltmeter and Digital Voltmeter
   Electronic Multimeters
   Q – Meter
   Vector Impedance Meter

Unit – V Oscilloscopes
   Cathode ray tube: construction, operation, screens, graticules
   Vertical deflection system, Horizontal deflection system, Delay line,
   Measurement of frequency, time delay, phase angle and modulation index (trapezoidal method)
   Oscilloscope probe: Structure of 1:1 and 10:1 probe
   Multiple Trace CRO

Unit – VI Transducers
   Classification, Selection Criteria, Characteristics, Construction, Working Principles and Application of following Transducers:
   RTD, Thermocouple, Thermistor
   LVDT, Strain Gauge
   Load Cell
   Piezoelectric Transducers
### SUGGESTED LEARNING RESOURCES:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Title of Book</th>
<th>Author</th>
<th>Publication</th>
</tr>
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<tbody>
<tr>
<td>2.</td>
<td>Electronic Instrument and Measurement Technique</td>
<td>W.D. Cooper</td>
<td>Prentice Hall International, India</td>
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<tr>
<td>4.</td>
<td>Measurement systems application and design</td>
<td>E.O. Doebelin and D. N. Manik</td>
<td>The Mcgraw-Hill</td>
</tr>
<tr>
<td>5.</td>
<td>Electronic Measurements and Instrumentation</td>
<td>Oliver and Cage</td>
<td>The Mcgraw-Hill</td>
</tr>
<tr>
<td>6.</td>
<td>Basic Electrical Measurement</td>
<td>M.B. Stout</td>
<td>Prentice hall of India, India</td>
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<tr>
<td>7.</td>
<td>Electronic Instrumentation</td>
<td>H. S. Kalsi</td>
<td>The Mcgraw-Hill</td>
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<table>
<thead>
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<th>Practical Outcomes (PrOs)</th>
<th>Unit No.</th>
<th>Approx Hrs. Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Measure unknown inductance using following bridges (a) Anderson Bridge (b) Maxwell Bridge</td>
<td>I</td>
<td>4</td>
</tr>
<tr>
<td>2.</td>
<td>Measure Low resistance by Kelvin's Double Bridge</td>
<td>I</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>Calibrate an ammeter using DC slide wire potentiometer</td>
<td>II</td>
<td>2</td>
</tr>
<tr>
<td>4.</td>
<td>Calibrate a voltmeter using Crompton potentiometer</td>
<td>II</td>
<td>2</td>
</tr>
<tr>
<td>5.</td>
<td>Measure low resistance by Crompton potentiometer</td>
<td>II</td>
<td>2</td>
</tr>
<tr>
<td>6.</td>
<td>Calibrate a single-phase energy meter by phantom loading</td>
<td>III</td>
<td>2</td>
</tr>
<tr>
<td>7.</td>
<td>Study the working of Q-meter and measure Q of coils</td>
<td>IV</td>
<td>2</td>
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</tbody>
</table>

Course Code : ECPC215
Course Title : Electronic Measurements and Instrumentation Lab
Number of Credits : 1 (L: 0, T:0 P: 2)
Prerequisites : NIL
Course Category : PC

Course Content:

**SUGGESTED PRACTICALS/ EXERCISES**

The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.
8. Study working and applications of (i) C.R.O. (ii) Digital Storage C.R.O. & (ii) C.R.O. Probes  

9. Measurement of displacement with the help of LVDT  

10. Draw the characteristics of the following temperature transducers (a) RTD (Pt-100) (b) Thermistor  

11. Measurement of strain/force with the help of strain gauge load cell  

<table>
<thead>
<tr>
<th>Reference Books:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>S. No.</strong></td>
</tr>
<tr>
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<td>5.</td>
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<tr>
<td>6.</td>
</tr>
<tr>
<td>7.</td>
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</table>

****

Course Code : ECPC217  
Course Title : Electric Circuits & Network  
Number of Credits : 3 (L: 2, T: 1 P: 0)  
Prerequisites : NIL  
Course Category : PC  

Course Content:  
**Unit – 1 Basics of Network and Network Theorem**  
Node and Mesh Analysis  
Superposition Theorem  
Thevenin Theorem  
Norton Theorem  
Maximum Power transfer theorem  
Reciprocity Theorem  

**Unit– 2 Graph Theory**  
Graph of network, tree, incidence matrix
Electronics and Communication Engineering Curriculum Structure

F- Tie Set Analysis
F-Cut Set Analysis
Analysis of resistive network using cut-set and tie-set
Duality

Unit- 3 Time Domain and Frequency Domain Analysis
Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits
Initial and Final conditions in network elements
Forced and Free response, time constants
Steady State and Transient State Response
Analysis of electrical circuits using Laplace Transform for standard inputs (unit, Ramp, Step)

Unit- 4 Trigonometric and exponential Fourier series
Discrete spectra and symmetry of waveform
Steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values
Fourier transform and continuous spectra

Unit- 5 Two Port Network
Two Port Network
Open Circuit Impedance Parameters
Short Circuit Admittance Parameters
Transmission Parameters
Hybrid Parameters
Interrelationship of Two Port Network
Inter Connection of Two Port Network

SUGGESTED LEARNING RESOURCES:
SUGGESTED SOFTWARE/LEARNING WEBSITES

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Title of Book</th>
<th>Author</th>
<th>Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Networks and Systems</td>
<td>Ashfaq Husain</td>
<td>Khanna Publishing House</td>
</tr>
<tr>
<td>2</td>
<td>Network Analysis</td>
<td>M. E. Van Valkenburg</td>
<td>Prentice Hall of India</td>
</tr>
<tr>
<td>4</td>
<td>Electrical Circuits</td>
<td>Joseph Edminister</td>
<td>Schaum's Outline, Tata McGraw Hill</td>
</tr>
<tr>
<td>5</td>
<td>Basic Circuit Theory</td>
<td>Lawrence P. Huelsma</td>
<td>Prentice Hall of India</td>
</tr>
<tr>
<td>6</td>
<td>Network &amp; Systems</td>
<td>D. Roy Choudhury</td>
<td>Wiley Eastern Ltd</td>
</tr>
<tr>
<td>7</td>
<td>Linear Circuit Analysis</td>
<td>De Carlo and Lin</td>
<td>Oxford Press</td>
</tr>
</tbody>
</table>

******
SEMESTER IV

Course Code : ECPC202
Course Title : Microcontroller and Applications
Number of Credits : 3 (L: 3, T: 0 P: 0)
Prerequisites : NIL
Course Category : PC

Course Content:

Unit I Introduction
Introduction to Microprocessors and Microcontrollers, Architectures [8085,8086] Intel MCS-51 family features – 8051 -organization and architecture

Unit II Programming with 8051
10 8051 instruction set, addressing modes, conditional instructions, I/O Programming, Arithmetic logic instructions, single bit instructions, interrupt handling, programming counters, timers and Stack

Unit III
MCS51 and external Interfaces 8 User interface – keyboard, LCD, LED, Real world interface - ADC, DAC, SENSORS Communication interface.

Unit IV C programming with 8051
8 I/O Programming, Timers/counters, Serial Communication, Interrupt, User Interfaces-LCD, Keypad, LED and communication interfaces [RS232].

Unit V ARM processor core based microcontrollers 14 Need for RISC Processor-ARM processor fundamentals, ARM core based controller [LPC214X], IO ports, ADC/DAC, Timers.

References:

<table>
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<tr>
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<th>Publication</th>
</tr>
</thead>
</table>

******
Course Code : ECPC204
Course Title : Microcontroller and Applications Lab
Number of Credits : 1 (L: 0, T:0 P: 2)
Prerequisites : NIL
Course Category : PC

Course Content:
2. Programming with Arithmetic logic instructions [Assembly]
3. Program using constructs (Sorting an array) [Assembly]
4. Programming using Ports [Assembly and C]
5. Delay generation using Timer [Assembly and C]
6. Programming Interrupts [Assembly and C]
7. Implementation of standard UART communication (using hyper terminal) [Assembly and C].
8. Interfacing LCD Display. [Assembly and C]
9. Interfacing with Keypad [Assembly and C]
10. Programming ADC/DAC [Assembly and C]
11. Interfacing with stepper motor. [Assembly and C]
13. GPIO programming in ARM microcontroller. [ C Programming].
14. Timers programing in ARM Microcontroller. [C Programming].

References:

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>5.</td>
<td>ARM Developer’s Guide. UM10139 LPC214X User manual – Rev.4</td>
<td>Andrew N.Sloss, Dominic Symes, Chris Wright</td>
<td>User manual – Rev.4</td>
</tr>
</tbody>
</table>

******


**Course Code:** ECPC206  
**Course Title:** Consumer Electronics  
**Number of Credits:** 3 (L: 3, T:0 P: 0)  
**Prerequisites:** NIL  
**Course Category:** PC

**Course Content:**

**UNIT-I Audio Fundamentals and Devices**
Basic characteristics of sound signal, Audio level metering, decibel level in acoustic measurement, Microphone & Types, speaker types & working principle, Sound recording principle & types

**UNIT-II Audio Systems**
CD player, home theatre sound system, surround sound, Digital console block diagram, working principle, applications, FM tuner, ICs used in FM tuner TDA 7021T, PA address system.

**UNIT-III Television Systems**
Monochrome TV standards, scanning process, aspect ratio, persistence of vision and flicker, interlace scanning, picture resolution, Composite video signal, Colour TV standards, colour theory, hue, brightness, saturation, luminance and chrominance, Different types of TV camera, Transmission standards

**UNIT-IV Television Receivers and Video Systems**
PAL-D colour TV receiver, Digital TVs:- LCD, LED, PLASMA, HDTV, 3-D TV, projection TV, DTH receiver, Video interface, Digital Video, SDI, HDMI Multimedia Interface, Digital Video Interface, CD and DVD player

**UNIT-V Home / Office Appliances**
Diagrams, operating principles and controller for FAX and Photocopier, Microwave Oven, Washing Machine, Air conditioner and Refrigerators, Digital camera and cam coder.

**References:**

<table>
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<th>Publication</th>
</tr>
</thead>
</table>

******
Course Code : ECPC208
Course Title : Digital Communication Systems
Number of Credits : 3 (L: 3, T:0, P: 0)
Prerequisites : NIL
Course Category : PC

Course Content:
UNIT 1
Block diagram and sub-system description of a digital communication system. Sampling of low-pass and band-pass signals, PAM, PCM, signal to quantization noise ratio analysis of linear and nonlinear quantizers, Line codes and bandwidth considerations; PCM TDM hierarchies, frame structures, frame synchronization and bit stuffing.

UNIT 2
Quantization noise analysis of DM and ADM; DPCM and ADPCM; Low bit rate coding of speech and video signals. Baseband transmission, matched filter, performance in additive Gaussian noise; Intersymbol interference (ISI), Nyquist criterion for zero ISI, sinusoidal roll-off filtering, correlative coding, equalizers and adaptive equalizers; Digital subscriber lines.

UNIT 3
Geometric representation of signals, maximum likelihood decoding; Correlation receiver, equivalence with matched filter:Generation, detection and probability of error analysis of OOK, BPSK, coherent and non-coherent FSK, QPSK and DPSK; QAM, MSK and multicarrier modulation; Comparison of bandwidth and bit rate of digital modulation schemes.

UNIT 4
Introduction to Information and Coding Theories: Information Theory: information measures, Shannon entropy, differential entropy; mutual information, capacity theorem for point-to-point channels with discrete and continuous alphabets. Coding Theory: linear block codes – definitions, properties, bounds on minimum distance (singleton, Hamming, GV, MRRW), soft versus hard decision decoding, some specific codes (Hamming, RS, Concatenated); Convolutional codes – structure, decoding (the Viterbi and BCJR algorithms); Turbo codes, LDPC codes.

References:

<table>
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<th>Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.</td>
<td>Elements of Information Theory</td>
<td>T. Cover and J. Thomas</td>
<td>2/e, Wiley.</td>
</tr>
<tr>
<td>7.</td>
<td>A Foundation in Digital Communication</td>
<td>A. Lapidoth</td>
<td>Cambridge Univ. Press</td>
</tr>
<tr>
<td>8.</td>
<td>Error Control Coding</td>
<td>S. Lin and D. Costello</td>
<td>2/e, Prentice Hall.</td>
</tr>
</tbody>
</table>
### Course Content:

5. Implementation of Amplitude Shift Keying
6. Implementation of Frequency Shift Keying
8. Time Division Multiplexing: PLL (CD 4046) based synch, clock and data extraction

### References:

<table>
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<td>S. Lin and D. Costello</td>
<td>2/e, Prentice Hall.</td>
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</tbody>
</table>

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### Course Content:

**Unit 1:** Fundamental Troubleshooting Procedures Inside An Electronic Equipment: Reading Drawings And Diagrams – Block Diagram, Circuit Diagram, Wiring Diagram; Dis-assembly and re-assembly of equipment, Equipment Failures and causes such as poor design, production deficiencies, careless storage and transport, inappropriate operating conditions, Nature of faults, Fault location procedure, Fault finding aids – Service and maintenance manuals and instruction manuals, Test and Measuring instruments, special tools Troubleshooting techniques, Approaching components for tests, Ground-
ing systems in Electronic Equipment, Temperature sensitive Intermittent problems Corrective
actions, Situations where repairs should not be attempted.

**Unit 2** : Passive Components and Their Testing Passive Components - Resistors, Capacitors, Induc-
tors Failures in fixed resistors, testing of resistors, variable resistors, variable resistors as potenti-
ometers, failures in potentiometers, testing of potentiometers, servicing potentiometers, LDRs and
Thermistors Types of capacitors and their performance, Failures in capacitors, testing of capacitors
and precautions therein, variable capacitor types, Testing of inductors and inductance measurement

**Unit 3** : Testing of Semiconductor Devices Types of semiconductor devices, Causes of failure in
Semiconductor Devices, Types of failure Test procedures for Diodes, special types of Diodes, Bipolar
Junction Transistors, Field Effect Transistors, Thyristors Operational Amplifiers, Fault diagnosis in
op-amp circuits

**Unit 4** : Logic IC families, Packages in Digital ICs, IC identification, IC pin-outs, Handling ICs, Digital
troubleshooting methods - typical faults, testing digital ICs with pulse generators Logic clip, Logic
Probe, Logic Pulser, Logic Current Tracer, Logic Comparator Special consideration for fault diagnosis
in digital circuits Handling precautions for ICs sensitive to static electricity Testing flip-flops, count-
ers, registers, multiplexers and de-multiplexers, encoders and decoders; Tri-state logic.

**Unit 5** : Rework and Repair of Surface Mount Assemblies Surface Mount Technology and surface
mount devices Surface Mount Semiconductor packages – SOIC, SOT, LCCC, LGA, BGA, COB, Flatpacks
and Quad Packs, Cylindrical Diode Packages, Packaging of Passive Components as SMDs Repairing
Surface Mount PCBs, Rework Stations.

**References:**

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<th>Author</th>
<th>Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Modern Electronic Equipment: Troubleshooting, Repair and Maintenance</td>
<td>Khandpur</td>
<td>TMH 2006</td>
</tr>
<tr>
<td>3</td>
<td>Student Reference Manual for Electronic Instrumentation Laboratories</td>
<td>David L Terrell</td>
<td>Butterworth-Heinemann</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Course Code</th>
<th>:</th>
<th>ECPE204</th>
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<tr>
<td>Course Title</td>
<td>:</td>
<td>Linear Integrated Circuits</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>:</td>
<td>4 (L: 3, T: 1, P: 0)</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>:</td>
<td>NIL</td>
</tr>
<tr>
<td>Course Category</td>
<td>:</td>
<td>PE</td>
</tr>
</tbody>
</table>

**Course Contents:**

**UNIT I** - IC Fabrication and Circuit Configuration for Linear IC
Advantages of ICs over discrete components – Manufacturing process of monolithic lcs Construction
of monolithic bipolar transistor – Monolithic diodes – Integrated Resistors Monolithic Capacitors
– Inductors. Current mirror and current sources, Current sources as active loads, Voltage sources,
Voltage References, BJT Differential amplifier with active loads, General operational amplifier stages
-and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and
closed loop configurations.

**UNIT II** Applications Of Operational Amplifiers
Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder,
subtractor; Instrumentation amplifier, Integrator, Differentiator; Logarithmic amplifier, Antilogarith-
mic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper,
Low-pass, high-pass and band-pass Butterworth filters.
UNIT III Analog Multiplier and PLL
Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing.

UNIT IV Analog to digital and digital to analog converters

UNIT V Waveform generators and special function ICs
Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator Monolithic switching regulator, Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters, Audio Power amplifier, Video Amplifier, Isolation Amplifier, Opto-couplers and fibre optic IC.

SUGGESTED TEXT/REFERENCE BOOKS:

<table>
<thead>
<tr>
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<th>Title of Book</th>
<th>Author</th>
<th>Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Linear Integrated Circuits, D/A converter – specifications - weighted resistor type, R-2R Ladder type</td>
<td>D.Roy Choudhry, Shail Jain</td>
<td>New Age International Pvt. Ltd</td>
</tr>
<tr>
<td>6.</td>
<td>Operational Amplifier and Linear Integrated Circuits</td>
<td>K Lal Kishore</td>
<td></td>
</tr>
</tbody>
</table>

******

Course Code : ECPE206
Course Title : Electronic Devices and Circuits Practical
Number of Credits : 1 (L: 0, T: 0, P: 2)
Prerequisites : NIL
Course Category : PE

1. Operational Amplifiers (IC741)-Characteristics and Application.
3. Applications of Timer IC555.
4. Design of Active filters.
5. Study and application of PLL IC's
6. Design of binary adder and subtractor.
7. Design of counters.
8. Study of multiplexer and demultiplexer /decoders.
10. Study of DAC and ADC 11. Op-Amp voltage Regulator- IC 723
SEMESTER V

Course Code : ECPC301
Course Title : Embedded Systems
Number of Credits : 3     (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : PC

Course Content:

Unit I - Embedded C basics operators for Arduino
- Familiarizing with the Arduino IDE.
- Sketch designing for Arduino
- Communication interface using serial port
- Basic understanding of the code with boolean operations, pointer access operations, bitwise operations, compounded operations.

Unit II - Embedded C control structure blocks
- Looping mechanism – for, do and while.
- The branching operations based on conditions expression

Unit III - Introduction to Arduino Mega
- Arduino Mega specifications including power ratings, digital and analog peripherals.
- Difference between the C language and Embedded C language
- Arduino Mega Ports, Pins, Digital and Analog Peripherals

Unit IV - Communication with Arduino
- Different communication modules available with their real-life application
- Communication interface

SUGGESTED LEARNING RESOURCES:

<table>
<thead>
<tr>
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<th>Author</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Arduino Projects For Dummies (For Dummies Series)</td>
<td>Kennedy George; Davis Bernard; Prasanna SRM</td>
<td>Wiley (5 July 2013) ISBN : 978-1118551479</td>
</tr>
</tbody>
</table>

SUGGESTED SOFTWARE/LEARNING WEBSITES:

e. https://learn.adafruit.com/category/learn-arduino

*****
**Course Code**: ECPC303  
**Course Title**: Embedded Systems Lab  
**Number of Credits**: 1  
**Prerequisites**: NIL  
**Course Category**: PC

**Course Content:**

**SUGGESTED PRACTICALS/ EXERCISES**

The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Practical Outcomes (PrOs)</th>
<th>Unit No.</th>
<th>Approx. Hrs. Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Built-in LED state control by push button sketch implementation</td>
<td>I</td>
<td>02*</td>
</tr>
<tr>
<td>2.</td>
<td>Built-in LED blinking sketch implementation</td>
<td>I</td>
<td>02</td>
</tr>
<tr>
<td>3.</td>
<td>Built-in LED blinking by toggling states based on binary operation</td>
<td>I</td>
<td>02</td>
</tr>
<tr>
<td>4.</td>
<td>Built-in LED state control by user interface through serial port</td>
<td>I</td>
<td>02*</td>
</tr>
<tr>
<td>5.</td>
<td>User interface for boolean operation and bit wise operation through serial port</td>
<td>I</td>
<td>02*</td>
</tr>
<tr>
<td>6.</td>
<td>User interface for compounded operation through serial port</td>
<td>I</td>
<td>02</td>
</tr>
<tr>
<td>7.</td>
<td>Looping mechanism to check the state of pin and if change print its status on serial port</td>
<td>II</td>
<td>02</td>
</tr>
<tr>
<td>8.</td>
<td>Controlling multiple LEDs with a loop and an array</td>
<td>II</td>
<td>02</td>
</tr>
<tr>
<td>9.</td>
<td>Use a potentiometer to control the blinking of an LED</td>
<td>III</td>
<td>02*</td>
</tr>
<tr>
<td>10.</td>
<td>Uses an analog output (PWM pin) to fade an LED</td>
<td>III</td>
<td>02</td>
</tr>
<tr>
<td>11.</td>
<td>Servo Motor Control using PWM</td>
<td>III</td>
<td>02</td>
</tr>
<tr>
<td>12.</td>
<td>Temperature sensor interfacing and sending its reading over serial port</td>
<td>IV</td>
<td>04</td>
</tr>
<tr>
<td>13.</td>
<td>I2C light sensor interfacing and sending its reading over serial port</td>
<td>IV</td>
<td>04*</td>
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</table>

**Total**

30

**SUGGESTED LEARNING RESOURCES:**

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**SUGGESTED SOFTWARE/LEARNING WEBSITES:**

- [https://learn.adafruit.com/category/learn-arduino](https://learn.adafruit.com/category/learn-arduino)

*****
Course Code : ECPC305
Course Title : Mobile and Wireless Communication
Number of Credits : 3 (L: 3, T: 0 P: 0)
Prerequisites : NIL
Course Category : PC

Course Content:

Unit I - Overview of Cellular Systems
Evolution 2g/3G/4G/5G
Cellular Concepts – Frequency reuse, Cochannel and Adjacent channel Interference

Unit II - Wireless propagation
Link budget, Free-space path loss, Noise figure of receiver
Multipath fading, Shadowing, Fading margin, Shadowing margin

Unit III Antenna diversity, wireless channel capacity and MIMO

Unit IV Overview of CDMA, OFDM and LTE

SUGGESTED LEARNING RESOURCES:

<table>
<thead>
<tr>
<th>S. No.</th>
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<th>Author</th>
<th>Publication</th>
</tr>
</thead>
</table>

********

Course Code : ECPC307
Course Title : Mobile and Wireless Communication Lab
Number of Credits : 1 (L: 0, T: 0, P: 2)
Prerequisites : NIL
Course Category : PC

Course Content:

SUGGESTED PRACTICALS/ EXERCISES
The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Practical Outcomes (PrOs)</th>
<th>Unit No.</th>
<th>Approx. Hrs. Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>To understand the cellular frequency reuse concept to find the co-channel cells for a particular cell.</td>
<td>I</td>
<td>04</td>
</tr>
<tr>
<td>2</td>
<td>To understand the path loss</td>
<td>II</td>
<td>04</td>
</tr>
<tr>
<td>3</td>
<td>Understand the path loss with shadowing</td>
<td>II</td>
<td>04</td>
</tr>
<tr>
<td>S. No.</td>
<td>Practical Outcomes (PrOs)</td>
<td>Unit No.</td>
<td>Approx. Hrs. Required</td>
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<td>-------</td>
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</tr>
<tr>
<td>4.</td>
<td>Understanding the Flat fading</td>
<td>II</td>
<td>04</td>
</tr>
<tr>
<td>5.</td>
<td>Understanding the Frequency selective fading</td>
<td>II</td>
<td>04</td>
</tr>
<tr>
<td>6.</td>
<td>Understanding the Multipath channel for the following objectives</td>
<td>II</td>
<td>04</td>
</tr>
<tr>
<td></td>
<td>1. No Fading</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Flat Fading</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Dispersive Fading</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>To simulate a dipole antenna ($\lambda$, $\lambda/4$, $\lambda/2$, $3\lambda/2$) for a particular frequency using 4NEC2</td>
<td>III</td>
<td>04</td>
</tr>
<tr>
<td>8.</td>
<td>Perform following experiments using CDMA trainer kit</td>
<td>IV</td>
<td>04</td>
</tr>
<tr>
<td></td>
<td>1. PSK modulation and demodulation experiment</td>
<td></td>
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<tr>
<td></td>
<td>2. Bit synchronization extraction experiment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Error correction encoding experiment</td>
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</tbody>
</table>

**Total**: 32

**REFERENCES/SUGGESTED LEARNING RESOURCES:**

<table>
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</table>

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Course Code : ECPE301
Course Title : Industrial Automation
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : PE

Course Content:

**Unit I** - Industrial automation overview and data acquisition
- Measurement Systems Characteristics
- Data Acquisition Systems

**Unit II** - Control Generation
- Introduction to Automatic Control
- P-I-D Control
- Feedforward Control Ratio Control
- The branching operations based on conditions expression

**Unit III** Sequential control and PLC
- Introduction to Sequence Control, PLC, RLL
PLC Hardware Environment

**Unit IV** Industrial control application

- Hydraulic Control Systems
- Pneumatic Control Systems
- Energy Savings with Variable Speed Drives
- Introduction To CNC Machines

**REFERENCES / SUGGESTED LEARNING RESOURCES:**

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<th>Publication</th>
</tr>
</thead>
</table>

**Course Code** : ECPE303

**Course Title** : Industrial Automation lab

**Number of Credits** : 1 (L: 0, T: 0, P: 2)

**Prerequisites** : NIL

**Course Category** : PE

**Course Content:**

**SUGGESTED PRACTICALS/EXERCISES**

The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Practical Outcomes (PrOs)</th>
<th>Unit No.</th>
<th>Approx. Hrs. Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Develop a data acquisition system using arduino</td>
<td>I</td>
<td>04</td>
</tr>
<tr>
<td>2.</td>
<td>Temperature control system using PID</td>
<td>II</td>
<td>04</td>
</tr>
<tr>
<td>3.</td>
<td>Level control system based on error feedback</td>
<td>II</td>
<td>04</td>
</tr>
<tr>
<td>4.</td>
<td>PLC programming using Relay ladder Logic for AND, OR, XOR and NOR gate</td>
<td>III</td>
<td>04</td>
</tr>
<tr>
<td>5.</td>
<td>PLC, RLL programming using CASCADE method</td>
<td>III</td>
<td>04</td>
</tr>
<tr>
<td>6.</td>
<td>PLC timer, counter, registers and analog input/output functions</td>
<td>III</td>
<td>04</td>
</tr>
<tr>
<td>7.</td>
<td>Variable Speed drive of an induction motor</td>
<td>IV</td>
<td>04</td>
</tr>
<tr>
<td>8.</td>
<td>PLC/ microcontroller based computer numerical control machine job completion</td>
<td>IV</td>
<td>04</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>32</strong></td>
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SUGGESTED LEARNING RESOURCES:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Title of Book</th>
<th>Author</th>
<th>Publication</th>
</tr>
</thead>
</table>

Course Code : ECPE305
Course Title : Microwave and Radar
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : PE

Course Content:

**Unit I - Introduction to Microwaves**
- History and applications of Microwaves
- Mathematical Model of Microwave Transmission-Microwave transmission modes, wave-guides and transmission lines, Impedance Matching
- Microwave Network Analysis

**Unit II - Passive and Active Microwave Devices**
- Directional Coupler, Power Divider, Attenuator, Resonator.
- Microwave active components: Diodes, Transistors, Microwave Tubes

**Unit III - Microwave Design Principles**
- Microwave Filter Design, Microwave Amplifier Design,
- Microwave Mixer Design, Microwave Oscillator Design
- Microwave Antennas

**Unit IV - Microwave Measurements, Microwave Systems, Effect of Microwaves on human body.**

SUGGESTED LEARNING RESOURCES:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Title of Book</th>
<th>Author</th>
<th>Publication</th>
</tr>
</thead>
</table>
Course Code : ECPE307
Course Title : Microwave and RADAR Lab
Number of Credits : 1  (L: 0, T: 0, P: 2)
Prerequisites : NIL
Course Category : PE

Course Content:

SUGGESTED PRACTICALS/ EXERCISES
The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Practical Outcomes (PrOs)</th>
<th>Unit No.</th>
<th>Approx. Hrs. Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>To study wave guide components.</td>
<td>I</td>
<td>04</td>
</tr>
<tr>
<td>2.</td>
<td>To study the characteristics of Gunn oscillator Gun diode as modulated source.</td>
<td>I</td>
<td>04</td>
</tr>
<tr>
<td>3.</td>
<td>Introduction to Smith chart and its application for the unknown impedance measurement.</td>
<td>I</td>
<td>04</td>
</tr>
<tr>
<td>4.</td>
<td>Study the behavior of impedance matching for passive networks using Smith chart.</td>
<td>II</td>
<td>04</td>
</tr>
<tr>
<td>5.</td>
<td>To study loss and attenuation measurement of attenuator</td>
<td>II</td>
<td>04</td>
</tr>
<tr>
<td>6.</td>
<td>Construct a cavity resonator in waveguide and study its characteristics using the network analyzer and a frequency counter.</td>
<td>III</td>
<td>04</td>
</tr>
<tr>
<td>7.</td>
<td>To determine the frequency and wavelength in a rectangular waveguide working in TE10 mode</td>
<td>IV</td>
<td>04</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td><strong>28</strong></td>
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SUGGESTED LEARNING RESOURCES:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Title of Book</th>
<th>Author</th>
<th>Publication</th>
</tr>
</thead>
</table>
SEMESTER VI

<table>
<thead>
<tr>
<th>Course Code</th>
<th>ECPC302</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Computer Networking and Data Communication</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3 (L: 3, T: 0, P: 0)</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>NIL</td>
</tr>
<tr>
<td>Course Category</td>
<td>PC</td>
</tr>
</tbody>
</table>

Course Content:

**Unit 1** - Introduction to data communication.
- Basics of OSI and TCP/IP reference models.
- Computer Network Topologies – Point to Point, Bus topology, Star topology, ring topology, mesh topology, tree topology, Daisy Chain, Hybrid Topology.

**Unit 2** – Digital & Analog Transmission.
- Digital Transmission – Digital to Digital Conversion, Line Coding, Unipolar Encoding, Polar Encoding, Bipolar Encoding, block Coding
- Analog Transmission - Analog-to-Digital Conversion, Digital to analog Conversion, Analog to Analog Conversion.
- Sampling, Quantization, Encoding, Transmission Modes.

**Unit 3** – Wireless Communication.
- Radio, Microwave, Infra-red, Light Transmission.
- Wireless Communication Standards, Characterization of the Wireless Channel, Receiver Techniques for Fading Dispersive Channels,
- Mobility Management in Wireless Networks, Mobile IP, Mobile Ad hoc Networks, Ad hoc Routing Protocols, Performance Analysis of DSR and CBRP,
- Cluster Techniques, Incremental Cluster Maintenance Scheme, Space time Coding for Wireless Communication.

**Unit 4** – Data Link Layer Technologies.
- Types of Network Routing, Network Layer Protocols. FDM, TDM and CDMA.
- Error Detection and Correction - Types of Errors, Detection, Correction Switching and Data link layer, data link control and protocols
**Unit 5 - Transmission Media & Transmission Control protocol.**
- Magnetic Media, Twisted Pair Cable, Coaxial Cable, Power Lines, Fiber Optics.
- Protocol – Features, Header, Addressing, Connection Management, Error Control and Flow Control, Multiplexing, Congestion Control, Timer Management, Crash Recover

**REFERENCES / SUGGESTED LEARNING RESOURCES:**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Title of Book</th>
<th>Author</th>
<th>Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Computer Networks and Internet</td>
<td>D.E. Comer</td>
<td>Pearson</td>
</tr>
<tr>
<td>4.</td>
<td>Wireless Communication and Networking</td>
<td>John W. Mark, Weihua Zhuang</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Modelling and Analysis of Computer Communication Networks</td>
<td>Jeremiah F. Hayes</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Data communication &amp; Networking</td>
<td>Stallings</td>
<td></td>
</tr>
</tbody>
</table>

**SUGGESTED SOFTWARE/LEARNING WEBSITES:**

- a) www.tutorialspoint.com/data_communication_computer_network/data_communication_computer_network_tutorial.pdf
- b) www.turbofuture.com/industrial/Elements-of-Electronic-Communications-System
- d) www.antenna-theory.com/basics/main.php
- e) www.explainthatstuff.com/antennas.html
- f) www.circuitdiagram.org/am-radio-receiver-with-mk484.html
- g) www.circuitstoday.com/single-chip-fm-radio-circuit

*******

**Course Code:** ECPC304  
**Course Title:** Computer Networking and Data Communication Lab  
**Number of Credits:** 1 (L: 0, T: 0, P: 2)  
**Prerequisites:** NIL  
**Course Category:** PC

**Course Content:**

**SUGGESTED PRACTICALS/ EXERCISES**

The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Practical Outcomes (PrOs)</th>
<th>Unit No.</th>
<th>Approx. Hrs. Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>To study the different physical equipment used for networking</td>
<td>02*</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Study the different internetworking devices in a computer network</td>
<td>02*</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Study the working of basic networking commands</td>
<td>02*</td>
<td></td>
</tr>
<tr>
<td>S. No.</td>
<td>Practical Outcomes (PrOs)</td>
<td>Unit No.</td>
<td>Approx. Hrs. Required</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------------------------------------------------------------------------</td>
<td>----------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>4.</td>
<td>To study PC to PC communication using parallel port</td>
<td>02</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Study of LAN in Star Topology</td>
<td>02</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Study of LAN in Bus Topology</td>
<td>02</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Study of LAN in Tree Topology</td>
<td>02</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Study and configuration of modem of computer</td>
<td>02</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Study of wireless communication</td>
<td>02*</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Studying PC Communication using LAN</td>
<td>02</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
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<td><strong>20</strong></td>
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Reference Books:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Title of Book</th>
<th>Author</th>
<th>Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.</td>
<td>Basic Electrical and Electronics Engineering</td>
<td>Jegathesan, V.</td>
<td>Wiley India, New Delhi, 2015 ISBN : 97881236529513</td>
</tr>
</tbody>
</table>

SUGGESTED SOFTWARE/LEARNING WEBSITES:

- en.wikipedia.org/wiki/Transformer
- www.animations.physics.unsw.edu.au//jw/AC.html
- www.alpharubicon.com/altenergy/understandingAC.htm
- www.electronics-tutorials
- learn.sparkfun.com/tutorials/transistors
- www.pitt.edu/~qiw4/Academic/ME2082/Transistor%20Basics.pdf
- www.technologystudent.com/elec1/transis1.htm
- www.learningaboutelectronics.com
- www.electrical4u.com

******
Appendix - I
Common Courses
(III to VI Semesters)
APPENDIX – I

COMMON COURSES TO ALL BRANCHES (From III to VI Semesters)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>HS 302</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Entrepreneurship and Start-ups</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>4</td>
</tr>
<tr>
<td>Prerequisites (Course code)</td>
<td>None</td>
</tr>
<tr>
<td>Course Category</td>
<td>HS</td>
</tr>
</tbody>
</table>

Course Learning Objectives:
1. Acquiring Entrepreneurial spirit and resourcefulness.
2. Familiarization with various uses of human resource for earning dignified means of living.
3. Understanding the concept and process of entrepreneurship - its contribution and role in the growth and development of individual and the nation.
5. Learning the process and skills of creation and management of entrepreneurial venture.

Course Content:

Unit 1 - Introduction to Entrepreneurship and Start – Ups
- Definitions, Traits of an entrepreneur, Intrapreneurship, Motivation
- Types of Business Structures, Similarities/differences between entrepreneurs and managers.

Unit 2 – Business Ideas and their implementation
- Discovering ideas and visualizing the business
- Activity map
- Business Plan

Unit 3 – Idea to Start-up
- Market Analysis – Identifying the target market,
- Competition evaluation and Strategy Development,
- Marketing and accounting,
- Risk analysis

Unit 4 – Management
- Company’s Organization Structure,
- Recruitment and management of talent.
- Financial organization and management

Unit 5 - Financing and Protection of Ideas
- Financing methods available for start-ups in India
- Communication of Ideas to potential investors – Investor Pitch
- Patenting and Licenses
Unit 6: Exit strategies for entrepreneurs, bankruptcy, and succession and harvesting strategy

Learning Outcome:

Upon completion of the course, the student will be able to demonstrate knowledge of the following topics:
1. Understanding the dynamic role of entrepreneurship and small businesses
2. Organizing and Managing a Small Business
3. Financial Planning and Control
4. Forms of Ownership for Small Business
5. Strategic Marketing Planning
6. New Product or Service Development
7. Business Plan Creation

SUGGESTED LEARNING RESOURCES:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Title of Book</th>
<th>Author</th>
<th>Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>ISBN – 978-0984999392</td>
</tr>
<tr>
<td>2.</td>
<td>The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses</td>
<td>Eric Ries</td>
<td>Penguin UK</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ISBN – 978-0670921607</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ISBN: 978-142219602</td>
</tr>
</tbody>
</table>

SUGGESTED SOFTWARE/LEARNING WEBSITES:

d.  https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your-business/
Appendix - II
Open Elective Courses
# APPENDIX – II

## OPEN ELECTIVE COURSES (OE)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Code No.</th>
<th>Course Title</th>
<th>Hours per week</th>
<th>Semes- ter</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>OE###</strong></td>
<td>Economic Policies in India</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td><strong>OE###</strong></td>
<td>Artificial Intelligence &amp; Machine Learning</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td><strong>OE###</strong></td>
<td>Soft Computing Techniques</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td><strong>OE###</strong></td>
<td>Project Management</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td><strong>OE###</strong></td>
<td>Renewable Energy Technologies</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td><strong>OE###</strong></td>
<td>Energy Conservation &amp; Audit</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td><strong>OE###</strong></td>
<td>Product Design</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td><strong>OE###</strong></td>
<td>Engineering Economics &amp; Accountancy</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td><strong>OE###</strong></td>
<td>Operations Research</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
<tr>
<td>10</td>
<td><strong>OE###</strong></td>
<td>Renewable Energy Technologies</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
<tr>
<td>11</td>
<td><strong>OE###</strong></td>
<td>Energy Efficiency and Audit</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
<tr>
<td>12</td>
<td><strong>OE###</strong></td>
<td>Web Designing and Multimedia Technology (*)</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
<tr>
<td>13</td>
<td><strong>OE###</strong></td>
<td>History of Science and Engineering (*)</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
<tr>
<td>14</td>
<td><strong>OE###</strong></td>
<td>Internet of Things</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
<tr>
<td>15</td>
<td><strong>OE###</strong></td>
<td>Professional Orientation (*)</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
<tr>
<td>16</td>
<td><strong>OE###</strong></td>
<td>Disaster Management</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
<tr>
<td>17</td>
<td><strong>OE###</strong></td>
<td>Sustainable Development (*)</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
<tr>
<td>18</td>
<td><strong>OE###</strong></td>
<td>Smart Systems (*)</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
<tr>
<td>19</td>
<td><strong>OE###</strong></td>
<td>Robotics (*)</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
<tr>
<td>20</td>
<td><strong>OE###</strong></td>
<td>Introduction to E-Governance (*)</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
<tr>
<td>21</td>
<td><strong>OE###</strong></td>
<td>Cyber Security Laws, Standards and IPR (*)</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
<tr>
<td>22</td>
<td><strong>OE###</strong></td>
<td>Organic and Natural Farming Practices (*)</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
<tr>
<td>23</td>
<td><strong>OE###</strong></td>
<td>Classical Text Reading (*)</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
<tr>
<td>24</td>
<td><strong>OE###</strong></td>
<td>3-D Printing (*)</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
<tr>
<td>25</td>
<td><strong>OE###</strong></td>
<td>Virtual Reality (*)</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
<tr>
<td>26</td>
<td><strong>OE###</strong></td>
<td>Mechatronics</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
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<tr>
<td>27</td>
<td><strong>OE###</strong></td>
<td>Artificial Intelligence</td>
<td>3 0 0</td>
<td>V / VI</td>
<td>3</td>
</tr>
</tbody>
</table>

**Note:** (*) means that course details will be added soon.
Course Code : **OE###
Course Title : ECONOMIC POLICIES IN INDIA
Number of Credits : 3       (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : OE

Course Learning Objectives:
The objective of this course is to familiarize the students of different streams with the basic concepts, structure, problems and issues concerning Indian economy.

Course Content:
UNIT-I: Basic features and problems of Indian Economy: Economic History of India; Nature of Indian Economy, demographic features and Human Development Index, Problems of Poverty, Unemployment, Inflation, income inequality, Black money in India.

UNIT-II: Sectoral composition of Indian Economy: Issues in Agriculture sector in India, land reforms Green Revolution and agriculture policies of India,

UNIT-III: Industrial development, small scale and cottage industries, industrial Policy, Public sector in India, service sector in India.

UNIT-IV: Economic Policies: Economic Planning in India, Planning commission v/s NITI Aayog, Five Year Plans, monetary policy in India, Fiscal Policy in India, Centre state Finance Relations, Finance commission in India. LPG policy in India

UNIT-V: External sector in India: - India’s foreign trade value composition and direction, India Balance of payment since 1991, FDI in India, Impact of Globalization on Indian Economy, WTO and India.

Reference Books:

Course outcomes:
At the end of the course, the student will be able to:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Understand Indian economics policy, planning strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>It will enable to students to comprehend theoretical and empirical development across countries and region for policy purposes</td>
</tr>
</tbody>
</table>
Open Elective Courses

| CO3 | Development Economics as a discipline encompasses different approaches to the problems of unemployment, poverty, income generation, industrialization from different perspectives |
| CO4 | Able to identify the problems and capable to decide the application for future development |
| CO5 | Analyze economic issues and find solutions to complex economic problems and take correct economic judgment |

Course Code : **OE###
Course Title : ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : OE

Course Learning Objectives:
Have a thorough understanding of classical and modern AI applications. Be able to implement a wide range of AI concepts using Prolog. Understand non-classical AI approaches such as genetic algorithms and neural networks. Be able to assess the potential of AI in research and real-world environments.

Course Content:
UNIT-I: Introduction: History and foundations of AI, Problem solving: Uninformed and informed Search; Constraint Satisfaction Problems and Constrained Optimization problems (complete and incomplete techniques).
UNIT-II: Adversarial Search: Two players games, games with uncertainty; Decision support systems and technologies; Knowledge representation, Reasoning, Expert systems Contents (2/2), Planning (basics).
UNIT-III: Machine learning Basics: Decision trees, Ensemble learning, Reinforcement learning, Evolutionary computation, Neural networks, Problems, data, and tools; Visualization;
UNIT-IV: Linear regression; SSE; gradient descent; closed form; normal equations; features, Overfitting and complexity; training, validation, test data, and introduction to Matlab.
UNIT-V: Classification problems; Decision boundaries; Probability and classification, Bayes optimal decisions, Naive Bayes and Gaussian class-conditional distribution.

References:

Course outcomes:
At the end of the course, the student will be able to:
Course Learning Objectives:

- To learn Fuzzy logic and its applications.
- To learn artificial neural networks and its applications.
- To solving single-objective optimization problems using GAs.
- To solving multi-objective optimization problems using Evolutionary algorithms (MOEAs).
- Applications of soft computing to solve problems in varieties of application domains.

Course Content:


UNIT-II: Evolutionary Computing Methods: Principles of Evolutionary Processes and genetics, A history of Evolutionary computation and introduction to evolutionary algorithms, Genetic algorithms, Evolutionary strategy, Evolutionary programming, Genetic programming.

Genetic Algorithm and Genetic Programming: Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, applications.

UNIT-III: Swarm Optimization: Introduction to Swarm intelligence, Ant colony optimization (ACO), Particle swarm optimization (PSO), Artificial Bee colony algorithm (ABC), Other variants of swarm intelligence algorithms.


Artificial Neural Networks: Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward
networks, recurrent networks. Back propagation algorithm, factors affecting back propagation training, applications

UNIT-V: Application of Soft Computing to Mechanical Engineering/Production Engineering Problems: Application to Inventory control, Scheduling problems, Production, Distribution, Routing, Transportation, Assignment problems

Reference Books:

Course outcomes:
At the end of the course, the student will be able to:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Classify and differentiate problem solving methods and tools.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Apply A*, AO*, Branch and Bound search techniques for problem solving.</td>
</tr>
<tr>
<td>CO3</td>
<td>Formulate an optimization problem to solve using evolutionary computing methods.</td>
</tr>
<tr>
<td>CO4</td>
<td>Design and implement GA, PSO and ACO algorithms for optimization problems in Mechanical Engineering.</td>
</tr>
<tr>
<td>CO5</td>
<td>Apply soft computing techniques for design, control and optimization of Manufacturing systems.</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Course Code</th>
<th>**OE###</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>PROJECT MANAGEMENT</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3 (L: 3, T: 0, P: 0)</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>NIL</td>
</tr>
<tr>
<td>Course Category</td>
<td>OE</td>
</tr>
</tbody>
</table>

Course Learning Objectives:
- To develop the idea of project plan, from defining and confirming the project goals and objectives, identifying tasks and how goals will be achieved.
- To develop an understanding of key project management skills and strategies.

Course Content:
UNIT-I: Concept of a project: Classification of projects- importance of project management- The project life cycle- establishing project priorities (scope-cost-time) project priority matrix- work breakdown structure.

UNIT-II: Capital budgeting process: Planning- Analysis-Selection-Financing-Implementation-Review. Generation and screening of project ideas- market and demand analysis- Demand forecasting techniques. Market planning and marketing research process- Technical analysis


UNIT-V: **Project administration**: progress payments, expenditure planning, project scheduling and network planning, use of Critical Path Method (CPM), schedule of payments and physical progress, time-cost trade off. Concepts and uses of PERT cost as a function of time, Project Evaluation and Review Techniques/cost mechanisms. Determination of least cost duration. Post project evaluation. Introduction to various Project management softwares.

**Reference Books:**
4. Project Management – Gopala krishnan – Mcmillan India Ltd.
5. Project Management-Harry-Maylor-Peason Publication

**Course outcomes:**
At the end of the course, the student will be able to:

| CO1 | Understand the importance of projects and its phases. |
| CO2 | Analyze projects from marketing, operational and financial perspectives. |
| CO3 | Evaluate projects based on discount and non-discount methods. |
| CO4 | Develop network diagrams for planning and execution of a given project. |
| CO5 | Apply crashing procedures for time and cost optimization. |

******

| Course Code | **OE### |
| Course Title | RENEWABLE ENERGY TECHNOLOGIES |
| Number of Credits | 3 (L: 3, T: 0, P: 0) |
| Prerequisites | NIL |
| Course Category | OE |

**Course Learning Objectives:**
- To understand present and future scenario of world energy use.
- To understand fundamentals of solar energy systems.
- To understand basics of wind energy.
• To understand bio energy and its usage in different ways.
• To identify different available non-conventional energy sources.

Course Content:

UNIT-I: Introduction: World Energy Use; Reserves of Energy Resources; Environmental Aspects of Energy Utilisation; Renewable Energy Scenario in India and around the World; Potentials; Achievements / Applications; Economics of renewable energy systems.

Unit-II: Solar energy: Solar Radiation; Measurements of Solar Radiation; Flat Plate and Concentrating Collectors; Solar direct Thermal Applications; Solar thermal Power Generation Fundamentals of Solar Photo Voltaic Conversion; Solar Cells; Solar PV Power Generation; Solar PV Applications.

Unit-III: Wind Energy: Wind Data and Energy Estimation; Types of Wind Energy Systems; Performance; Site Selection; Details of Wind Turbine Generator; Safety and Environmental Aspects.

Unit-IV: Bio-Energy: Biomass direct combustion; Biomass gasifiers; Biogas plants; Digesters; Ethanol production; Bio diesel; Cogeneration; Biomass Applications.

Unit-V: Other Renewable Energy Sources: Tidal energy; Wave Energy; Open and Closed OTEC Cycles; Small Hydro-Geothermal Energy; Hydrogen and Storage; Fuel Cell Systems; Hybrid Systems.

Reference Books:


Course outcomes:

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

| CO1 | Understand present and future energy scenario of the world. |
| CO2 | Understand various methods of solar energy harvesting. |
| CO3 | Identify various wind energy systems. |
| CO4 | Evaluate appropriate methods for Bio energy generations from various Bio wastes. |
| CO5 | Identify suitable energy sources for a location. |

*****
Course Code : **OE###
Course Title : ENERGY CONSERVATION AND AUDIT
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : OE

Course Learning Objectives:

- To identify demand-supply gaps in the present scenario.
- To understand conservation approaches to an industry.
- To draw the energy flow diagram of an industry.
- To identify energy wastage and suggest alternative methods.
- To understand the concepts of energy audit.

Course Content:

UNIT-I: Introduction: General energy problem, sector-wise energy consumption, demand-supply gap, scope for energy conservation and its benefits; Energy Efficiency Principle – Maximum energy efficiency, maximum cost effectiveness; Mandatory provisions of EC act; Features of EC act: Standards and labeling, designated consumers, Energy Conservation Building Codes (ECBC);

UNIT-II: Energy Conservation Approaches in Industries: Methods and techniques of energy conservation in ventilation and air conditioners - compressors, pumps, fans, and blowers - area sealing, insulating the heating/cooling fluid pipes, automatic door closing - air curtain, thermostat/contro; energy conservation in electric furnaces, ovens, and boilers.

UNIT-III: Energy Conservation Option: New equipment, technology, staffing, training; calculation and costing of energy conservation project; depreciation cost, sinking fund method. Cost evaluation by Return On Investment (ROI) and payback method etc.

UNIT-IV: Performance improvement of existing power plant: cogeneration, small hydro, DG Set; demand-side management; load response programmes; types of tariff and restructuring of electric tariff. Technical measures to optimize T and D losses.

UNIT-V: Energy Audit: Energy audit and its benefits; energy flow diagram; preliminary, detailed energy audit; methodology of preliminary energy audit and detailed energy audit – Phase I, pre-audit, phase II - audit and phase III - post audit; energy audit report; electrical measuring instruments - power analyzer.

Reference Books:

2. Project Management, Prasanna Chandra, Tata Mcgraw Hill, New Delhi
Course outcomes:
At the end of the course, the student will be able to:

| CO1 | Identify demand supply gaps in the present scenario. |
| CO2 | Understand the conservation approaches for an industry. |
| CO3 | Draw the energy flow diagram of an industry and identify waste stream. |
| CO4 | Identify energy wastage and suggest alternative methods. |
| CO5 | Evaluate the concepts of energy audit. |

Course Code: **OE###
Course Title: PRODUCT DESIGN
Number of Credits: 3 (L: 3, T: 0, P: 0)
Prerequisites: NIL
Course Category: OE

Course Learning Objectives:
- To acquire the basic concepts of product design and development process
- To understand the engineering and scientific process in executing a design from concept to finished product
- To study the key reasons for design or redesign.

Course Content:
UNIT-I: Definition of a product; Types of product; Levels of product; Product-market mix; New product development (NPD) process; Idea generation methods; Creativity; Creative attitude; Creative design process; Morphological analysis; Analysis of interconnected decision areas; Brain storming.

UNIT-II: Product life cycle; The challenges of Product development; Product analysis; Product characteristics; Economic considerations; Production and Marketing aspects; Characteristics of successful Product development; Phases of a generic product development process; Customer need identification; Product development practices and industry-product strategies.

UNIT-III: Product design; Design by evolution; Design by innovation; Design by imitation; Factors affecting product design; Standards of performance and environmental factors; Decision making and iteration; Morphology of design (different phases); Role of aesthetics in design.

UNIT-IV: Introduction to optimization in design; Economic factors in design; Design for safety and reliability; Role of computers in design; Modeling and Simulation; The role of models in engineering design; Mathematical modeling; Similitude and scale models; Concurrent design; Six sigma and design for six sigma; Introduction to optimization in design; Economic factors and financial feasibility in design; Design for manufacturing; Rapid Prototyping (RP); Application of RP in product design; Product Development versus Design.

UNIT-V: Design of simple products dealing with various aspects of product development; Design starting from need till the manufacture of the product,
Reference Books:

2. Engineering Design –George E. Dieter.
3. An Introduction to Engineering Design methods Vijay Gupta.

Course outcomes:

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

| CO1 | Understand the basic concepts of product design and development process. |
| CO2 | Illustrate the methods to define the customer needs. |
| CO3 | Describe an engineering design and development process. |
| CO4 | Understand the intuitive and advanced methods used to develop and evaluate a concept. |
| CO5 | Apply modelling and embodiment principles in product design and development process. |

Course Code: **OE###
Course Title: ENGINEERING ECONOMICS & ACCOUNTANCY
Number of Credits: 3 (L: 3, T: 0, P: 0)
Prerequisites: NIL
Course Category: OE

Course Learning Objectives:

• To acquire knowledge of basic economics to facilitate the process of economic decision making.
• To acquire knowledge on basic financial management aspects.
• To develop the basic skills to analyze financial statements.

Course Content:

UNIT-I: Introduction: Managerial Economics; Relationship with other disciplines; Firms: Types, objectives and goals; Managerial decisions; Decision analysis.

Unit-II: Demand & Supply Analysis: Demand; Types of demand; Determinants of demand; Demand function; Demand elasticity; Demand forecasting; Supply; Determinants of supply; Supply function; Supply elasticity.

Unit-III: Production and Cost Analysis: Production function; Returns to scale; Production optimization; Least cost input; Isoquants; Managerial uses of production function; Cost Concepts; Cost function; Types of Cost; Determinants of cost; Short run and Long run cost curves; Cost Output Decision; Estimation of Cost.
Unit-IV: Pricing: Determinants of Price; Pricing under different objectives and different market structures; Price discrimination; Pricing methods in practice; Role of Government in pricing control.

Unit-V: Financial Accounting (Elementary Treatment): Balance sheet and related concepts; Profit & Loss Statement and related concepts; Financial Ratio Analysis; Cash flow analysis; Funds flow analysis; Comparative financial statements; Analysis & Interpretation of financial statements; Investments; Risks and return evaluation of investment decision; Average rate of return; Payback Period; Net Present Value; Internal rate of return.

Reference Books:
1. Premvir Kapoor, Sociology & Economics for Engineers, Khanna Publishing House, New Delhi, 2018

Course outcomes:
At the end of the course, the student will be able to:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Understand the macro-economic environment of the business and its impact on enterprise</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Understand cost elements of the product and its effect on decision making</td>
</tr>
<tr>
<td>CO3</td>
<td>Prepare accounting records and summarize and interpret the accounting data for managerial decisions</td>
</tr>
<tr>
<td>CO4</td>
<td>Understand accounting systems and analyze financial statements using ratio analysis</td>
</tr>
<tr>
<td>CO5</td>
<td>Understand the concepts of financial management and investment</td>
</tr>
</tbody>
</table>

Course Code : **OE###
Course Title : OPERATIONS RESEARCH
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : OE

Course Learning Objectives:
- To understand and analyze managerial problems in industry so that they are able to use resources (capitals, materials, staffing, and machines) more effectively.
- To acquire knowledge of formulating mathematical models for quantitative analysis of managerial problems in industry.
**Course Content:**

**UNIT-I: Development:** Definition, Characteristics and phase of Scientific Method, Types of models; General methods for solving operations research models.

**UNIT-II: Allocation:** Introduction to linear programming formulation, graphical solution, Simplex Method, artificial variable technique, Duality principle. Sensitivity analysis.

**UNIT-III: Transportation Problem:** Formulation; Optimal solution; Unbalanced Transportation problems; Degeneracy; Assignment problem: Formulation; Optimal solution.

**UNIT-IV: Sequencing:** Introduction; Terminology; Notations and Assumptions; Problems with n-jobs and two machines; Optimal sequence algorithm; Problems with n-jobs and three machines.

**UNIT-V: Theory of games:** Introduction; Two-person zero-sum games; The Maximum–Minimax principle; Games without saddle points; Mixed Strategies; 2 x n and m x 2 Games; Graphical solutions; Dominance property; Use of L.P. to games.

**Reference Books:**

3. Operations Research: Principles and Practice - Ravindran, Phillips and Solberg, Wiley India

**Course outcomes:**

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

<table>
<thead>
<tr>
<th>CO1</th>
<th>Recognize the importance and value of Operations Research and mathematical modeling in solving practical problems in industry.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Formulate a managerial decision problem into a mathematical model.</td>
</tr>
<tr>
<td>CO3</td>
<td>Understand Operations Research models and apply them to real-life problems.</td>
</tr>
<tr>
<td>CO4</td>
<td>Understand and implement the Transportation Models and Assignment Models at workplace.</td>
</tr>
<tr>
<td>CO5</td>
<td>Understand the characteristics of different types of decisions.</td>
</tr>
</tbody>
</table>

******
Course Code: **OE###
Course Title: Renewable Energy Technologies
Number of Credits: 3 (L: 3, T: 0, P: 0)
Prerequisites (Course code): NIL
Course Category: PC

Course Learning Objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain the renewable energy technology equipment.

Course Contents:

Unit – I Ocean Energy Technologies
Ocean energy map of India and its implications; Specification, Construction and working of the following ocean energy technologies:

- Tidal power technologies
- Wave power technologies
- Marine current technologies
- Ocean Thermal Energy Conversion (OTEC) technologies

Unit – II Solar PV and Concentrated Solar Power Plants
- Solar Map of India: Global solar power radiation, Solar PV
- Concentrated Solar Power (CSP) plants, construction and working of: Power Tower, Parabolic Trough, Parabolic Dish, Fresnel Reflectors
- Solar Photovoltaic (PV) power plant: components layout, construction, working.
- Rooftop solar PV power system

Unit – III Large Wind Power Plants
Wind Map of India: Wind power density in watts per square meter; Lift and drag principle; long path theory, Geared type wind power plants: components, layout and working, Direct drive type wind power plants: components, layout and working, Constant Speed Electric Generators: Squirrel Cage Induction Generators (SCIG), Wound Rotor Induction Generator (WRIG), Variable Speed Electric Generators: Doubly-fed induction generator (DFIG), wound rotor synchronous generator (WRSG), permanent magnet synchronous generator (PMSG).

Unit– IV Small Wind Turbines
- Horizontal axis small wind turbine: direct drive type, components and working.
- Horizontal axis small wind turbine: geared type, components and working.
- Vertical axis small wind turbine: direct drive and geared, components and working.
- Types of towers and installation of small wind turbines on roof tops and open fields.
- Electric generators used in small wind power plants.
Unit- V  Biomass-based Power Plants

- Properties of solid fuel for biomass power plants: bagasse, wood chips, rice husk, municipal waste.
- Properties of liquid and gaseous fuel for biomass power plants: Jatropha, bio-diesel gobar gas.
- Layout of a Bio-chemical based (e.g. biogas) power plant.
- Layout of a Thermo-chemical based (e.g. Municipal waste) power plant.
- Layout of a Agro-chemical based (e.g. bio-diesel) power plant.

Reference Books:
1. O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi

Course Outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

- Maintain ocean thermal energy technologies
- Maintain the optimised working of solar PV and CS power plants.
- Maintain the optimised working of large wind power plants
- Maintain the optimised working of small wind turbines.
- Maintain the optimised working of biomass-based power plants.

******
Course Code : **OE###
Course Title : ENERGY EFFICIENCY AND AUDIT
Number of Credits : 3 (L: 3, T: 0, P: 0)
Prerequisites : NIL
Course Category : PC

Course Learning Objectives:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Undertake energy efficiency measures and energy audit.

Course Contents:

Unit – I Introduction to Energy Efficiency
Energy Scenario: Energy demand and supply, National scenario.
Energy Efficiency and Energy Conservation; concepts
Indian Electricity Act 2001; relevant clauses of energy conservation
BEE and its Roles
Star Labelling: Need and its benefits.

Unit – II Pumping Systems, Fans and Blowers
Factors affecting pump performance
Efficient Pumping system operation
Energy conservation opportunities in Pumping systems
Fan types, flow control strategies
Fan performance Assessment
Energy Conservation opportunities in Pumping systems
Tips for energy saving in fans and blowers

Unit – III Air Compressors and Diesel Power Generator sets
Classification of compressors
Pneumatic System components
Effect of various parameters on efficiency of Compressor
Capacity control of Compressors
Checklist for Energy Efficiency in Compressed air systems
Operating guidelines for diesel generator, operational factors
Effects of improper ventilation of genset
Energy saving measures for DG sets

Unit – IV Energy Conservation in Lighting System
Replacing Lamp sources
Using energy efficient luminaries
Using light controlled gears
Installation of separate transformer / servo stabilizer for lighting
Periodic survey and adequate maintenance programs
Innovative measures of energy savings in lighting
Unit– V Energy Efficient Electrical Machines

Need for energy conservation in induction motor and transformer
Energy conservation techniques in induction motor by:
Energy conservation techniques in Transformer
Energy efficient motor; significant features, advantages, applications and Limitations
Energy efficient transformers, amorphous transformers; epoxy Resin cast transformer / Dry type of transformer
Aggregated Technical and commercial losses (ATC), Technical losses; causes and measures to reduce, Commercial losses: pilferage, causes and remedies
Application of tariff system to reduce energy bill
Co-generation and Tariff; concept, significance for energy conservation

Unit– VI Energy Audit of Electrical Systems

Energy audit (definition as per Energy Conservation Act)
Energy audit instruments and their use
Questionnaire for energy audit projects
Energy flow diagram (Sankey diagram)
Simple payback period, Energy Audit procedure (walk through audit and detailed audit).
Energy Audit report format.

Reference Books:

Course Outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

- Undertake energy efficiency activities
- Use energy efficient pumps, compressors and blowers
- Use energy efficient Air Compressors and DG sets
- Use energy efficient Lighting Systems
- Apply energy efficient electrical machines.
- Use Co-generation and relevant tariff for reducing losses in facilities.

*******
Course Code: **OE###
Course Title: Internet of Things
Number of Credits: 3
Prerequisites (Course code): -
Course Category: OE

Course Content:

Unit I - Introduction to Internet of Things
- Define the term “Internet of Things”
- State the technological trends which have led to IoT.
- Describe the impact of IoT on society.

Unit II - Design consideration of IoT
- Enumerate and describe the components of an embedded system.
- Describe the interactions of embedded systems with the physical world.
- Name the core hardware components most commonly used in IoT devices.

Unit III - Interfacing by IoT devices
- Describe the interaction between software and hardware in an IoT device.
- Explain the use of networking and basic networking hardware.
- Describe the structure of the Internet.

SUGGESTED LEARNING RESOURCES:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Title of Book</th>
<th>Author</th>
<th>Publication</th>
</tr>
</thead>
</table>

SUGGESTED SOFTWARE/LEARNING WEBSITES:

5. http://esp32.net/
Course Code : **OE###
Course Title : Disaster Management
Number of Credits : 3  (L:3, T: 0, P: 0)
Prerequisites : NIL
Course Category : OE

Course Learning Objectives:
Following are the objectives of this course:

- To learn about various types of natural and man-made disasters.
- To know pre- and post-disaster management for some of the disasters.
- To know about various information and organisations in disaster management in India.
- To get exposed to technological tools and their role in disaster management.

Course Content:

Unit – I: Understanding Disaster
Understanding the Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity – Disaster and Development, and disaster management.

Unit – II: Types, Trends, Causes, Consequences and Control of Disasters
Geological Disasters (earthquakes, landslides, tsunami, mining); Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves) Biological Disasters (epidemics, pest attacks, forest fire);
Technological Disasters (chemical, industrial, radiological, nuclear) and Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters) Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters.

Unit- III: Disaster Management Cycle and Framework
Disaster Management Cycle – Paradigm Shift in Disaster Management.
Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness.
During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency Operation Centre – Incident Command System – Relief and Rehabilitation –

Unit– IV: Disaster Management in India
Disaster Profile of India – Mega Disasters of India and Lessons Learnt.
Disaster Management Act 2005 – Institutional and Financial Mechanism,
National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national),Non-Government and Inter Governmental Agencies
Unit– V: Applications of Science and Technology for Disaster Management

Geo-informatics in Disaster Management (RS, GIS, GPS and RS).

Disaster Communication System (Early Warning and Its Dissemination).

Land Use Planning and Development Regulations, Disaster Safe Designs and Constructions, Structural and Non Structural Mitigation of Disasters

S&T Institutions for Disaster Management in India

References

1. Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management
5. Ghosh, G. K., Disaster Management, A P H Publishing Corporation

Course outcomes:

After competing this course, student will be:

- Acquainted with basic information on various types of disasters
- Knowing the precautions and awareness regarding various disasters
- Decide first action to be taken under various disasters
- Familiarised with organisation in India which are dealing with disasters
- Able to select IT tools to help in disaster management

*****
Open Elective Courses

**Course Code**: **OE###**

**Course Title**: Mechatronics

**Number of Credits**: 3

**Prerequisites**: None

**Course Category**: OE

**Course Content:**

**Unit 1** – Introduction to Mechatronics
- Introduction to System Concepts, Analysis and Design
- Mechatronics basic definitions; systems and components;
- Systems with mixed disciplines
- Electronics Fundamentals Review

**Unit 2** – Elements in Mechatronics
- Data conversion devices, sensors, micro-sensors, transducers, signal processing devices, timers
- Microprocessors, Microcontrollers
- PID Controllers and PLCs

**Unit 3** – Drives
- Stepper Motors, Servo Drives
- Linear Motion bearings, cams
- Systems controlled by camshafts, electronic cams
- Tool magazines and indexing mechanisms.

**Unit 4** – Hydraulic Systems
- Flow, Pressure and Direction Control Valves
- Actuators, Supporting Elements, Hydraulic Power Packs, Pumps
- Design of Hydraulic circuits

**Unit 5** – Pneumatic System
- Production, Distribution and conditioning of compressed air
- System Components and Graphic representations
- Design of Systems

**SUGGESTED LEARNING RESOURCES:**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Title of Book</th>
<th>Author</th>
<th>Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.</td>
<td>Mechatronics</td>
<td>Bolton, W</td>
<td>Pearson</td>
</tr>
<tr>
<td>S.No.</td>
<td>Title of Book</td>
<td>Author</td>
<td>Publication</td>
</tr>
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</tr>
</tbody>
</table>

SUGGESTED SOFTWARE/LEARNING WEBSITES:

6. https://youtu.be/Ro_tFv1iH6g

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Course Code : **OE###
Course Title : Artificial Intelligence
Number of Credits : 3
Prerequisites (Course code) : None
Course Category : OE

Course Content:

**Unit 1** – Introduction to Artificial Intelligence
- Artificial Intelligence (AI) definition
- Goals of AI
- History of AI
- Applications of AI

**Unit 2** – Agents and Environments
- Agent Terminology, Types of Agents – Simple Reflex Agents, Model Based Reflex Agents, Goal Based Agents
- Nature of Environments, Properties of Environments

**Unit 3** – Search Algorithms
Terminology
- Brute Force Search Strategies – Breadth First Search, Depth First Search.

**Unit 4** – Fuzzy Logic Systems
Introduction to Fuzzy Logic and Fuzzy systems,
- Membership functions,
- Fuzzification/Defuzzification

**Unit 5** – Neural Networks
Basic structure of Neural Networks
- Perceptron
- Back-propagation

Suggested Learning Resources:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Title of Book</th>
<th>Author</th>
<th>Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Artificial Intelligence By Example: Develop machine intelligence from scratch using real artificial intelligence use cases</td>
<td>Denis Rothman</td>
<td>Packt Publishing, ISBN – 978-1788990547</td>
</tr>
</tbody>
</table>
Appendix - III
Audit Courses
APPENDIX – III

AUDIT COURSES

<table>
<thead>
<tr>
<th>Course Code</th>
<th>:</th>
<th>AU 102</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>:</td>
<td>Environmental Science</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>:</td>
<td>0 (L: 2, T:0; P:0)</td>
</tr>
<tr>
<td>Prerequisites (Course code)</td>
<td>:</td>
<td>High School Science</td>
</tr>
<tr>
<td>Course Category</td>
<td>:</td>
<td>AU</td>
</tr>
</tbody>
</table>

Course Learning Objectives:
Technicians working in industries or elsewhere essential require the knowledge of environmental science so as to enable them to work and produce most efficient, economical and eco-friendly finished products.

- Solve various engineering problems applying ecosystem to produce eco-friendly products.
- Use relevant air and noise control method to solve domestic and industrial problems.
- Use relevant water and soil control method to solve domestic and industrial problems.
- To recognize relevant energy sources required for domestic and industrial applications.
- Solve local solid and e-waste problems.

Course Content:
Pre requisite: - High School Chemistry

Unit 1: Ecosystem
- Structure of ecosystem, Biotic & Abiotic components
- Food chain and food web
- Aquatic (Lentic and Lotic) and terrestrial ecosystem
- Carbon, Nitrogen, Sulphur, Phosphorus cycle.
- Global Warming-Causes, effects, process, Green House Effect, Ozone depletion

Unit 2: Air and, Noise Pollution
- Definition of pollution and pollutant, Natural and manmade sources of air pollution (Refrigerants, I.C., Boiler)
- Air Pollutants: Types, Particulate Pollutants: Effects and control (Bag filter, Cyclone separator, Electrostatic Precipitator)
- Gaseous Pollution Control: Absorber, Catalytic Converter, Effects of air pollution due to Refrigerants, I.C., Boiler
- Noise pollution: sources of pollution, measurement of pollution level, Effects of Noise pollution, Noise pollution (Regulation and Control) Rules, 2000

Unit– 3 Renewable sources of Energy
- Wind energy: Current status and future prospects of wind energy. Wind energy in India. En
environmental benefits and problem of wind energy.

- New Energy Sources: Need of new sources. Different types new energy sources. Applications of (Hydrogen energy, Ocean energy resources, Tidal energy conversion.) Concept, origin and power plants of geothermal energy

**Unit-4 Solid Waste Management, ISO 14000 & Environmental Management**

- Solid waste generation - Sources and characteristics of: Municipal solid waste, E- waste, biomedical waste.
- Metallic wastes and Non-Metallic wastes (lubricants, plastics, rubber) from industries.
- Collection and disposal: MSW (3R, principles, energy recovery, sanitary landfill), Hazardous waste
- Structure and role of Central and state pollution control board.
- Concept of Carbon Credit, Carbon Footprint.
- Environmental management in fabrication industry.
- ISO14000: Implementation in industries, Benefits.

**Reference Books:**

**Suggested Learning Resources:**

**a) Books:**


**b) Open source software and website address:**

- www.eco-prayer.org
- www.teriin.org
- www.cpcp.nic.in
- www.cpcp.gov.in
- www.indiaenvironmentportal.org.in
- www.whatistechtarget.com
- www.sustainabledevelopment.un.org
• www.conserve-energy-future.com)

**Course outcomes:**
At the end of the course student will be able to:

1. Understand the ecosystem and terminology and solve various engineering problems applying ecosystem knowledge to produce eco-friendly products.
2. Understand the suitable air, extent of noise pollution, and control measures and acts.
3. Understand the water and soil pollution, and control measures and acts.
4. Understand different renewable energy resources and efficient process of harvesting.

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<table>
<thead>
<tr>
<th>Course Code</th>
<th>AU 202</th>
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</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Essence of Indian Knowledge and Tradition</td>
</tr>
<tr>
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</tr>
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<td>AU</td>
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</table>

**Course Content:**
Basic Structure of Indian Knowledge System:

(i) वेद, (ii) उऩवेद (आयुवेद, धनुवेद, गन्धवेद, स्थानत्य आदां) (iii) वेदांग (शिक्षा, कल्य, नननत, व्याकरण, ज्योति क्षांद), (iv) उऩथाइग (धर्म शास्त्र, र्ीर्थांसथा, नुरथाण, तककमिस) 

• Modern Science and Indian Knowledge System
• Yoga and Holistic Health care
• Case Studies.

**SUGGESTED TEXT/REFERENCE BOOKS:**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Title of Book</th>
<th>Author</th>
<th>Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Modern Physics and Vedant</td>
<td>Swami Jitatmanand</td>
<td>Bharatiya Vidya Bhavan</td>
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<tr>
<td>3.</td>
<td>The wave of Life</td>
<td>Fritzof Capra</td>
<td></td>
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<tr>
<td>4.</td>
<td>Tao of Physics</td>
<td>Fritzof Capra</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Tarkasangraha of Annam Bhatta, Inernational</td>
<td>V N Jha</td>
<td>Chinmay Foundation, Velliarnad, Amaku,am</td>
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<table>
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<tr>
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<tr>
<td>Course Title</td>
<td>Indian Constitution</td>
</tr>
<tr>
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</tr>
<tr>
<td>Prerequisites (Course code)</td>
<td>None</td>
</tr>
<tr>
<td>Course Category</td>
<td>AU</td>
</tr>
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</table>
Course Content

Unit 1 – The Constitution - Introduction
- The History of the Making of the Indian Constitution
- Preamble and the Basic Structure, and its interpretation
- Fundamental Rights and Duties and their interpretation
- State Policy Principles

Unit 2 – Union Government
- Structure of the Indian Union
- President – Role and Power
- Prime Minister and Council of Ministers
- Lok Sabha and Rajya Sabha

Unit 3 – State Government
- Governor – Role and Power
- Chief Minister and Council of Ministers
- State Secretariat

Unit 4 – Local Administration
- District Administration
- Municipal Corporation
- Zila Panchayat

Unit 5 – Election Commission
- Role and Functioning
- Chief Election Commissioner
- State Election Commission

Suggested Learning Resources:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Title of Book</th>
<th>Author</th>
<th>Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.</td>
<td>Introduction to the Constitution of India</td>
<td>DD Basu</td>
<td>Lexis Nexis; Twenty-Third 2018 edition</td>
</tr>
</tbody>
</table>

Suggested Software/Learning Websites:

c. https://www.sci.gov.in/constitution

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Appendix - IV
Student Induction Program
The students will have to undergo a mandatory induction program as part of their Diploma Programme right at the start of the first year. The duration of the induction program will be of two weeks wherein students will undergo a wide variety of activities without actually starting with their usual classes. Normal classes will start only after the induction program is over.

This will help build confidence among the new students, instil a sense of connect and appreciation towards their institution, provide them with the comfortable environment to adjust and pick up friendship with other students, facilitate them to get to know important functionaries and faculty members of the institution, equip them with human and social values.

The Induction Program will help the new students in building social character, leadership qualities, self-confidence, creativity and appreciation for mankind and nature at large. In nutshell, the induction program is envisaged to give the new students the broader foundational experience for the lifelong success.

The new students, in the process, will get to learn about various processes and procedures in place in the institution, facilities and best practices, student activities, and the culture & values prevailing in the institution. The Program is also expected to be used for rectifying some critical lacunas, for example, Communication Skills in English for those students who have deficiency in it. Such students can be identified by conducting diagnostic tests and special Proficiency Modules can be conducted for them.

The mentor-mentee groups of the students are formed with each group comprising small number of students and being associated with a faculty mentor. Then the different activities start with a healthy daily routine.

**The suggestive list of activities is as mentioned below:**

- Physical Activity
- Creative Arts and Culture
- Mentoring & Universal Human Values
- Familiarization with the institution, Dept./Branch
- Literary Activity
- Proficiency Modules
- Lectures & Workshops by Eminent People
- Visits in Local Area
- Extra-Curricular Activities in the institution
- Feedback and Report on the Program

**Induction Program Schedule (Suggestive only)**

*Note:* It is presumed that the first year students are so divided into two major groups that the number of students in each group is almost equal with some branches forming part of Group-I while the rest of the branches being part of Group-II.
<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Students’ Group</th>
<th>Venue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole day</td>
<td>Students arrive - Hostel allotment</td>
<td>I &amp; II</td>
<td></td>
</tr>
<tr>
<td><strong>DAY 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.30 am – 10.45 am</td>
<td>Mentor-mentee groups - Introduction within group.</td>
<td>I</td>
<td>Suitable Venue as per number of mentor-mentee groups</td>
</tr>
<tr>
<td></td>
<td>Screening of Institute Documentary Movie; video clips of various functions and events</td>
<td>II</td>
<td>Conference/Seminar Hall</td>
</tr>
<tr>
<td>11.00 am – 12.15 pm</td>
<td>Mentor-mentee groups - Introduction within group.</td>
<td>II</td>
<td>Suitable Venue as per number of mentor-mentee groups</td>
</tr>
<tr>
<td></td>
<td>Screening of Institute Documentary Movie; video clips of various functions and events</td>
<td>I</td>
<td>Conference/Seminar Hall</td>
</tr>
<tr>
<td>12.30 pm – 2.30 pm</td>
<td>Lunch</td>
<td>I &amp; II</td>
<td>Respective Hostels</td>
</tr>
<tr>
<td>3.30 pm – 5.30 pm</td>
<td>Institute Excursion</td>
<td>I &amp; II</td>
<td>Around the Campus</td>
</tr>
<tr>
<td>5.30 pm – 9.30 pm</td>
<td>Rest and Dinner</td>
<td>I &amp; II</td>
<td>Respective Hostels</td>
</tr>
<tr>
<td><strong>DAY 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6:00 am</td>
<td>Wake up call</td>
<td>I &amp; II</td>
<td>Respective Hostels</td>
</tr>
<tr>
<td>6:30 am – 7:20 am</td>
<td>Physical activity (mild exercise/yoga)</td>
<td>I &amp; II</td>
<td>Sports Ground</td>
</tr>
<tr>
<td>7:30 am – 9:20 am</td>
<td>Bath, Breakfast etc.</td>
<td>I &amp; II</td>
<td>Respective Hostels</td>
</tr>
<tr>
<td>9.30 am – 12.30 pm</td>
<td>Presentation cum Interactive Session with: Important Institution Functionaries like Principal, HoDs etc.</td>
<td>I</td>
<td>Conference/Seminar Hall</td>
</tr>
<tr>
<td></td>
<td>Visit to Respective Departments</td>
<td>II</td>
<td>Respective Departments</td>
</tr>
<tr>
<td>12.30 pm – 2.30 pm</td>
<td>Lunch</td>
<td>I &amp; II</td>
<td>Respective Hostels</td>
</tr>
<tr>
<td>2.30 pm – 5.30 pm</td>
<td>Presentation cum Interactive Session with: Important Institution Functionaries like Principal, HoDs etc.</td>
<td>II</td>
<td>Conference/Seminar Hall</td>
</tr>
<tr>
<td></td>
<td>Visit to Respective Departments</td>
<td>I</td>
<td>Respective Departments</td>
</tr>
<tr>
<td><strong>DAY 3</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6:00 am</td>
<td>Wake up call</td>
<td>I &amp; II</td>
<td>Respective Hostels</td>
</tr>
<tr>
<td>6:30 am – 7:20 am</td>
<td>Physical activity (mild exercise/yoga)</td>
<td>I &amp; II</td>
<td>Sports Ground</td>
</tr>
<tr>
<td>7:30 am – 9:20 am</td>
<td>Bath, Breakfast etc.</td>
<td>I &amp; II</td>
<td>Respective Hostels</td>
</tr>
<tr>
<td>9.30 am – 10.30 am</td>
<td>Diagnostic test (for English)</td>
<td>I &amp; II</td>
<td>Suitable venue as per strength of students</td>
</tr>
<tr>
<td>Time</td>
<td>Activity</td>
<td>Section(s)</td>
<td>Venue Details</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>10.30 am – 11.00 am</td>
<td>Break</td>
<td>I &amp; II</td>
<td></td>
</tr>
<tr>
<td>11.00 am – 12.30 pm</td>
<td>Universal Human Values</td>
<td>I (Section wise)</td>
<td>Suitable venue as per number of sections</td>
</tr>
<tr>
<td></td>
<td>Creative Arts / Technical Workshops / Proficiency Modules</td>
<td>II (Section wise)</td>
<td>Suitable venue as per number of sections</td>
</tr>
<tr>
<td>12.30 pm – 2.30 pm</td>
<td>Lunch</td>
<td>I &amp; II</td>
<td>Respective Hostels</td>
</tr>
<tr>
<td>2.30 pm – 4.00 pm</td>
<td>Universal Human Values</td>
<td>II (Section wise)</td>
<td>Suitable venue as per number of sections</td>
</tr>
<tr>
<td></td>
<td>Creative Arts / Technical Workshops / Proficiency Modules</td>
<td>I (Section wise)</td>
<td>Suitable venue as per number of sections</td>
</tr>
<tr>
<td>4.00 pm – 4.30 pm</td>
<td>Break</td>
<td>I &amp; II</td>
<td></td>
</tr>
<tr>
<td>4.30 pm – 6.30 pm</td>
<td>Lecture Sessions or Films on Universal Human Values / Cultural / Talent</td>
<td>II</td>
<td>Conference/Seminar Hall</td>
</tr>
<tr>
<td></td>
<td>hunt Activities / Performances by Classical or folk artists</td>
<td>I</td>
<td>Sports Ground</td>
</tr>
<tr>
<td></td>
<td>Sports &amp; Games</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.30 pm – 6.30 pm</td>
<td>Local visits</td>
<td>02/03</td>
<td>Historical places in and around the area</td>
</tr>
<tr>
<td></td>
<td>sections (by rotation)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.30 pm – 9.30 pm</td>
<td>Rest and Dinner</td>
<td>I &amp; II</td>
<td>Respective Hostels</td>
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**DAY 4**

<table>
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<td>6:00 am</td>
<td>Wake up call</td>
<td>I &amp; II</td>
<td>Respective Hostels</td>
</tr>
<tr>
<td>6:30 am - 7:20 am</td>
<td>Physical activity (mild exercise/yoga)</td>
<td>I &amp; II</td>
<td>Sports Ground</td>
</tr>
<tr>
<td>7:30 am - 9:20 am</td>
<td>Bath, Breakfast etc.</td>
<td>I &amp; II</td>
<td>Respective Hostels</td>
</tr>
<tr>
<td>9.30 am – 10.30 am</td>
<td>Universal Human Values</td>
<td>I (Section wise)</td>
<td>Suitable venue as per number of sections</td>
</tr>
<tr>
<td></td>
<td>Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker</td>
<td>II</td>
<td>Conference/Seminar Hall</td>
</tr>
<tr>
<td>10.30 am – 11.00 am</td>
<td>Break</td>
<td>I &amp; II</td>
<td></td>
</tr>
<tr>
<td>11.00 am – 12.00 pm</td>
<td>Creative Arts / Technical Workshops / Proficiency Modules</td>
<td>I (Section wise)</td>
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<td>Conference/Seminar Hall</td>
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<td>12.30 pm – 2.30 pm</td>
<td>Lunch Break</td>
<td>I &amp; II</td>
<td>Respective Hostels</td>
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<td>2.30 pm – 3.30 pm</td>
<td>Universal Human Values</td>
<td>II (Section wise)</td>
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<td>Conference/Seminar Hall</td>
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<tr>
<td>Time</td>
<td>Activity</td>
<td>Section</td>
<td>Venue</td>
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<td>3.30 pm – 4.30 pm</td>
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<td>Break</td>
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<tr>
<td>5.00 pm – 7.00 pm</td>
<td>Lecture Sessions or Films on Universal Human Values / Cultural / Talent hunt Activities / Performances by Classical or folk artists</td>
<td>II</td>
<td>Conference/Seminar Hall</td>
</tr>
<tr>
<td></td>
<td>Sports &amp; Games</td>
<td>I</td>
<td>Sports Ground</td>
</tr>
<tr>
<td>2.30 pm – 7.00 pm</td>
<td>Local visits</td>
<td>02/03 sections (by rotation)</td>
<td>Historical places in and around the area</td>
</tr>
<tr>
<td>7.00 pm – 9.30 pm</td>
<td>Rest and Dinner</td>
<td>I &amp; II</td>
<td>Respective Hostels</td>
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**DAY 5**

<table>
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<th>Section</th>
<th>Venue</th>
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</thead>
<tbody>
<tr>
<td>6:00 am</td>
<td>Wake up call</td>
<td>I &amp; II</td>
<td>Respective Hostels</td>
</tr>
<tr>
<td>6:30 am – 7:20 am</td>
<td>Physical activity (mild exercise/yoga)</td>
<td>I &amp; II</td>
<td>Sports Ground</td>
</tr>
<tr>
<td>7:30 am – 9:20 am</td>
<td>Bath, Breakfast etc.</td>
<td>I &amp; II</td>
<td>Respective Hostels</td>
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<tr>
<td>9:30 am – 10:30 am</td>
<td>Universal Human Values</td>
<td>II (Section wise)</td>
<td>Suitable venue as per number of sections</td>
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<td>Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker</td>
<td>I</td>
<td>Conference/Seminar Hall</td>
</tr>
<tr>
<td>10:30 am – 11:00 am</td>
<td>Break</td>
<td>I &amp; II</td>
<td></td>
</tr>
<tr>
<td>11.00 am – 12.00 pm</td>
<td>Creative Arts / Technical Workshops / Proficiency Modules</td>
<td>II (Section wise)</td>
<td>Suitable venue as per number of sections</td>
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<td></td>
<td>Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker</td>
<td>I</td>
<td>Conference/Seminar Hall</td>
</tr>
<tr>
<td>12.30 pm – 2.30 pm</td>
<td>Lunch Break</td>
<td>I &amp; II</td>
<td>Respective Hostels</td>
</tr>
<tr>
<td>2.30 pm – 3.30 pm</td>
<td>Universal Human Values</td>
<td>I (Section wise)</td>
<td>Suitable venue as per number of sections</td>
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<td>Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker</td>
<td>II</td>
<td>Conference/Seminar Hall</td>
</tr>
<tr>
<td>3.30 pm – 4.30 pm</td>
<td>Creative Arts / Technical Workshops / Proficiency Modules</td>
<td>I (Section wise)</td>
<td>Suitable venue as per number of sections</td>
</tr>
<tr>
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<td>Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker</td>
<td>II</td>
<td>Conference/Seminar Hall</td>
</tr>
<tr>
<td>4.30 pm – 5.00 pm</td>
<td>Break</td>
<td>I &amp; II</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>Activity</td>
<td>Section</td>
<td>Venue</td>
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</tr>
<tr>
<td>5.00 pm –</td>
<td>Lecture Sessions or Films on Universal Human Values / Cultural / Talent</td>
<td>I</td>
<td>Conference/Seminar Hall</td>
</tr>
<tr>
<td>7.00 pm</td>
<td>hunt Activities / Performances by Classical or folk artists (coordinated</td>
<td>II</td>
<td>Sports Ground</td>
</tr>
<tr>
<td></td>
<td>by Students’ Clubs and Technical Societies)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sports &amp; Games</td>
<td>I</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>II</td>
<td></td>
</tr>
<tr>
<td>2.30 pm –</td>
<td>Local visits</td>
<td>02/03</td>
<td>Historical places in and around the</td>
</tr>
<tr>
<td>7.00 pm</td>
<td></td>
<td>sections</td>
<td>area</td>
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<td></td>
<td></td>
<td>(by rota</td>
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<td>tion)</td>
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</tr>
<tr>
<td>7.00 pm –</td>
<td>Rest and Dinner</td>
<td>I &amp; II</td>
<td>Respective Hostels</td>
</tr>
<tr>
<td>9.30 pm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DAY 6</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6:00 am</td>
<td>Wake up call</td>
<td>I &amp; II</td>
<td>Respective Hostels</td>
</tr>
<tr>
<td>6:30 am –</td>
<td>Physical activity (mild exercise/yoga)</td>
<td>I &amp; II</td>
<td>Sports Ground</td>
</tr>
<tr>
<td>7:20 am</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.30 am</td>
<td>Bath, Breakfast etc.</td>
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<td>7.00 pm</td>
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**DAY 7**

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**DAY 8**

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**DAY 9**

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<td>9.30 am –</td>
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**DAY 10**

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<tr>
<td>9.30 am –</td>
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<td>Sports Ground</td>
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<td>Sports Ground</td>
</tr>
<tr>
<td>7:30 am</td>
<td>Bath, Breakfast etc.</td>
<td>I &amp; II</td>
<td>Respective Hostels</td>
</tr>
<tr>
<td>9:30 am –</td>
<td>Universal Human Values</td>
<td>I (Section wise)</td>
<td>Suitable venue as per number of sections</td>
</tr>
<tr>
<td>10.30 am –</td>
<td>Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker</td>
<td>II</td>
<td>Conference/Seminar Hall</td>
</tr>
<tr>
<td>11.00 am –</td>
<td>Break</td>
<td>I &amp; II</td>
<td></td>
</tr>
<tr>
<td>12.00 pm</td>
<td>Creative Arts / Technical Workshops / Proficiency Modules</td>
<td>I (Section wise)</td>
<td>Suitable venue as per number of sections</td>
</tr>
<tr>
<td></td>
<td>Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker</td>
<td>II</td>
<td>Conference/Seminar Hall</td>
</tr>
<tr>
<td>12.30 pm –</td>
<td>Lunch Break</td>
<td>I &amp; II</td>
<td>Respective Hostels</td>
</tr>
<tr>
<td>2.30 pm –</td>
<td>Universal Human Values</td>
<td>II (Section wise)</td>
<td>Suitable venue as per number of sections</td>
</tr>
<tr>
<td>3.30 pm –</td>
<td>Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker</td>
<td>I</td>
<td>Conference/Seminar Hall</td>
</tr>
<tr>
<td>3.30 pm –</td>
<td>Creative Arts / Technical Workshops / Proficiency Modules</td>
<td>II (Section wise)</td>
<td>Suitable venue as per number of sections</td>
</tr>
<tr>
<td>4.30 pm</td>
<td>Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker</td>
<td>I</td>
<td>Conference/Seminar Hall</td>
</tr>
</tbody>
</table>
### Student Induction Program

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Groups</th>
<th>Venue</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.30 pm – 5.00 pm</td>
<td>Break</td>
<td>I &amp; II</td>
<td></td>
</tr>
<tr>
<td>6.00 pm – 8.00 pm</td>
<td>Talent Show and Valedictory Function Principal’s Address</td>
<td>I &amp; II</td>
<td>Suitable venue (indoor/outdoor)</td>
</tr>
<tr>
<td>8.00 pm – 9.30 pm</td>
<td>Rest and Dinner</td>
<td>I &amp; II</td>
<td>Respective Hostels</td>
</tr>
</tbody>
</table>

**Note:**

1. Total duration of the Induction Program is two weeks i.e. 12 working days with Saturdays being working and Sundays off.

2. Sundays can be utilized for screening some Patriotic / Socially Significant Movies in the Jubilee Hall.

3. Faculty mentors would be required to obtain the feedback cum suggestions of the students of their respective groups about the Induction programme on the last day.

4. Coordinators can be assigned for various activities during the induction programme. The suggestive template is as under:

5. | S. No. | Name of the activity                                                                 | Coordinators                  |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Visits to different departments and around the campus</td>
<td>HoDs</td>
</tr>
<tr>
<td>2.</td>
<td>Physical/Sports activities in the Sports Ground (Morning as well as Evening)</td>
<td>In charge of Physical Education / Sports</td>
</tr>
<tr>
<td>3.</td>
<td>• Creative Arts / Technical Workshops.</td>
<td>In charge of Technical / Cultural activities</td>
</tr>
<tr>
<td></td>
<td>• Lecture Sessions or Films on Universal Human Values / Cultural / Talent hunt Activities / Performances by Classical or folk artists.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Talent Show and Valedictory Function.</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker</td>
<td>Training &amp; Placement In charge</td>
</tr>
<tr>
<td>5.</td>
<td>Universal Human Values</td>
<td>Suitable Faculty members</td>
</tr>
<tr>
<td>6.</td>
<td>Proficiency Module (English)</td>
<td>Faculty of English language</td>
</tr>
<tr>
<td>7.</td>
<td>Local Visits</td>
<td>Hostel Wardens / Discipline in charge</td>
</tr>
<tr>
<td>8.</td>
<td>• Wake up call/Hostel related activities</td>
<td>Chief Wardens (Boys/Girls)</td>
</tr>
<tr>
<td></td>
<td>• Arrangements at Valedictory Function</td>
<td></td>
</tr>
</tbody>
</table>
Schedule of local visits

<table>
<thead>
<tr>
<th>Dates</th>
<th>Sections</th>
</tr>
</thead>
<tbody>
<tr>
<td>…</td>
<td>…</td>
</tr>
<tr>
<td>…</td>
<td>…</td>
</tr>
<tr>
<td>…</td>
<td>…</td>
</tr>
</tbody>
</table>

Note:

1. The faculty mentors of the respective mentor-mentee groups/sections will accompany the students on local visits.

2. The Institute buses, if there, may be made available for the purpose each day or some other arrangements may be made.

3. Attendance of the students be taken at the time of departure and return.

*****
Appendix - V

List of Books in Hindi
## APPENDIX – V

### LIST OF BOOKS IN HINDI

अभावशिप द्वारा 1998 से संचालित हिंदी की तकनीकी पाठ्यपुस्तक पुस्तकार योजना के
अंतर्गत अब तक की पुस्तकों के लेखकों की सूची—

<table>
<thead>
<tr>
<th>क्रम सं.</th>
<th>लेखक का नाम</th>
<th>पुस्तक का नाम</th>
<th>प्रकाशक एवं पता</th>
<th>संस्करण</th>
</tr>
</thead>
</table>
| 1.     | डॉ. आई. सी. भारती | कैड कैम                                          | दीपक प्रकाशन
dौ, पी. हाउस
1, दुर्गा कोलोनी, 6 नं. चौपाठा
कार्लपी रोड, मुंबई व्यालियर
(म.प्र.)–474006                      | 2015     |
| 2.     | डॉ. पंकज जैन      | विपणन प्रबंध                                      | एस. क. जैन एण्ड सन्स
721, खजांरी सदन,
बॉर्डर का रास्ता,
किशोरपोल बाजार, जयपुर–302003    | 2013     |
| 3.     | श्री शिवानन्द कामदेव | द्रव अभियंत्रिकी एवं द्रवचालित मशीनें          | मैलंसे यूनिभर्सिटी बुक हाउस (म.प.)
लिट. 79, चौड़ा रास्ता, जयपुर        | 2015     |
| 4.     | डॉ. एम.एफ. कुरोंसी | वेदोत संस्थापन तथा अनुसंधान                | दीपक प्रकाशन
डौ, पी. हाउस
1, दुर्गा कोलोनी, 6 नं. चौपाठा
कार्लपी रोड, मुंबई व्यालियर
(म.प्र.)–474006                      | 2014     |
| 5.     | श्री योगेन्द्र वार्षिक | अभियंत्रिकी मापन एवं अनुसंधान अभ्यास          | दीपक प्रकाशन
डौ, पी. हाउस
1, दुर्गा कोलोनी, 6 नं. चौपाठा
कार्लपी रोड, मुंबई व्यालियर
(म.प्र.)–474006                      | प्रथम: 2014 |
| 6.     | डॉ. पंकज जैन      | विद्यार्थी लेखांकन                                  | संजय पब्लिकेशनस
73, मायापुरी कोलोनी, पाल्डी मीणा,
जयपुर–32                           | 2014     |
| 7.     | श्री देवेन्द्र कुमार   | तकनीकी आरंभ                                         | अरिहत प्रकाशन
कार्लिन्द, डौ,पी. नगर, मेरठ
(यूपी)–250002
0121–2401479                       | प्रथम: 2011 |
| 8.     | डॉ. एम.एस. परमार  | सिस्टेम सिलायथ बस्त्रो पर रासायनिक अभिक्रियावरूप    | नॉर्दर्न इंडिया टेक्स्टाइल रिसर्च
एसोसिएशन संकर–23, रजनगर,
गाजियाबाद (उ.प्र.)–201002        | प्रथम: 2011 |
<p>| 9. | श्री डी.वी. गुप्ता | भूकम्प इंजीनियरी तथा आपदा प्रबंधन | एशियन प्लेटफॉर्म, 46/20, कंबल वाला बाग, नई मंडी मुजफ्फरनगर—251001 | प्रथम : 2008—2009 |
| 10. | स्व. श्री बी. एल. गुप्ता | श्री अमित गुप्ता | उच्च सर्वेक्षण | स्टैंडर्ड प्लेटफॉर्म डिस्ट्रीब्यूटर्स 1705—बी, नई सड़क, पोस्ट बॉक्स नं. 1066, दिल्ली—110006 | प्रथम : 2011 |
| 11. | डॉ. आकाश गर्ग | पर्यावरण अभियांत्रिकी तथा सुख्स्था | दीपक प्रकाशन | डी.पी. हाउस 1, दुर्गा कॉलेज, 6 नं. चौराहा, कालपी रोड, मुराद, ग्वालियर (म. प्र.)—474006 |
| 12. | प्रो. एच. के. निहारिक | डॉ. मीरा सिंह | व्यावसायिक अर्थशास्त्र—एक प्रबंधकीय उपाधि | प्रयाग पुत्रक भवन 20—ए, सुनाम सिटी रोड इलाहाबाद—211002 | प्रथम : 2011 |
| 13. | श्री एस.एस.एल. पटेल | तपीय अभियांत्रिकी | स्टैंडर्ड प्लेटफॉर्म डिस्ट्रीब्यूटर्स 1705—बी, नई सड़क, पोस्ट बॉक्स नं. 1066, दिल्ली—110006 | प्रथम : 2010 |
| 14. | श्री संजय गुप्ता | मशीन सिद्धांत | दीपक प्रकाशन | डी. पी. हाउस 1, दुर्गा कॉलेज, 6 नं. चौराहा, कालपी रोड, मुराद, ग्वालियर (म. प्र.)—474006 | 2009 |
| 15. | श्री हेमंत कुमार पारिक | संयोग अनुसंधान एवं सुख्स्था (यात्रिक इंजीनियरी) | स्टैंडर्ड प्लेटफॉर्म डिस्ट्रीब्यूटर्स 1705—बी, नई सड़क, पोस्ट बॉक्स नं. 1066, दिल्ली—110006 | प्रथम : 2011 |
| 16. | श्री राज बहादुर गुप्ता | आयाम उपाधिय की पर्यावरण अनुसंधान तकनीकियाँ | पल्लवी प्रकाशन, सी—16, निवेदनी आवास, बजरंग नगर, कोटा (राजस्थान) | प्रथम : जनवरी 2010 |
| 17. | श्री अजीत कुमार शुक्ला | विविध प्रबंधन | वैभव लक्ष्मी प्रकाशन | बी—21/122—जी, बैजंतका कमच्चा, वाराणसी | 2009 |
| 18. | डॉ. बी.के.एल. श्रीवास्तव | डॉ. अनिल कुमार श्रीवास्तव | व्यावसायिक अर्थशास्त्र | वामु एजुकेशन ऑफ इंडिया, 2/25 अन्सारी रोड, दिल्ली गाँव, नई दिल्ली | प्रथम : 2010 |
| 19. | श्री डी.वी. गुप्ता | श्री विक्रम सिंह | जन स्वास्थ्य इंजीनियरी | एशियन प्लेटफॉर्म, 46/20, कंबल वाला बाग, नई मंडी मुजफ्फरनगर—251001 | दिसंबर संस्करण : 2009—2010 |
| 20. | श्री एस.एस.एल. पटेल | पदार्थ प्रौद्योगिकी | धनात्म राय एड्स का. (बी.) रजि. ऑफिस 4576/15. | 2010 |
| व्यक्ति | उपाधि/प्रेमक | भाषा | शैक्षणिक विषय | विभाग | प्रथम वर्ष स्नातक, संगठन, मुख्यालय | प्रथम सितंबर 2009 | प्रयोग उपयोगी विज्ञान, ग्वालियर | फार्मस्युटिस्ट्स—प्रथम | मेडिको सिकियर परिकीकरण | आगरा—६१/ए. आलोक नगर, आगरा—१० | प्रथम : २००८ |
|-------|-------------|-------|-----------------|------|-----------------------------------|----------------|---------------------------------|-----------------|---------------------------------|------------------|----------------|-------|
| 21. श्री सुनील पाटक | वेब प्रोग्रामिंग | कोलेज बुक हाउस (प्रा.), लि. चौड़ा रासायनिक, जयपुर | प्रथम : २०१० |
| 22. श्री मनोज भट्ट | व्यक्तिगत पहचान में अंगुलियों के निशान | हिंदी माध्यम कार्यालय, विकासविधालय, १० कंसेवली लाइन, दिल्ली | प्रथम सितंबर २००९ |
| 23. श्री ए.के. चौरसिया | महामार्ग आधारात्मिक | दीपक प्रकाशन | प्रथम : २००४ |
| 24. श्री शिवानंद कामडे | महामार्ग आधारात्मिक | दीपक प्रकाशन | प्रथम : २००४ |
| 25. श्री अनिल कुमार सकसेना | तेज स्वास्थ्य विज्ञान | दीपक प्रकाशन | प्रथम : २००८ |
| 26. श्री एस.एस.एल. पटेल | गति संस्तंग आधारात्मिक | दीपक प्रकाशन | प्रथम : २००७ |
| 27. श्री दी.वी. गुप्ता | भवनों व सिविल निर्माण के प्राक्कलन, तापमान एवं मूल्यांकन | उस्मान नंदलिङ्गम, ४६/२०, कमल वाला बाग, नई दिल्ली | प्रथम : २०१४ |
| 28. श्री एच.आर. मोहन | अनुभूति हांगिक | किंग सिड्नी पार्क, एनडी बिहार, नई दिल्ली | प्रथम : २०१४ |
| 29. श्रीमती ममता अध्यापिका | डिजिटल इलेक्ट्रॉनिक | दीपक प्रकाशन | प्रथम : २०१४ |
| 30. श्री सी.वी. गुप्ता | भवन निर्माण एवं अनुसंधान | उस्मान नंदलिङ्गम, ४६/२०, कमल वाला बाग, नई मण्डिर मुजफ्फरनगर—२५१००१ | प्रथम : २०१४ |
| 31. श्री साहब सरन सतसंगी | सरल वर्तमान रचना | डेस्ट्रेक्टिव पंजीर ५३—५३/वी/एस—IV | प्रथम : २००५ |
| 32. श्री एस.एस.एल. पटेल | तौलोगिक आधारात्मिक | दीपक प्रकाशन, ग्वालियर | प्रथम : २००५ |
| | | | | | | | | | | संस्करण—१ |</p>
<table>
<thead>
<tr>
<th>नं.</th>
<th>नाम</th>
<th>विषय</th>
<th>भवन/कॉलोनी, मीना पालडी, जयपुर</th>
<th>प्रथम: 2016 द्वितीय: अप्रैल 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>33.</td>
<td>श्री दिलीप गागिल</td>
<td>अनुप्रयुक्त यात्रिकी</td>
<td>संजय पश्चिमकेशन्स, 73, मयापुरी</td>
<td>कॉलोनी, मीना पालडी, जयपुर</td>
</tr>
<tr>
<td>34.</td>
<td>डॉ. आई.सी. भारसी</td>
<td>शक्ति संयुक्त अभियात्त्रीको</td>
<td>मैसर्स यूनिवर्सिटी बुक हाउस (प्रा.) लि</td>
<td>79 ए चौड़ा, जयपुर</td>
</tr>
<tr>
<td>37.</td>
<td>डॉ. शामिला जे.नी</td>
<td>प्रायोगिक रसायन विज्ञान</td>
<td>संजय पश्चिमकेशन्स, 73, मयापुरी कॉलोनी, मीना पालडी, जयपुर</td>
<td>2016</td>
</tr>
<tr>
<td>38.</td>
<td>डॉ. संगीता साकसेना</td>
<td>खादी विकास एवं भावी स्वरूप</td>
<td>राजस्थान हिन्दी ग्रंथ अकादमी, प्लांट नं. 1, झालाना सांस्थानिक क्षेत्र जयपुर</td>
<td>प्रथम</td>
</tr>
</tbody>
</table>