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

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रमेश पोखरियाल 'निशंक'
Ramesh Pokhriyal 'Nishank'

सत्यमेव जयते

मंत्री
मानव संसाधन विकास
भारत सरकार
MINISTER
HUMAN RESOURCE DEVELOPMENT
GOVERNMENT OF INDIA

MESSAGE

The effectiveness of 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.

(Ramesh Pokhriyal 'Nishank')

सबको शिक्षा, अच्छी शिक्षा।

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सत्यमेव जयते

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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

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Prof. O. R. Jaiswal ***Department of Applied Mechanics, Visvesvaraya National Institute of Technology, Nagpur***	***Chairman***
Dr. Hemant Sood ***Professor & Head, Department of Civil Engineering*** ***National Institute of Technical Teachers Training & Research Chandigarh***	***Member***
Dr. D.K Parbat, ***HOD Civil Engineering,*** ***Government Polytechnic, Chandrapur, Maharashtra***	***Member***
Shri Rajender Garg *General Manager (Tech.)* *National Highway Authority of India, New Delhi*	***Member***

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Dr. A. Veeresh Babu, Assoc. Professor, ***National Institute of Technology, Warangal***	***Member***
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Prof. Sanjeev Sofat, ***Deptt of Computer Science, PEC University, Sector 12, Chandigarh***	***Member***
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Shri Murali Mohan Josyula, ***GM Wipro Technologies***	***Member***

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Shri Ashish Bhushan DGM (TS & QC)-PNC IndianOil Corporation, Panipat Refinery	*Member*
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Ms. Komal Gupta, Sr. Systems Engineer, BrahMos Aerospace, New Delhi	*Member*
Prof. Ghanshyam Singh, Professor, ECE, MNIT, Jaipur	*Member*

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Applied Sciences & Humanities

Dr. B. C. Choudhary, Professor & Head *Dept. of Applied Science, N.I.T.T.T.R., Chandigarh*	*Chairman*
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Dr. G H Hugar, Asstt. Prof. (Sl. Gr) in Chemistry, CCET (Diploma Wing), Sector-26, Chandigarh	*Member*

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CONTENTS

CHAPTER
1

General Course Structure & Credit Distribution

Definition of Credit:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week	0.5 credit
2 Hours Practical (P) per week	1 credit

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:

Sr. No.	Category	Suggested Breakup of Credits
1.	Humanities & Social Sciences courses	8*
2.	Basic Science courses	19*
3.	Engineering Science courses	15*
4.	Program Core courses (Branch specific)	45*
5.	Program Elective courses (Branch specific)	12*
6.	Open Elective courses (from other technical and /or emerging subjects)	9*
7.	Project work, seminar and internship in industry or elsewhere	12*
8.	Audit Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge etc.]	(non-credit)
	Total	**120***

**Minor variation is allowed as per need of the respective disciplines.*

C. Course code and definition:

Course code	Definitions
L	Lecture
T	Tutorial
P	Practical
HS	Humanities & Social Sciences Courses
BS	Basic Science Courses
ES	Engineering Science Courses
PC	Program Core Courses
PE	Program Elective Courses
OE	Open Elective Courses
AU	Audit Courses
SI	Summer Internship
PR	Project
SE	Seminar

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

Sl. No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1.	HS101	Communication Skills in English	2	0	0	I	2
2.	HS103	Sports and Yoga	0	0	2	I	1
3.	HS105	Communication Skills in English Lab	0	0	2	I	1
4.	HS302	Entrepreneurship and Start-ups	3	1	0	VI	4
Total Credits							**8**

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BASIC SCIENCES COURSE [BS]

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

Sl. No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1.	BS101	Mathematics-I	2	1	0	I	3
2.	BS103	Applied Physics-I	2	1	0	I	3
3.	BS105	Applied Chemistry	2	1	0	I	3
4.	BS107	Applied Physics-I Lab	0	0	2	I	1
5.	BS109	Applied Chemistry Lab	0	0	2	I	1
6.	BS102	Mathematics-II	3	1	0	II	4
7.	BS104	Applied Physics-II	2	1	0	II	3
8.	BS106	Applied Physics-II Lab	0	0	2	II	1
Total Credits							**19**

ENGINEERING SCIENCE COURSES [ES]

Note:
(i) Number of Engineering Sciences Courses: 8
(ii) Credits: 15

Sl. No	Code No.	Course Title	Hours per week			Semes-ter	Credits
			L	T	P		
1.	ES101	Engineering Graphics	0	0	3	I	1.5
2.	ES103	Engineering Workshop Practice	0	0	3	I	1.5
3.	ES102	Introduction to IT Systems	2	0	0	II	2
4.	ES104	Fundamentals of Electrical & Electronics Engineering	2	1	0	II	3
5.	ES106	Engineering Mechanics	2	1	0	II	3
6.	ES108	Introduction to IT Systems Lab	0	0	4	II	2
7.	ES110	Fundamentals of Electrical & Electronics Engineering Lab	0	0	2	II	1
8.	ES112	Engineering Mechanics Lab	0	0	2	II	1
Total Credits							**15**

PROGRAM CORE COURSES [PC]

Note:

(i) Number of Program Core Courses: 20 to 30 (including lab courses)

(ii) Credits: 40 - 50

Sl. No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1	**PC###						
.							
.							
n							
Total Credits							**40 - 50**

** 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

Sl. No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1	**PE###						
.							
.							
n							
Total Credits							**12-16**

** 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

Sl. No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1	**OE###						
.							
.							
n							
Total Credits							**9-12**

** 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

Sl. No	Code No.	Course Title	Hours per week			Semes-ter	Credits
			L	T	P		
1.	SI201	Summer Internship – I (3-4 weeks) after IInd Sem					2
2.	SI301	Summer Internship – II (4-6 weeks) after IVth Sem					3
3.	PR 202	Minor Project	0	0	4	IV	2
4.	PR302	Major Project	0	0	2	V	4
5.			0	0	6	VI	
6.	SE302	Seminar	1	0	0	VI	1
Total Credits							**12**

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.

Sl. No	Code No.	Course Title	Hours per week			Semes-ter	Credits
			L	T	P		
1.	AU102	Environmental Science	2	0	0	II	0
2.	AU202	Essence of Indian Knowledge and Tradition	2	0	0	IV	0
3.	AU302	Indian Constitution	2	0	0	VI	0
Total Credits							**0**

DESCRIPTION OF BRANCH CODES

Sr. No.	Branch	Code
1.	Civil Engineering	CE
2.	Computer Engineering	CO
3.	Electronics and Communication Engineering	EC
4.	Electrical Engineering	EE
5.	Mechanical Engineering	ME
6.	Production Engineering	PE
7.	Information Technology	IT
8.	Chemical Engineering	CH

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)	Two-week duration
Induction program for students to be offered right at the start of the first year.	• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to local Areas • Familiarization to Dept./Branch & Innovations

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:

Range of Marks	Assigned Grade
91-100	AA/A$^+$
81-90	AB/A
71-80	BB/B$^+$
61-70	BC/B
51-60	CC/C$^+$
46-50	CD/C
40-45	DD/D
< 40	FF/F (Fail due to less marks)
-	F^R (Fail due to shortage of attendance and therefore, to repeat the course)

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CHAPTER 2

First Year Curriculum Structure

(Common to all Branches)

Semester I
(Common to all Branches)

Sl. No	Category of Course	Code No.	Course Title	Hours per week			Total contact hrs/ week	Cred-its
				L	T	P		
1.	Basic Science	BS101	Mathematics-I	2	1	0	3	3
2.	Basic Science	BS103	Applied Physics-I	2	1	0	3	3
3.	Basic Science	BS105	Applied Chemistry	2	1	0	3	3
4.	Humanities & Social Science	HS101	Communication Skills in English	2	0	0	2	2
5.	Engineering Science	ES101	Engineering Graphics	0	0	3	3	1.5
6.	Engineering Science	ES103	Engineering Workshop Practice	0	0	3	3	1.5
7.	Basic Science	BS107	Applied Physics-I Lab	0	0	2	2	1
8.	Basic Science	BS109	Applied Chemistry Lab	0	0	2	2	1
9.	Humanities & Social Science	HS103	Sports and Yoga	0	0	2	2	1
10.	Humanities & Social Science	HS105	Communication Skills in English Lab	0	0	2	2	1
	Total Credits							**18**

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Semester II
(Common to all Branches)

Sl. No	Category of Course	Code No.	Course Title	Hours per week L	T	P	Total contact hrs/ week	Cred-its
1	Basic Science	BS102	Mathematics-II	3	1	0	4	4
2	Basic Science	BS104	Applied Physics-II	2	1	0	3	3
3	Engineering Science	ES102	Introduction to IT Systems	2	0	0	2	2
4	Engineering Science	ES104	Fundamentals of Electrical & Electronics Engineering	2	1	0	3	3
5	Engineering Science	ES106	Engineering Mechanics	2	1	0	3	3
6	Basic Science	BS106	Applied Physics-II Lab	0	0	2	2	1
7	Engineering Science	ES108	Introduction to IT Systems Lab	0	0	4	4	2
8	Engineering Science	ES110	Fundamentals of Electrical & Electronics Engineering Lab	0	0	2	2	1
9	Engineering Science	ES112	Engineering Mechanics Lab	0	0	2	2	1
10	Audit	AU102	Environmental Science	2	0	0	2	0
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 $\lim_{x \to a} \frac{x^n - a^n}{x-a}$, $\lim_{x \to 0} \frac{\sin x}{x}$, $\lim_{x \to a} \left(\frac{a^x - 1}{x}\right)$ and $\lim_{x \to a} (1+x)^{\frac{1}{x}}$.

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-movier'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 ${}^nP_r$ and ${}^nC_r$.

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:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 40th Edition, 2007.
2. G. B. Thomas, R. L. Finney, Calculus and Analytic Geometry, Addison Wesley, 9th Edition, 1995.
3. Reena Garg, Engineering Mathematics, Khanna Publishing House, New Delhi (Revised Ed. 2018)
4. V. Sundaram, R. Balasubramanian, K.A. Lakshminarayanan, Engineering Mathematics, 6/e., Vi-

kas Publishing House.
5. Reena Garg & Chandrika Prasad, Advanced Engineering Mathematics, Khanna Publishing House, New Delhi

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.

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Course Code	:	BS103
Course Title	:	Applied Physics –I
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	High School Level Physics
Course Category	:	BS

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
2. Applied Physics, Vol. I and Vol. II, TTTI Publications, Tata McGraw Hill, Delhi.
3. Concepts in Physics by HC Verma, Vol. I & II, Bharti Bhawan Ltd. New Delhi
4. Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi
5. Engineering Physics by DK Bhhatacharya & PoonamTandan; Oxford University Press, New Delhi.
6. Comprehensive Practical Physics, Vol, I & II, JN Jaiswal, Laxmi Publications (P) Ltd., New Delhi
7. Practical Physics by C. L. Arora, S. Chand Publication.
8. e-books/e-tools/ learning physics software/websites etc.

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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 (H_2, F_2, HF hybridization in $BeCl_2$, BF_3, CH_4, NH_3, H_2O), coordination bond in NH_4^+, and anomalous properties of NH_3, H_2O 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):

  Port land 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), H_2 liberation and O_2 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 $BeCl_2$, BF_3, CH_4, NH_3, H_2O.

- **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 in to 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 recourses in India. Collection of data of various lubricants available in the market.

- **Unit 5: Electro Chemistry**

  Assignments: Simple problems on Faradays 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.
4. Choose fuel and lubricants suitable for economical industrial processing to obtain eco-friendly finished products.
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.
2) Agarwal, & Shikha, Engineering Chemistry, Cambridge University Press; New Delhi, 2015.
3) C.N. R. Rao, Understanding Chemistry, Universities Press (India) Pvt. Ltd., 2011.
4) Dara, S. S. & Dr.S.S.Umare, Engineering Chemistry, S.Chand. Publication, New Delhi, New Delhi, 2015.
5) Jain & Jain, Engineering Chemistry, Dhanpat Rai and Sons; New Delhi, 2015.
6) Dr. Vairam, S., Engineering Chemistry, Wiley India Pvt.Ltd., New Delhi, 2013.
7) Dr. G. H. Hugar & Prof A. N. Pathak, Applied Chemistry Laboratory Practices, Vol. I and Vol. II, NITTTR, Chandigarh, Publications, 2013-14.
8) Agnihotri, Rajesh, Chemistry for Engineers, Wiley India Pvt.Ltd., 2014.

(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)
6 www.em-ea.org/guide%20books/book-2/2.1%20fuels%20and%20combustion.pdf (Fuel and Combustion)
7 www.chemcollective.org (Metals, Alloys)
8 www.wqa.org(Water Treatment)

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Course Code	:	HS101
Course Title	:	Communication Skills in English
Number of Credits	:	2(L:2,T:0,P:0)
Prerequisites	:	NIL
Course Category	:	HS

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

- Introduction: Soft Skills and Hard Skills.
- 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:

1. J.D.O'Connor. *Better English Pronunciation.* Cambridge: Cambridge University Press, 1980.
2. Lindley Murray. *An English Grammar: Comprehending Principles and Rules.* London: Wilson and Sons, 1908.
3. Kulbhushan Kumar, Effective Communication Skills, Khanna Publishing House, New Delhi (Revised Edition 2018)
4. Margaret M. Maison. *Examine your English.* Orient Longman: New Delhi, 1964.
5. M. Ashraf Rizvi. *Effective Technical Communication*. Mc-Graw Hill: Delhi, 2002.
6. John Nielson. *Effective Communication Skills.* Xlibris, 2008.
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.

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Course Code	:	ES101
Course Title	:	Engineering Graphics
Number of Credits	:	1.5 (L: 0, T: 0, P: 3)
Prerequisites	:	NIL
Course Category	:	ES

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.

S. No.	Practical Exercises	Unit No.	Approx. Hrs
1	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)	I	02
2	Write alphabets and numerical (Vertical only) (do this exercise in sketch book)	I	02
3	Draw regular geometric constructions and redraw the given figure (do this exercise in sketch book) Part I	II	02
4	Draw regular geometric construction and redraw the given figure (do this exercise in sketch book) Part II	II	02
5	Draw a problem on orthographic projections using first angle method of projection having plain surfaces and slanting. Part I	III	02
6	Draw another problem on orthographic projections using first angle method of projection having slanting surfaces with slots. Part II	III	02
7	Draw two problems on orthographic projections using first angle method of projection having cylindrical surfaces, ribs. Part I	III	02
8	Draw two problems on Isometric view of simple objects having plain and slanting surface by using natural scale. Part I	IV	02
9	Draw some problems on Isometric projection of simple objects having cylindrical surface by using isometric scale. Part I	IV	02
10	Draw free hand sketches/ conventional representation of machine elements in sketch book such as thread profiles, nuts, bolts, studs, set screws, washers, Locking arrangements. Part I	V	02
11	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	III, II, V	02
12	Draw basic 2D entities like: Rectangle, Rhombus, Polygon using AutoCAD (Print out should be a part of progressive assessment). Part I	V	02
13	Draw basic 2D entities like: Circles, Arcs, circular using AutoCAD (Printout should be a part of progressive assessment). Part II	V	02
14	Draw basic 2D entities like: Circular and rectangular array using AutoCAD (Printout should be a part of progressive assessment). Part III	V	02

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	V	02
16	Draw basic branch specific components in 2D using AutoCAD (Print out should be a part of term work). Part I	VI	02
17	Draw complex branch specific components in 2D using AutoCAD (Print should be a part of progressive assessment). Part I	VI	02
	Total		**34**

SUGGESTED LEARNING RESOURCES

1. Bureau of Indian Standards. *Engineering Drawing Practice for Schools and Colleges IS: Sp-46.* BIS. Government of India, Third Reprint, October 1998; ISBN: 81-7061-091-2.
2. Bhatt, N. D. *Engineering Drawing*. Charotar Publishing House, Anand, Gujrat 2010; ISBN: 978-93-80358-17-8.
3. Jain & Gautam, Engineering Graphics & Design, Khanna Publishing House, New Delhi (ISBN: 978-93-86173-478)
4. Jolhe, D. A. *Engineering Drawing*. Tata McGraw Hill Edu. New Delhi, 2010; ISBN: 978-0-07-064837-1
5. Dhawan, R. K. *Engineering Drawing*. S. Chand and Company, New Delhi; ISBN: 81-219-1431-0.
6. Shah, P. J. *Engineering Drawing*. S. Chand and Company, New Delhi, 2008, ISBN:81-219-2964-4.
7. Kulkarni, D. M.; Rastogi, A. P.; Sarkar, A. K. *Engineering Graphics with AutoCAD*. PHI Learning Private Limited-New Delhi (2010); ISBN: 978-8120337831.
8. Jeyapoovan, T. *Essentials of Engineering Drawing and Graphics using AutoCAD*. Vikas Publishing HousePvt. Ltd, Noida, 2011; ISBN: 978-8125953005.
9. Autodesk. *AutoCAD User Guide*. Autodesk Press, USA, 2015.
10. Sham, Tickoo. *AutoCAD 2016 for Engineers and Designers*. Dreamtech Press; Galgotia Publication, New Delhi, 2015; ISBN 978-9351199113.

Software/Learning Websites

1. https://www.youtube.com/watch?v=TJ4jGyD-WCw
2. https://www.youtube.com/watch?v=dmt6_n7Sgcg
3. https://www.youtube.com/watch?v=_MQScnLXL0M
4. https://www.youtube.com/watch?v=3WXPanCq9LI
5. https://www.youtube.com/watch?v=fvjk7PlxAuo
6. http://www.me.umn.edu/coursesme2011/handouts/engg%20graphics.pdf
7. 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

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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 practic-es

Course Content:

S.No.	Details Of Practical Content
I	**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.
II	**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
III	**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
IV	**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.
V	**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 sep-arate switches, (iii) Connection of Fluorescent lamp/tube light, (iv) simple lamp circuits-in-stall bedroom lighting. And (v) Simple lamp circuits- install stair case wiring.
VI	**Demonstration:** i) Demonstration of measurement of Current, Voltage, Power and Energy. ii) Demonstration of advance power tools, pneumatic tools, electrical wiring tools and acces-sories. iii) Tools for Cutting and drilling

References:

1. S.K. Hajara Chaudhary, Workshop Technology, Media Promoters and Publishers, New Delhi, 2015
2. B.S. Raghuwanshi, Workshop Technology, Dhanpat Rai and sons, New Delhi 2014
3. K. Venkat Reddy, Workshop Practice Manual, BS Publications, Hyderabad 2014
4. Kents Mechanical Engineering Hand book, John Wiley and Sons, New York

Course outcomes

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

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

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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 ACTIVITES & 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
2. Comprehensive Practical Physics, Vol, I & II, JN Jaiswal, Laxmi Publications (P)Ltd.,
3. Practical Physics by C. L. Arora, S. Chand Publication.
4. e-books/e-tools/ learning physics software/YouTube videos/websites etc.

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Course Code	:	BS109
Course Title	:	Applied Chemistry Lab
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	NIL
Course Category	:	BS

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 $KMnO_4$ solution using standard oxalic acid and Determine the percentage of iron present in given Hematite ore by $KMnO_4$ 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.
9. Determination of the Iron content in given cement sample using colorimeter.
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:

1. Text Book of Chemistry for Class XI & XII (Part-I, Part-II); N.C.E.R.T., Delhi, 2017-18.
2. Dr. G. H. Hugar and Prof A. N. Pathak, Applied Chemistry Laboratory Practices, Vol. I and Vol. II, NITTTR, Chandigarh, Publications, 2013-14.
3. Agnihotri, Rajesh, Chemistry for Engineers, Wiley India Pvt.Ltd., 2014.
4. Jain & Jain, Engineering Chemistry, Dhanpat Rai and Sons; New Delhi, 2015.

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Course Code	:	HS103
Course Title	:	Sports and Yoga
Number of Credits	:	1(L:0,T:0,P:2)
Prerequisites	:	NIL
Course Category	:	HS

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, Dhayanchand 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
  - Effect of exercise on the functioning of Various Body Systems. (Circulatory System, Respiratory System, Neuro-Muscular System etc.)
- **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.
  - Obesity: Procedure, Benefits & contraindications for Vajrasana, Hastasana, Trikonasana, Ardh Matsyendrasana.
  - Back Pain: Tadasana, Ardh Matsyendrasana, Vakrasana, Shalabhasana, Bhujangasana.
  - Diabetes: Procedure, Benefits & contraindications for Bhujangasana, Paschimottasana, Pavan Muktasana, Ardh Matsyendrasana.
  - Asthema: Procedure, Benefits & contraindications for Sukhasana, Chakrasana, Gomukhasana, Parvatasana, Bhujangasana, Paschimottasana, Matsyasana.
- **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.
  - Latest General Rules 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.

(xi) Demonstrate an understanding of sound nutritional practices as related to health and physical performance.

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

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

(xiv) Understand and correctly apply biomechanical and physiological principles elated to exercise and training.

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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 1 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:
1. Daniel Jones. *The Pronunciation of English.* Cambridge: Cambridge University Press, 1956.
2. James Hartman& et al. Ed. *English Pronouncing Dictionary.* Cambridge: Cambridge University

Press, 2006.

3. Kulbhushan Kumar, Effective Communication Skills, Khanna Publishing House, New Delhi (Revised Ed. 2018)
4. J.D.O'Connor. *Better English Pronunciation.* Cambridge: Cambridge University Press, 1980.
5. Lindley Murray. *An English Grammar: Comprehending Principles and Rules.* London: Wilson and Sons, 1908.
6. Margaret M. Maison. *Examine your English.* Orient Longman: New Delhi, 1964.
7. J.Sethi & et al. *A Practice Course in English Pronunciation*. New Delhi: Prentice Hall, 2004.
8. Pfeiffer, William Sanborn and T.V.S Padmaja. *Technical Communication: A Practical Approach*. 6th ed. Delhi: Pearson, 2007.

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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Semester - II

Course Code	:	BS102
Course Title	:	Mathematics - II
Number of Credits	:	4 (L: 3, 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 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 $\int_0^{\frac{\pi}{2}} \sin^n x\, dx$, $\int_0^{\frac{\pi}{2}} \cos^n x\, dx$ and $\int_0^{\frac{\pi}{2}} \sin^m x \cos^n x\, dx$ 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:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 40^{th} Edition, 2007.
2. G. B. Thomas, R. L. Finney, Calculus and Analytic Geometry, Addison Wesley, 9^{th} Edition, 1995.
3. S.S. Sabharwal, Sunita Jain, Eagle Parkashan, Applied Mathematics, Vol. I & II, Jalandhar.
4. Comprehensive Mathematics, Vol. I & II by Laxmi Publications, Delhi.
5. Reena Garg & Chandrika Prasad, Advanced Engineering Mathematics, Khanna Publishing House, New Delhi

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.

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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

Electric Current and its units, Direct and alternating current, Resistance and its units, Specific resistance, Conductance, Specific conductance, Series and parallel combination of resistances. Factors affecting resistance of a wire, carbon resistances and colour coding.

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 magnetic 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, computers, 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
2. Applied Physics, Vol. I and Vol. II, TTTI Publications, Tata McGraw Hill, Delhi
3. Concepts in Physics by HC Verma, Vol. I & II, Bharti Bhawan Ltd. New Delhi
4. Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi.
5. Modern approach to Applied Physics-I and II, AS Vasudeva, Modern Publishers.
6. A Textbook of Optics, N Subramanyam, Brij Lal, MN Avahanulu, S Chand and Company Ltd.
7. Introduction to Fiber Optics, Ajoy Ghatak and K Thyagarajan, Cambridge University Press India Pvt. Ltd, New Delhi.
8. Nanoscience and Nanotechnology, KK Choudhary, Narosa Publishing House, Pvt. Ltd. New Delhi.
9. Nanotechnology: Importance and Applications, M.H. Fulekar, IK International Publishing House Pvt. Ltd, New Delhi.
10. e-books/e-tools/ learning physics software/websites etc.

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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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Course Code	:	ES104
Course Title	:	Fundamentals of Electrical and Electronics Engineering
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	ES

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 <u>Overview of Electronic Components & Signals:</u>

Passive Active Components: Resistances, Capacitors, Inductors, Diodes, Transistors, FET, MOS and CMOS and their Applications. Signals: DC/AC, voltage/current, periodic/non-periodic signals, average, rms, peak values, different types of signal waveforms, Ideal/non-ideal voltage/current sources, independent/dependent voltage current sources.

UNIT II <u>Overview of Analog Circuits:</u>

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 III Overview of Digital Electronics: Introduction to Boolean Algebra, Electronic Implementation of Boolean Operations, Gates-Functional Block Approach, Storage elements-Flip Flops-A Functional block approach, Counters: Ripple, Up/down and decade, Introduction to digital IC Gates (of TTL Type).

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
2. Mittle and Mittal, Basic Electrical Engineering, McGraw Education, New Delhi, 2015, ISBN : 978-0-07-0088572-5
3. Saxena, S. B. Lal, Fundamentals of Electrical Engineering, Cambridge University Press, latest edition ISBN : 9781107464353
4. Theraja, B. L., Electrical Technology Vol – I, S. Chand Publications, New Delhi, 2015, ISBN: 9788121924405
5. Theraja, B. L., Electrical Technology Vol – II, S. Chand Publications, New Delhi, 2015, ISBN: 9788121924375
6. Jegathesan, V., Basic Electrical and Electronics Engineering, Wiley India, New Delhi, 2015, ISBN : 97881236529513
7. Sedha, R.S., A text book of Applied Electronics, S.Chand, New Delhi, 2008, ISBN-13: 978-8121927833
8. Malvino, Albert Paul, David, Electronics Principles, McGraw Hill Education, New Delhi,2015, ISBN-13: ٠٠٧٠٦٣٤٢٤٤-٩٧٨
9. Mehta, V.K., Mehta, Rohit, Principles of Electronics, S. Chand and Company, New Delhi, 2014, ISBN-13-9788121924504
10. Bell Devid, Fundamental of Electronic Devices and Circuits, Oxford University Press, New Delhi 2015 ISBN : 9780195425239

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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:

1. D.S. Bedi, Engineering Mechanics, Khanna Publications, New Delhi (2008)
2. Khurmi, R.S., Applied Mechanics, S. Chand & Co. New Delhi.
3. Bansal R K, A text book of Engineering Mechanics, Laxmi Publications.
4. Ramamrutham, Engineering Mechanics, S. Chand & Co. New Delhi.
5. Dhade, Jamadar & Walawelkar, Fundamental of Applied Mechanics, Pune Vidhyarthi Gruh.
6. Ram, H. D.; Chauhan, A. K., Foundations and Applications of Applied Mechanics, Cambridge University Press.
7. Meriam, J. L., Kraige, L.G., Engineering Mechanics- Statics, Vol. I, Wiley Publication, New Delhi.

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.

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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
2. Comprehensive Practical Physics, Vol, I & II, JN Jaiswal, Laxmi Publications (P) Ltd., New Delhi
3. Practical Physics by C. L. Arora, S. Chand & Company Ltd.
4. e-books/e-tools/ learning physics software/you Tube videos/ websites etc.

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Course Code	:	ES 108
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:

S.No.	Topics for Practice
1	Browser features, browsing, using various search engines, writing search queries
2	Visit various e-governance/Digital India portals, understand their features, services offered
3	Read Wikipedia pages on computer hardware components, look at those components in lab, identify them, recognise various ports/interfaces and related cables, etc.
4	Install Linux and Windows operating system on identified lab machines, explore various options, do it multiple times

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

S. No.	Practical Outcomes (PrOs)	Approx. Hrs.
1.	Determine the permeability of magnetic material by plotting its B-H curve.	02*
2.	Measure voltage, current and power in 1-phase circuit with resistive load.	02*
3.	Measure voltage, current and power in R-L series circuit.	02*
4.	Determine the transformation ratio (K) of 1-phase transformer.	02
5.	Connect single phase transformer and measure input and output quantities.	02
6.	Make Star and Delta connection in induction motor starters and measure the line and phase values.	02
7.	Identify various passive electronic components in the given circuit	02
8.	Connect resistors in series and parallel combination on bread board and measure its value using digital multimeter.	02
9.	Connect capacitors in series and parallel combination on bread board and measure its value using multimeter.	02*

S. No.	Practical Outcomes (PrOs)	Approx. Hrs.
10.	Identify various active electronic components in the given circuit.	02
11.	Use multimeter to measure the value of given resistor.	02
12.	Use LCR-Q tester to measure the value of given capacitor and inductor.	02
13.	Determine the value of given resistor using digital multimeter to confirm with colour code.	02*
14.	Test the PN-junction diodes using digital multimeter.	02*
15.	Test the performance of PN-junction diode.	02
16.	Test the performance of Zener diode.	02
17.	Test the performance of LED.	02
18.	Identify three terminals of a transistor using digital multimeter.	02
19.	Test the performance of NPN transistor.	02*
20.	Determine the current gain of CE transistor configuration.	02
21.	Test the performance of transistor switch circuit.	02
22.	Test the performance of transistor amplifier circuit.	02
23.	Test Op-Amp as amplifier and Integrator	02
	Total	**46**

References:

1. Ritu Sahdev, Basic Electrical Engineering, Khanna Publishing House, 2018
2. Mittle and Mittal, Basic Electrical Engineering, McGraw Education, New Delhi, 2015, ISBN : 978-0-07-0088572-5
3. Saxena, S. B. Lal, Fundamentals of Electrical Engineering, Cambridge University Press, latest edition ISBN : 9781107464353
4. Theraja, B. L., Electrical Technology Vol – I, S. Chand publications, New Delhi, 2015, ISBN: 9788121924405
5. Theraja, B. L., Electrical Technology Vol – II, S. Chand publications, New Delhi, 2015, ISBN: 9788121924375
6. Jegathesan, V., Basic Electrical and Electronics Engineering, Wiley India, New Delhi, 2015, ISBN : 97881236529513
7. Sedha, R.S., A text book of Applied Electronics, S.Chand ,New Delhi, 2008, ISBN-13: 978-8121927833
8. Malvino, Albert Paul, David, Electronics Principles, McGraw Hill Eduction, New Delhi,2015, ISBN-13: ٠٠٧٠٦٣٤٢٤٤-٩٧٨
9. Mehta, V.K., Mehta, Rohit, Principles of Electronics, S. Chand and Company, New Delhi, 2014, ISBN-13-9788121924504
10. Bell Devid, Fundamental of Electronic Devices and Circuits, Oxford University Press, New Delhi 2015 ISBN : 9780195425239

Suggested Softwares/Learning Websites:

a. en.wikipedia.org/wiki/Transformer

b. www.animations.physics.unsw.edu.au//jw/AC.html

c. www.alpharubicon.com/altenergy/understandingAC.htm

d. www.electronics-tutorials

e. learn.sparkfun.com/tutorials/transistors

f. www.pitt.edu/~qiw4/Academic/ME2082/Transistor%20Basics.pdf

g. www.technologystudent.com/elec1/transis1.htm
h. www.learningaboutelectronics.com
i. www.electrical4u.com

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.

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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.
4. Derive Law of machine using Worm and worm wheel.
5. Derive Law of machine using Single purchase crab.
6. Derive Law of machine using double purchase crab.
7. Derive Law of machine using Weston's differential or wormed geared pulley block.
8. Determine resultant of concurrent force system applying Law of Polygon of forces using force table.
9. Determine resultant of concurrent force system graphically.
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.
14. Obtain support reactions of beam using graphical method.
15. Determine coefficient of friction for motion on horizontal and inclined plane.
16. Determine centroid of geometrical plane figures.

Suggested Learning Resources:

1. Bedi D.S., Engineering Mechanics, Khanna Publishing House
2. Khurmi, R.S., Applied Mechanics, S.Chand & Co. New Delhi.
3. Bansal R K, A text book of Engineering Mechanics, Laxmi Publications.
4. Ramamrutham, Engineering Mechanics, S.,S Chand & Co. New Delhi.
5. Dhade, Jamadar & Walawelkar, Fundamental of Applied Mechanics, Pune Vidhyarthi Gruh.
6. Ram, H. D.; Chauhan, A. K. Foundations and Applications of Applied Mechanics, Cambridge University Press.
7. Meriam, J. L., Kraige, L.G. , Engineering Mechanics- Statics, Vol. I, Wiley Publication, New Delhi.

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.

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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

Waste Water Treatment: Primary methods: sedimentation, froth floatation, Secondary methods: Activated sludge treatment, Trickling filter, Bioreactor, Tertiary Method: Membrane separation technology, RO (reverse osmosis).

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

Solar Energy: Basics of Solar energy. Flat plate collector (Liquid & Air). Theory of flat plate collector. Importance of coating. Advanced collector. Solar pond. Solar water heater, solar dryer. Solar stills.

Biomass: Overview of biomass as energy source. Thermal characteristics of biomass as fuel. Anaerobic digestion. Biogas production mechanism. Utilization and storage of biogas.

Wind energy: Current status and future prospects of wind energy. Wind energy in India. 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-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

Air quality act 2004, air pollution control act 1981 and water pollution and control act1996.

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.

References:

(a) Suggested Learning Resources:

Books:

1. S.C. Sharma & M.P. Poonia, Environmental Studies,Khanna Publishing House,NewDelhi
2. C.N. R. Rao, Understanding Chemistry, Universities Press (India) Pvt. Ltd., 2011.

3. Arceivala, Soli Asolekar, Shyam, Waste Water Treatment for Pollution Control and
4. Reuse, Mc-Graw Hill Education India Pvt. Ltd., New York, 2007, ISBN:978-07-062099-
5. Nazaroff, William, Cohen, Lisa, Environmental Engineering Science, Willy, New York, 2000, ISBN 10: 0471144940.
6. O.P. Gupta, Elements of Environmental Pollution Control, Khanna Publishing House, New Delhi
7. Rao, C. S., Environmental Pollution Control and Engineering, New Age International Publication, 2007, ISBN: 81-224-1835-X.
8. Rao, M. N.Rao, H.V.N, Air Pollution, Tata Mc-Graw Hill Publication, New delhi, 1988, ISBN: 0-07-451871-8.
9. Frank Kreith, Jan F Kreider, Principles of Solar Engineering, McGraw-Hill, New York ; 1978, ISBN: 9780070354760.
10. Aldo Vieira, Da Rosa, Fundamentals of renewable energy processes, Academic Press Oxford, UK; 2013. ISBN: 9780123978257.
11. Patvardhan, A.D, Industrial Solid Waste, Teri Press, New Delhi, 2013, ISBN:978-81-7993-502-6
12. Metcalf & Eddy, Waste Water Engineering, Mc-Graw Hill, New York, 2013, ISBN: 077441206.
13. Keshav Kant, Air Pollution & Control, Khanna Publishing House, New Delhi (Edition 2018)

(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.
5. Understand solid Waste Management, ISO 14000 & Environmental Management.

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CHAPTER 3

Civil Engineering Curriculum Structure

(III to VI Semesters)

3.1 List of Programme Core Courses [PC]

Sl. No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1.	CEPC201	Construction Materials	3	0	0	III	3
2.	CEPC203	Basic Surveying	2	0	0	III	2
3.	CEPC205	Mechanics of Materials	2	0	0	III	2
4.	CEPC207	Building Construction	2	0	0	III	2
5.	CEPC209	Concrete Technology	2	0	0	III	2
6.	CEPC211	Geotechnical Engineering	2	0	0	III	2
7.	CEPC213	Construction Materials Lab.	0	0	2	III	1
8.	CEPC215	Basic Surveying Lab.	0	0	2	III	1
9.	CEPC217	Mechanics of Materials Lab.	0	0	2	III	1
10.	CEPC219	Concrete Technology Lab.	0	0	2	III	1
11.	CEPC221	Geotechnical Engineering Lab.	0	0	2	III	1
12.	CEPC202	Hydraulics	2	0	0	IV	2
13.	CEPC204	Advanced Surveying	2	0	0	IV	2
14.	CEPC206	Theory of Structure	2	0	0	IV	2
15.	CEPC208	Building Planning and Drawing	1	0	0	IV	1
16.	CEPC210	Water Resources Engineering	2	0	0	IV	2
17.	CEPC212	Transportation Engineering	2	0	0	IV	2
18.	CEPC214	Hydraulics Lab.	0	0	2	IV	1
19.	CEPC216	Advanced Surveying Lab.	0	0	2	IV	1
20.	CEPC218	Building Planning and Drawing Lab.	0	0	4	IV	2
21.	CEPC220	Water Resources Engineering Lab.	0	0	2	IV	1
22.	CEPC222	Transportation Engineering Lab.	0	0	2	IV	1
23.	CEPC301	Design of Steel and RCC structures	3	0	0	V	3
24.	CEPC303	Estimating and Costing	2	0	0	V	2
25.	CEPC305	Design of Steel and RCC structures Lab.	0	0	2	V	1
26.	CEPC307	Estimating and Costing Lab.	0	0	2	V	1
27.	CEPC302	Public Health Engineering	2	0	0	VI	2
28.	CEPC304	Public Health Engineering Lab.	0	0	2	VI	1
Total Credits							**45**

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3.2 List of Programme Elective Courses [PE]

Sl. No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
Elective I (any one to be selected)							
1	CEPE202	Precast and Prestressed Concrete	3	0	0	IV	3
2	CEPE204	Construction Management	3	0	0	IV	3
3	CEPE206	Rural Construction Technology	3	0	0	IV	3
Elective II (any one to be selected)							
1	CEPE301	Traffic Engineering	3	0	0	V	3
2	CEPE303	Solid Waste Management	3	0	0	V	3
3	CEPE305	Advanced Construction Technology	3	0	0	V	3
Elective III (any one to be selected)							
1	CEPE307	Pavement Design & maintenance	3	0	0	V	3
2	CEPE309	Green Building and Energy Conservation	3	0	0	V	3
3	CEPE311	Building Services and Maintenance	3	0	0	V	3
Elective IV (any one to be selected)							
1	CEPE302	Repairs and Maintenance of Structures	3	0	0	VI	3
2	CEPE304	Advanced Design of Structures	3	0	0	VI	3
3	CEPE306	Tendering and Accounts	3	0	0	VI	3
Total Credits							**12**

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3.3 Semester-wise Detailed Curriculum

Semester III

Sl. No	Category	Code No.	Course Title	Hours per week L	T	P	Total contact hrs/ week	Cred-its
1.	Program core course	CEPC201	Construction Material	3	0	0	3	3
2.	Program core course	CEPC203	Basic Surveying	2	0	0	2	2
3.	Program core course	CEPC205	Mechanics of Mate-rials	2	0	0	2	2
4.	Program core course	CEPC207	Building Construc-tion	2	0	0	2	2
5.	Program core course	CEPC209	Concrete Technology	2	0	0	2	2
6.	Program core course	CEPC211	Geotechnical Engi-neering	2	0	0	2	2
7.	Program core course	CEPC213	Construction Material Lab	0	0	2	2	1
8.	Program core course	CEPC215	Basic Surveying Lab	0	0	2	2	1
9.	Program core course	CEPC217	Mechanics of Materi-als Lab	0	0	2	2	1
10.	Program core course	CEPC219	Concrete Technology Lab	0	0	2	2	1
11.	Program core course	CEPC221	Geotechnical Engi-neering Lab	0	0	2	2	1
12.	Summer Internship-I (4 weeks) after IInd Sem	SI201		0	0	0	0	2
	Total Credits							**20**

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Semester IV

Sl. No	Category	Code No.	Course Title	Hours per week L	T	P	Total contact hrs/ week	Cred-its
1.	Program core course	CEPC202	Hydraulics	2	0	0	2	2
2.	Program core course	CEPC204	Advanced Surveying	2	0	0	2	2
3.	Program core course	CEPC206	Theory of Structure	2	0	0	2	2
4.	Program core course	CEPC208	Building Planning and Drawing	1	0	0	1	1
5.	Program core course	CEPC210	Water Resource Engineering	2	0	0	2	2
6.	Program core course	CEPC212	Transportation Engineering	2	0	0	2	2
7.	Program core course	CEPC214	Hydraulics Lab	0	0	2	2	1
8.	Program core course	CEPC216	Advanced Surveying Lab	0	0	2	2	1
9.	Program core course	CEPC218	Building Planning and Drawing Lab	0	0	4	4	2
10.	Program core course	CEPC220	Water Resource Engineering Lab	0	0	2	2	1
11.	Program core course	CEPC222	Transportation Engineering Lab	0	0	2	2	1
12.	Program Elective course	CEPE20#	Elective - I	3	0	0	3	3
13.	Minor Project	Proj.202		0	0	4	4	2
14.	Mandatory Course	AU202	Essence of Indian Knowledge and Tradition	2	0	0	0	0
	Total Credits							22

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Semester V

Sl. No	Category	Code No.	Course Title	Hours per week L	T	P	Total contact hrs/ week	Credits
1.	Program core course	CEPC301	Design of Steel and RCC structure	3	0	0	3	3
2.	Program core course	CEPC303	Estimating, Costing and valuation	2	0	0	2	2
3.	Program core course	CEPC305	Design of Steel and RCC structure Lab	0	0	2	2	1
4.	Program core course	CEPC307	Estimating, Costing and valuation Lab	0	0	2	2	1
5.	Program Elective course	CEPE30#	Elective - II	3	0	0	3	3
6.	Program Elective course	CEPE30#	Elective -III	3	0	0	3	3
7.	Open Elective	**OE30#		3	0	0	3	3
8.	Summer Internship-II (6 weeks) after IVth Sem	SI301		0	0	0	0	3
9.	Major Project	PR302		0	0	2	2	^
	Total Credits							**19**

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Semester VI

Sl. No	Category	Code No.	Course Title	Hours per week L	T	P	Total contact hrs/ week	Credits
1.	Program core course	CEPC302	Public Health Engg	2	0	0	2	2
2.	Program core course	CEPC304	Public Health Engg Lab	0	0	2	2	1
3.	Program Elective course	CEPE30#	Elective IV	3	0	0	3	3
4.	Humanities and Social Science course	HS302	Entrepreneurship and Start-ups	3	1	0	4	4
5.	Open Elective	**OE30#		3	0	0	3	3
6.	Open Elective	**OE30#		3	0	0	3	3
7.	Mandatory Course	AU302	Indian Constitution	2	0	0	2	0
8.	Major Project	PR302		0	0	6	6	4^
9.	Seminar	SE302		1	0	0	1	1
	Total Credits							**21**

^one credit is carried forward from the V^{th} semester major project evaluation.

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SEMESTER III

Course Code	:	CEPC201
Course Title	:	Construction Materials
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 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: Water proofing, 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:

1. Ghose, D. N., Construction Materials, Tata McGraw Hill, New Delhi.
2. S.K. Sharma, Civil Engineering Construction Materials, Khanna Publishing House, Delhi
3. Varghese, P.C. , Building Materials, PHI learning, New Delhi.
4. Rangwala, S.C., Engineering Materials, Charator publisher, Ahemdabad.
5. Somayaji, Shan, Civil Engineering Materials, Pearson education, New Delhi.
6. Rajput, R.K, Engineering Materials, S. Chand and Co., New Delhi.
7. Sood H., Laboratory Manual on Testing of Engineering Materials, New Age Publishers, New Delhi.
8. Sharma C. P., Engineering Materials, PHI Learning, New Delhi.
9. Duggal, S. K, Building Materials, New International, New Delhi.

Course outcomes:

After competing 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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Course Code	:	CEPC203
Course Title	:	Basic Surveying
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 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.
- Leveling Types: Simple, Differential, Fly, Profile and Reciprocal Leveling.
- 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

1. Punmia, B.C,; Jain, Ashok Kumar; Jain, Arun Kumar, Surveying I, Laxmi Publications, New Delhi.
2. Basak, N. N., Surveying and Levelling, McGraw Hill Education, New Delhi.
3. Kanetkar, T. P.; Kulkarni, S. V., Surveying and Levelling volume I, Pune Vidyarthi Gruh Prakashan.
4. Duggal, S. K., Survey I, McGraw Hill Education, New Delhi.
5. Saikia, M D.; Das. B.M.; Das. M.M., Surveying, PHI Learning, New Delhi.
6. Subramanian, R., Fundamentals of Surveying and Levelling, Oxford University Press. New Delhi.
7. Rao, P. Venugopala Akella, Vijayalakshmi, Textbook of Surveying, PHI Learning New Delhi.
8. Bhavikatti, S. S., Surveying and Levelling, Volume 1, I. K. International, New Delhi.
9. Arora K R , Surveying Vol. I, Standard Book House.

Course outcomes:

After competing 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.

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Course Code	:	CEPC205
Course Title	:	Mechanics of Material
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 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:

1. Bedi D.S. , Strength of Materials, Khanna Publishing House, Delhi, Ed. 2018
2. Timoshenko, S., Strength of Materials, Vol. I, CBS, New Delhi.
3. Khurmi, R.S., Strength of Materials, S Chand and Co. Ltd. New Delhi.
4. Ramamurtham, S, Strength of Materials, Dhanpat Rai and sons, New Delhi.
5. Punmia B C, Strength of Materials, Laxmi Publications (p) Ltd. New Delhi.
6. Rattan S.S., Strength of Materials, McGraw Hill Education; New Delhi.
7. Bansal R K, Strength of Materials, Laxmi Publications.
8. Subramaniam R, Strength of Materials, Oxford University Press.

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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Course Code	:	CEPC207
Course Title	:	Building Construction
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 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.
- Superstructure – Walls, Partition wall, Cavity wall, Sill, Lintel, Doors and Windows, Floor, Mezzanine floor, Roof, Columns, Beams, Parapet.

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.
- Foundation: Functions of foundation, Types of foundation – Shallow Foundation, Stepped Footing, Wall Footing, Column Footing, Isolated and Combined Column Footing, Raft Foundation, Grillage Foundation. Deep Foundation - Pile Foundation, Well foundation and Caissons, Pumping Methods of Dewatering, Deep wells, Well points, Cofferdams (Introduction only).

Unit- III: Construction of Superstructure

- **Stone Masonry:** Terms used in stone masonry- facing, backing, hearting, Through stone, corner stone, cornice. Types of stone masonry: Rubble masonry, Ashlar Masonry and their types. Joints in stone masonry and their purpose. Selection of Stone Masonry, Precautions to be taken in Stone Masonry Construction.
- **Brick masonry:** Terms used in brick masonry- header, stretcher, closer, quoins, course, face, back, hearting, bat bond, joints, lap, frog line, level and plumb. Bonds in brick masonry- header bond, stretcher bond, English bond and Flemish bond. Requirements of good brick masonry. Junctions in brick masonry and their purpose and procedure. Precautions to be observed in Brick Masonry Construction. Comparison between stone and Brick Masonry. Tools and plants required for construction of stone and brick masonry. Hollow concrete block masonry and composite masonry.

- **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.
- **Windows:** Component of windows, Types of Windows - Full Paneled, Partly Paneled and Glazed, wooden, Steel, Aluminum windows, Sliding Windows, Louvered Window, Bay window, Corner window, clear-storey window, Gable and Dormer window, Skylight. Sizes of Windows recommended by BIS. Ventilators.
- Fixtures and fastenings for doors and windows- Material used and functions of Window Sill and Lintels, 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

- **Floors and Roofs**: Types of Floor Finishes and its suitability- Kota, Marble, Granite, Ceramic Tiles, Vitrified, Chequered Tiles, Paver Blocks, Concrete Floors, wooden Flooring, Skirting and Dado. Process of Laying and Construction, Finishing and Polishing of Floors, Roofing Materials- RCC, Mangalore Tiles, AC Sheets, G.I. sheets, Corrugated G.I. Sheets, Plastic and Fibre Sheets. Types of Roof: Flat roof, Pitched Roof-King Post truss, Queen Post Truss, terms used in roofs.
- **Wall Finishes:** Plastering – Necessity of Plastering, Procedure of Plastering, Single Coat Plaster, Double Coat Plaster, Rough finish, Neeru Finishing and Plaster of Paris (POP). Special Plasters- Stucco plaster, sponge finish, pebble finish. Plaster Board and Wall Claddings. Precautions to be taken in plastering, defects in plastering. Pointing – Necessity, Types of pointing and procedure of Pointing. Painting –Necessity, Surface Preparation for painting, Methods of Application.

Suggested learning resources:

1. S. P. Arora and Bindra., Building Construction, Dhanpat Rai Publication, Delhi.
2. Sushil Kumar., Building Construction, Standard Publication.
3. Rangawala, S. C., Building Construction, Charotar Publication, Anand.
4. Punmia B. C., and Jain A. K., Building Construction ,Firewall Media.
5. Sharma S. K., Building Construction, S. Chand and Co. Pvt. Ltd., New Delhi.
6. Janardan Zha , Building Construction, Khanna Publication.
7. Bhavikatti S. S., Building Construction, Vikas Publication House Pvt. Ltd., Delhi.
8. Mantri S., A to Z Building Construction, Satya Prakashan, New Delhi.

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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Course Code	:	CEPC211
Course Title	:	Concrete Technology
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 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.
- Properties of fresh concrete: Workability: Factors affecting workability of concrete. Determination of workability of concrete by slump cone, compaction factor, Vee-Bee Consistometer. Value of workability requirement for different types of concrete works. Segregation, bleeding and preventive measures.
- Properties of Hardened concrete: Strength, Durability, Impermeability.

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

- Concreting Operations: Batching, Mixing, Transportation, Placing, Compaction, Curing and Finishing 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:

1. Gambhir, M.L., Concrete Technology, Tata McGraw Hill Publishing Co. Ltd., Delhi.
2. Shetty, M.S., Concrete Technology, S. Chand and Co. Pvt. Ltd., Ram Nagar, Delhi.
3. Santhakumar, A. R., Concrete Technology, Oxford University Press, New Delhi.
4. Neville, A. M. and Brooks, J.J., Concrete Technology, Pearson Education Pvt. Ltd.
5. Neville, A. M., Concrete Technology, Pearson Education Pvt. Ltd., New Delhi.
6. Sood, H., Kulkarni P. D., Mittal L. N., Laboratory Manual in Concrete Technology, CBS Publishers, New 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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Course Code	:	CEPC211
Course Title	:	Geotechnical 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 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).
- Shear failure of soil, concept of shear strength of soil. Components of shearing resistance of soil – cohesion, internal friction. Mohr-Coulomb failure theory, Strength envelope, strength equation for purely cohesive and cohesion less soils. Direct shear and vane shear test –laboratory methods.

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 Compaction 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:

1. Punmia, B.C., Soil Mechanics and Foundation Engineering, Laxmi Publication, Delhi.
2. Murthy, V.N.S., A text book of soil mechanics and foundation Engineering, CBS Publishers & Distributors Pvt. Ltd., New Delhi.
3. Ramamurthy, T.N. & Sitharam,T.G., Geotechnical Engineering(Soil Mechanics), S Chand and Company LTD., New Delhi.
4. Raj, P. Purushothama, Soil Mechanics and Foundation Engineering, Pearson India, New Delhi.
5. Kasamalkar, B. J., Geotechnical Engineering, Pune Vidyarthi Griha Prakashan, Pune.
6. Arora K R, Soil Mechanics and Foundation Engineering, Standard Publisher.

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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Course Code	:	CEPC213
Course Title	:	Construction Materials 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 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:

1. Ghose, D. N., Construction Materials , Tata McGraw Hill, New Delhi.
2. S.K. Sharma, Civil Engineering Construction Materials, Khanna Publishing House, New Delhi
3. Varghese, P.C. , Building Materials, PHI learning, New Delhi.
4. Rangwala, S.C., Engineering Materials, Charator publisher, Ahemdabad.
5. Somayaji, Shan, Civil Engineering Materials, Pearson education, New Delhi.
6. Rajput, R.K, Engineering Materials, S. Chand and Co., New Delhi.
7. Sood H., Laboratory Manual on Testing of Engineering Materials, New Age Publishers, New Delhi.
8. Sharma C. P., Engineering Materials, PHI Learning, New Delhi.
9. Duggal, S. K, Building Materials, New International, New Delhi.

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.

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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:

1. Punmia, B.C,; Jain, Ashok Kumar; Jain, Arun Kumar, Surveying I, Laxmi Publications., New Delhi.
2. Basak, N. N., Surveying and Levelling, McGraw Hill Education, New Delhi.
3. Kanetkar, T. P.; Kulkarni, S. V., Surveying and Levelling volume I, Pune Vidyarthi Gruh Prakashan.
4. Duggal, S. K., Survey I, McGraw Hill Education, New Delhi.
5. Saikia, M D.; Das. B.M.; Das. M.M., Surveying, PHI Learning, New Delhi.
6. Subramanian, R., Fundamentals of Surveying and Levelling, Oxford University Press. New Delhi.
7. Rao, P. Venugopala Akella, Vijayalakshmi, Textbook of Surveying, PHI Learning
8. Bhavikatti, S. S., Surveying and Levelling, Volume 1, I. K. International, New Delhi.
9. Arora K R , Surveying Vol. I, Standard Book House

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.

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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 (part7), 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:

1. Bedi D.S., Strength of Materials, Khanna Publishing House, New Delhi (Edition 2018)
2. Timoshenko, S., Strength of Materials, Vol. I, CBS, New Delhi.
3. Khurmi, R.S., Strength of Materials, S Chand and Co. Ltd. New Delhi.
4. Ramamurtham, S, Strength of Materials, Dhanpat Rai and sons, New Delhi.
5. Punmia B C, Strength of Materials, Laxmi Publications (p) Ltd. New Delhi.
6. Rattan S.S., Strength of Materials, McGraw Hill Education; New Delhi.
7. Bansal R K, Strength of Materials, Laxmi Publications.
8. Subramaniam R, Strength of Materials, Oxford University Press.

Course outcomes:

After competing 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 Code	:	CEPC219
Course Title	:	Concrete Technology 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 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:

1	Determine fineness of cement by Blaine's air permeability apparatus Or by sieving.
2	Determine specific gravity, standard consistency, initial and final setting times of cement.
3	Determine compressive strength of cement.
4	Determine silt content in sand.
5	Determine bulking of sand.
6	Determine bulk density of fine and coarse aggregates.
7	Determine water absorption of fine and coarse aggregates.
8	Determine Fineness modulus of fine aggregate by sieve analysis.
9	Determine impact value of aggregate
10	Determine crushing value of aggregate.
11	Determine abrasion value of aggregate.
12	Determine elongation and flakiness index of coarse aggregates
13	Determine workability of concrete by slump cone test.
14	Determine workability of concrete by compaction factor test.
15	To prepare concrete mix of a particular grade and determine compressive strength of concrete for 7 and 28 days.
16	Demonstration of NDT equipments .

Suggested learning resources:

1. Gambhir, M.L., Concrete Technology, Tata McGraw Hill Publishing Co. Ltd., Delhi.
2. Shetty, M.S., Concrete Technology, S. Chand and Co. Pvt. Ltd., Ram Nagar, Delhi.
3. Santhakumar, A. R., Concrete Technology, Oxford University Press, New Delhi.
4. Neville, A. M. and Brooks, J.J., Concrete Technology, Pearson Education Pvt. Ltd.
5. Neville, A. M., Concrete Technology, Pearson Education Pvt. Ltd., New Delhi.
6. Sood, H., Kulkarni P. D., Mittal L. N., Laboratory Manual in Concrete Technology, CBS Publishers, New 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.

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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
2. Murthy, V.N.S., A text book of soil mechanics and foundation Engineering, CBS Publishers & Distributors Pvt. Ltd., New Delhi.
3. Ramamurthy, T.N. & Sitharam,T.G., Geotechnical Engineering(Soil Mechanics), S Chand and Company LTD., New Delhi.
4. Raj, P. Purushothama, Soil Mechanics and Foundation Engineering, Pearson India
5. Kasamalkar, B. J., Geotechnical Engineering, Pune Vidyarthi Griha Prakashan, Pune.
6. Arora K R, Soil Mechanics and Foundation Engineering, Standard Publisher.

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.

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SEMESTER IV

Course Code	:	CEPC202
Course Title	:	Hydraulics
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 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:

1. Modi, P. N.and Seth, S.M., Hydraulics and Fluid Mechanics, Standard book house, Delhi.
2. S.S. Rattan, Fluid Mechanics & Hydraulic Machines, Khanna Book Publishing Co., New Delhi
3. Ramamrutham, and Narayan, R., Hydraulics, Fluid Mechanics and Fluid Machines, Dhanpat Rai Publishing Company, New Delhi.
4. Khurmi R S, Hydraulics, Fluid Mechanics, Hydraulic machines, S. Chand Publishers
5. Rajput, R K, Fluid Mechanics, S Chand, New Delhi.
6. Ojha, C S P, Berndtsson, R, and Chandramoulli P. N., Fluid Mechanics and Machinery, Oxford University Press, New 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.

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Course Code	:	CEPC204
Course Title	:	Advanced Surveying
Number of Credits	:	2 (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 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 horizontal angle- Direct and Repetition method, Errors eliminated by method of repetition.
- 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:

1. Kanetkar, T. P.; Kulkarni, S. V., Surveying and Levelling Part I and II, Pune Vidyarthi Gruh Prakashan, Pune.
2. Basak, N. N.,Surveying and Levelling, McGraw Hill Education (India) Pvt. Ltd.,Noida.
3. Duggal, S. K., Survey I and Survey II, Tata McGraw Hill Education Pvt. Ltd., Noida.
4. Saikia, M D.; Das. B.M.; Das. M.M., Surveying PHI Learning Pvt. Ltd., New Delhi.
5. Subramanian, R., Surveying and Levelling, Oxford University Press. New Delhi.
6. Punmia, B.C,; Jain, Ashok Kumar; Jain, Arun Kumar, Surveying Vol. I and Surveying Vol. II, Laxmi Publications Pvt. Ltd., New Delhi.
7. Rao, P. Venugopala Akella, Vijayalakshmi, Textbook of Surveying, PHI Learning Pvt. Ltd., New Delhi.
8. Venkatramaiah, C, Textbook of Surveying, Universities Press, Hyderabad.
9. Anderson, James M and Mikhail, Edward M, Surveying theory and practice, Mc Graw Hill Education, Noida.
10. De, Alak, Plane Surveying, S.Chand Publications, New Delhi.

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.

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Course Code	:	CEPC206
Course Title	:	Theory of structures
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 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:

1. Ramamrutham.S, Theory of structures, Dhanpatrai & Sons.
2. Khurmi, R. S. , Theory of Structures S. Chand and Co., New Delhi.
3. Bhavikatti, S S , Structural Analysis Vol-1, ,Vikas Publishing House Pvt Ltd.New Delhi.
4. Junnarkar, S. B. , Mechanics of structures, Volume-I and II Charotar Publishing House, Anand.
5. Pandit, G.S. and Gupta, S.P., Theory of Structures, Tata McGraw Hill, New Delhi.
6. Agor R, Structural Analysis, Khanna Publishing House, Delhi.

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.

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Course Code	:	CEPC208
Course Title	:	Building Planning and Drawing
Number of Credits	:	1 (L: 1, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

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:

1. Shah. M.G. Kale, CM, Patki, S.Y., Building Drawing, Mcgraw Hill Publishing company Ltd. New Delhi.
2. Malik and Mayo, Civil Engineering Drawing, Computech Publication Ltd New Asian Publishers, New Delhi.
3. M. G. Shah and C. M. Kale, Principles of Perspective Drawing, Mcgraw Hill Publishing company Ltd. New Delhi.
4. Swamy, Kumara; Rao, N, Kameshwara, A ., Building Planning and Drawing, Charotar Publication, Anand.
5. Bhavikatti, S. S., Building Construction, Vikas Publication House Pvt. Ltd., New Delhi.
6. Mantri, Sandip, A to Z Building Construction, Satya Prakashan, New Delhi.
7. Singh, Ajit, Working with Auto CAD 2000, Mcgraw Hill Publishing company Ltd. New Delhi.
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.

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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
2. Subramanayan, Engineering Hydrology, McGraw Hill.
3. Mutreja K N, Applied Hydrology, McGraw Hill
4. Sharma, R.K. and Sharma, T.K., Irrigation Engineering, S.Chand
5. Basak, N.N., Irrigation Engineering, McGraw Hill Education
6. Asawa, G.L., Irrigation and water resource Engineering, New Age
7. Dahigaonkar, J.G., Irrigation Engineering, Asian Book Pvt. Ltd., New Delhi.
8. Garg, S K, Irrigation and Hydraulic Structures, Khanna Publishers, Delhi.
9. Priyani V.B., Irrigation Engineering, Charotar Book Stall, Anand.

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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Course Code	:	CEPC212
Course Title	:	Transportation 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 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.
- Cement concrete road -methods of construction, Alternate and Continuous Bay Method, Construction joints, filler and sealers, merits and demerits of concrete roads. Types of joints.

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:

1. L.R. Kadiyali, Transportation Engineering, Khanna Book Publishing Co., Delhi (ISBN: 978-93-82609-858) Edition 2018
2. Khanna S.K., Justo, C E G and Veeraragavan, A., Highway Engineering, Nem Chand and Brothers, Roorkee.
3. Arora, N. L., Transportation Engineering, Khanna Publishers, Delhi.
4. Saxena S C and Arora S P, A Textbook of Railway Engineering, Dhanpat Rai Publication.
5. Birdi, Ahuja, Road, Railways, Bridge and Tunnel Engg , Standard Book House, New Delhi.
6. Sharma, S.K., Principles, Practice and Design of Highway Engineering,, S. Chand Publication, New Delhi.
7. Duggal, Ajay K. and Puri, V. P., Laboratory Manual in Highway Engineering, New Age International (P) Limited, Publishers, New Delhi.
8. Subramanian, K.P., Highway, Railway, Airport and Harbour Engineering, Scitech Publications, Hyderabad.

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.

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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:

1	Use piezometer to measure pressure at a given point.
2	Use Bourdon's Gauge to measure pressure at a given point.
3	Use U tube differential manometer to measure pressure difference between two given points.
4	Find the resultant pressure and its position for given situation of liquid in a tank.
5	Use Reynold's apparatus to determine type of flow.
6	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.
7	Use Friction factor Apparatus to determine friction factor for a given pipe.
8	Determine minor losses in pipe fittings due to sudden contraction and sudden enlargement.
9	Determine minor losses in pipe fitting due to Bend and Elbow.
10	Calibrate Venturi meter to find out the discharge in a pipe.
11	Calibrate the Orifice to find out the discharge through a tank
12	Use Current meter to measure the velocity of flow of water in open channel.
13	Use Pitot tube to measure the velocity of flow of water in open channel.
14	Use triangular notch to measure the discharge through open channel.
15	Use Rectangular notch to measure the discharge through open channel.
16	Determine the efficiency of centrifugal pump.

Suggested learning resources:

1. Modi,P. N.and Seth, S.M., Hydraulics and Fluid Mechanics, Standard book house, Delhi.
2. S.S. Rattan, Fluid Mechanics and Hydraulic Machines, Khanna Publishing House, Delhi
3. Ramamrutham, and Narayan, R., Hydraulics, Fluid Mechanics and Fluid Machines, Dhanpat Rai Publishing Company, New Delhi.
4. Khurmi,R S, Hydraulics, Fluid Mechanics, Hydraulic machines, S Chand Publishers, New Delhi.
5. Rajput, R K, Fluid Mechanics, S Chand, New Delhi.
6. Ojha, C S P, Berndtsson, R, and Chandramoulli P. N., Fluid Mechanics and Machinery, Oxford University Press, New 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.

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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

1	Use plane table survey to prepare plans of a plot of seven sided closed traverse by Radiation Method.
2	Use plane table survey to prepare plans, locate details by Intersection Method.
3	Use plane table survey to prepare plans, locate details by Traversing Method.
4	Use plane table survey to carry out Survey Project for closed traverse for minimum five sides around a building.
5	Use transit theodolite to measure Horizontal and Vertical angle by Direct Method.
6	Plot the traverse on A1 size imperial drawing sheet for the collected data from preceding Theodolite Survey Project.
7	Use Thedolite as a Tacheometer to compute reduced levels and horizontal distances.
8	Set out a circular curve by Rankine's Method of Deflection Angles.
9	Use micro optic Theodolite to Measure Horizontal angle by Direct Method.
10	Use EDM to measure horizontal distance.
11	Use Total station instrument to measure horizontal distances.
12	Use Total station instrument to measure vertical angle.
13	Use Total station instrument to carry out Survey Project for closed traverse for minimum five sides.
14	Plot the traverse on A1 size imperial drawing sheet for the collected data from preceding Total Station Survey Project.
15	Use GPS to locate the coordinates of a station.

Suggested learning resources

1. Kanetkar, T. P.; Kulkarni, S. V., Surveying and Levelling Part I and II, Pune Vidyarthi Gruh Prakashan, Pune.
2. Basak, N. N.,Surveying and Levelling, McGraw Hill Education (India) Pvt. Ltd.,Noida.
3. Duggal, S. K., Survey I and Survey II, Tata McGraw Hill Education Pvt. Ltd., Noida.
4. Saikia, M D.; Das. B.M.; Das. M.M., Surveying PHI Learning Pvt. Ltd., New Delhi.
5. Subramanian, R., Surveying and Levelling, Oxford University Press. New Delhi.
6. Punmia, B.C,; Jain, Ashok Kumar; Jain, Arun Kumar, Surveying Vol. I and Surveying Vol. II, Laxmi Publications Pvt. Ltd., New Delhi.
7. Rao, P. Venugopala Akella, Vijayalakshmi, Textbook of Surveying, PHI Learning Pvt. Ltd., New Delhi.
8. Venkatramaiah, C, Textbook of Surveying, Universities Press, Hyderabad.
9. Anderson, James M and Mikhail, Edward M, Surveying theory and practice, Mc Graw Hill Education, Noida.
10. De, Alak, Plane Surveying, S.Chand Publications, New Delhi.

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

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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:

A. Sketch Book	
1	Draw various types of lines, graphical symbols for materials, doors and windows, symbols for sanitary, water supply and electrical installations and write abbreviations as per IS 962.
2	Write summary of observations of all technical details from the given drawing (One/Two BHK) obtained from the professional architect or civil engineer (Group activity in four students)

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 Bunglows (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** W.C. 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:

1. Shah. M.G. Kale, CM, Patki, S.Y., Building Drawing, Mcgraw Hill Publishing
2. Malik and Mayo, Civil Engineering Drawing, Computech Publication Ltd
3. M. G. Shah and C. M. Kale, Principles of Perspective Drawing, Mcgraw Hill
4. Swamy, Kumara; Rao, N, Kameshwara, A ., Building Planning and Drawing, Charotar Publication, Anand.
5. Bhavikatti, S. S., Building Construction, Vikas Publication House Pvt. Ltd., Delhi.
6. Mantri, Sandip, A to Z Building Construction, Satya Prakashan, New Delhi.
7. Singh, Ajit, Working with Auto CAD 2000, Mcgraw Hill Publishing company Ltd.
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.

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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
2. Subramanayan, Engineering Hydrology, McGraw Hill.
3. Mutreja K N, Applied Hydrology, McGraw Hill
4. Sharma, R.K. and Sharma, T.K., Irrigation Engineering, S.Chand and Company
5. Basak, N.N., Irrigation Engineering, McGraw Hill Education India Pvt. Ltd.
6. Asawa, G.L., Irrigation and water resource Engineering, New Age International(P)
7. Dahigaonkar, J.G., Irrigation Engineering, Asian Book Pvt. Ltd., New Delhi.
8. Garg, S K, Irrigation and Hydraulic structures, Khanna Publishers, Delhi.
9. Priyani V.B., Irrigation Engineering, Charotar Book Stall, Anand.

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:

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

Suggested learning resources:

1. L.R. Kadiyali, Transportation Engineering, Khanna Book Publishing Co., New Delhi (ISBN: 978-93-82609-858) Edition 2018
2. Khanna S.K., Justo, C E G and Veeraragavan, A., Highway Engineering, Nem Chand and Brothers, Roorkee.
3. Arora, N. L., Transportation Engineering, Khanna Publishers, Delhi.
4. Saxena S C and Arora S P, A Textbook of Railway Engineering, Dhanpat Rai Publication.
5. Birdi, Ahuja, Road, Railways, Bridge and Tunnel Engg , Standard Book House, Delhi.
6. Sharma, S.K., Principles, Practice and Design of Highway Engineering,, S. Chand
7. Duggal, Ajay K. and Puri, V. P., Laboratory Manual in Highway Engineering, New Age International (P) Limited, Publishers, New Delhi.
8. Subramanian, K.P., Highway, Railway, Airport and Harbour Engineering, Scitech Publications, Hyderabad.

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

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PROGRAM ELECTIVE I

Course Code	:	CEPE202
Course Title	:	Precast and Prestressed Concrete
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 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.
- Loss of pre-stress occurring subsequently: losses due to shrinkage of concrete, creep of concrete, elastic shortening, and creep in steel, (Simple Numerical problems to determine loss of pre-stress).
- 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

1. Krishna Raju, N., Pre-stressed Concrete, Tata McGraw Hill, New Delhi.
2. Shrikant B. Vanakudre, Prestressed Concrete, Khanna Publishing House, New Delhi
3. Marzuki, Nor Ashikin, Pre Cast and Pre Stress Technology: Process, Method and Future Technology, Createspace Independent Publication.
4. Indian Concrete Institute., Handbook on Precast Concrete buildings.
5. Elliott, Kim S., Precast Concrete Structures, CRC Press, New York.
6. Lin, T.Y., Design of Pre-Stressed Concrete Structures, John Wiley and Sons, New York Nagarajan, 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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Course Code	:	CEPE204
Course Title	:	Construction Management
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 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 floats, 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

1. Sharma S C and Deodhar S V, Construction Engineering and Management, Khanna Book Publishing, New Delhi
2. Gahlot,P.S. and Dhir, B.M Construction planning and management New Age International (P) Ltd. Publishers, New Delhi.
3. Shrivastava, U.K., Construction planning and management, Galgotia Publication Pvt Ltd. New Delhi
4. Mantri, S., The A To Z of Practical Building Construction and its Management, Satya Prakashan New Delhi
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.
7. Sengupta, B., Guha H., Construction Management and Planning, Tata-McGraw Hill.
8. Harpal, Singh, Construction Management and accounts, Mc-Graw Hill.
9. Sharma, S.C., Industrial Engineering and Management, Khanna Publications, New Delhi

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.

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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:

1. Madhov Rao A G, and Ramachandra Murthy, D S, Appropriate Technologies for low cost Housing Oxford and IBH Publishing Co. Pvt. Ltd.
2. CBRI, Roorkee, Advances in Building Materials and Constriction.
3. Desai,Vasant , Rural Development in India: Past, Present and Future : a Challenge in the Crisis, Himalaya Publishing House, Delhi.
4. Rastogi, A.K.Rural Development Strategy, Wide Vision, Jaipur.
5. Singh, Katar, Rural Development Principles, Policies and Management, Sage Publications India Pvt Ltd.
6. Gaur, Keshav Dev, Dynamics of Rural Development, Mittal Publications, Delhi.
7. Document Published by Ministry of Rural development, Govt. of India, Ministry of Rural development.

Course outcomes:

After competing 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

Course Code	:	CEPC301
Course Title	:	Design of Steel and RCC Structures
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 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 90^0 hook, Lapping of bars.
- Simple numericals 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:

- Shah, V. L., and Gore, V., Limit State Design of Steel Structures, Structures Publications, Pune.
- 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.
- Shah, V. L., and Karve, S.R., Limit State Theory and Design of Reinforced Concrete Structures, Structures Publications, Pune,2014.
- Sinha N.C., and Roy S.K., Fundamentals of Reinforced Concrete, S. Chand & Co., New Delhi.
- Krishna Raju, and N. Pranesh, R.N., Reinforced Concrete Design Principles and Practice, New Age International, Mumbai.
- Pillai, S.U., and Menon, Devdas, Reinforced concrete Design, McGraw Hill Publications, New Delhi.
- Varghese, P. C., Limit State Design of Reinforced Concrete, Prentice Hall India Learning Private Limited, Delhi.

Course outcomes:

After competing 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.

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Course Code	:	CEPC303
Course Title	:	Estimating and Costing
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 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

- Estimating and Costing – Meaning, purpose, Administrative approval, Technical Sanction and Budget provision.
- 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.
- Standard formats of Measurement sheet, Abstract sheet, Face sheet.
- 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, Prismoidal 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

1. Datta, B.N., Estimating and Costing in Civil engineering, UBS Publishers Distributors Pvt. Ltd. New Delhi.
2. Peurifoy,Robert L. Oberlender,Garold, Estimating construction cost (fifth edition), McGraw Hill Education, , New Delhi.
3. Rangwala,S.C., Estimating and Costing, Charotar Publishing House PVT. LTD., Anand.
4. Birdie,G.S., Estimating and Costing, Dhanpat Rai Publishing Company(P) Ltd. New Delhi.
5. Patil,B.S., Civil Engineering Contracts and Estimates, Orient Longman, Mumbai.
6. Chakraborti,M., Estimating and costing, specification and valuation in civil engineering, Monojit Chakraborti, Kolkata.
7. PWD Schedule of Rates.
8. Ministry of Road Transport and Highways (MORT&H) Specifications and Analysis of Schedule of Rates.
9. Manual of Specifications and Standards for DBFOT projects, EPC works.

Course outcomes:

After competing 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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Course Code	:	CEPC305
Course Title	:	Design of Steel and RCC Structures 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 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:

1. Shah, V. L., and Gore, V., Limit State Design of Steel Structures, Structures Publications, Pune.
2. Dayarathnam, P., Design of Steel Structures, S. Chand and Company, Delhi.
3. Subramanian N., Design of Steel Structures, Oxford University Press.
4. Sairam, K.S., Design of Steel Structures, Pearson Publication, Chennai, Delhi.
5. Shah, V. L., and Karve, S.R., Limit State Theory and Design of Reinforced Concrete Structures, Structures Publications, Pune,2014.
6. Sinha N.C., and Roy S.K., Fundamentals of Reinforced Concrete, S. Chand & Co., New Delhi.
7. Krishna Raju, and N.Pranesh, R.N., Reinforced Concrete Design Principles and Practice, New Age International, Mumbai.
8. Pillai, S.U., and Menon, Devdas, Reinforced concrete Design, McGraw Hill Publications, New Delhi.
9. Varghese, P. C., Limit State Design of Reinforced Concrete, Prentice Hall India Learning Private Limited, Delhi.

Course outcomes:

After competing 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.

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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:

1. Datta, B.N., Estimating and Costing in Civil engineering, UBS Publishers Distributors
2. Peurifoy, Robert L. Oberlender,Garold, Estimating construction cost (fifth edition), McGraw Hill Education, , New Delhi.
3. Rangwala,S.C., Estimating and Costing, Charotar Publishing House, Anand.
4. Birdie,G.S., Estimating and Costing, Dhanpat Rai Publishing Company(P) Ltd. Delhi.
5. Patil,B.S., Civil Engineering Contracts and Estimates, Orient Longman, Mumbai.
6. Chakraborti,M., Estimating and costing, specification and valuation in civil engineering, Monojit Chakraborti, Kolkata.

7. PWD Schedule of Rates.
8. Ministry of Road Transport and Highways (MORT&H) Specifications and Analysis of Schedule of Rates.
9. Manual of Specifications and Standards for DBFOT projects, EPC works.

Course outcomes:

After competing 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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Course Code	:	CEPE301
Course Title	:	Traffic Engineering
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 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:

1. Khanna S.K., Justo, C E G and Veeraragavan, A., Highway Engineering, Nem Chand and Brothers, Roorkee.
2. Kadiyali L.R., Transportation Engineering, Khanna Book Publishing Co., Delhi
3. Vazirani, V N , Chaondola, S P, Transportation Engineering Vol. I & II, Khanna Publishers. Delhi.
4. Saxena, S C, Traffic planning and design, Dhanpat Rai & Sons 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.

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Course Code	:	CEPE303
Course Title	:	Solid Waste Management
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 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.
- Methods of composting – Manual Composting – Bangalore method, Indore Method, Mechanical Composting – Dano Process, Vermi composting.

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

Suggested learning resources:

1. Gupta O.P, Elements of Solid Hazardous Waste Management, Khanna Book Publishing Co., Delhi Ed. 2018
2. Bhide, A. D., Solid Waste Management, Indian National Scientific Documentation Centre, New Delhi.
3. George Techobanoglous, Kreith, Frank., Solid Waste, McGraw Hill Publication, New Delhi.
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.

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Course Code	:	CEPE305
Course Title	:	Advanced 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 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

- Ready Mix Concrete: Necessity and use of ready mix concrete. Products and equipments for ready mix concrete plant. Conveying of ready mix concrete, transit mixers.
- Vibrators for concrete consolidation: Internal, needle, surface, platform and form vibrators.
- Underwater Concreting: Procedure and equipments required for Tremie method, Drop bucket method. Properties, workability and water cement ratio of the concrete.
- 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

- Hoisting Equipments: Principles and working of Derrick-Pole, Gin Pole, Crane, Power driven scotch derrick crane, Hand operated crane, Locomotive crane, Tower crane, Lattice Girder, Winches, Elevators, ladders. Crawler cranes, Truck mounted cranes, Gantry cranes, Mast cranes.
- 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 belt 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:

1. Sharma S C and Deodhar S V, Construction Engineering and Management, Khanna Book Publishing, New Delhi
2. Chudly, R., Construction Technology Vol. I to II, ELBS-Longman Group.
3. Peurifoy, R. L., Construction Planning Equipment and Methods, McGraw Hill Co. Ltd. New York.

4. Seetharaman, S., Construction Engineering and Management, Umesh Publication, New Delhi.
5. Sengupta, B. and Guha., Construction Management and Planning, McGraw Hill Education, New Delhi.
6. Smith, R. C., Materials of Construction, McGraw Hill Co. Ltd.
7. Satyanarayana, R Saxena, S. C., Construction Planning and Equipment, Standard Publication, New Delhi.
8. Rangawala,S. C., Construction of Structures and Management of works, Charotar Publication, Anand.
9. Ghose,D. N., Materials of Construction, McGraw Hill Publishing Co, New Delhi.

Course outcomes:

After competing 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

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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
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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 and causes of damages in flexible pavement, surface defects, cracks. Deformations - Rutting, fatigue, settlement and upheaval. Disintegration- loss of aggregate, stripping, pothole. Remedial measures - slurry seal, liquid seal, fog seal, patching, ready mix patch.
- 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

1. Kadiyali, L.R., Highway Engineering, Khanna Book Publishing House, New Delhi
   (ISBN: 978-93-86173-133)
2. Chakroborty, Partha Das, Animesh., Principles of Transportation engineering, Prentice-Hall of India Pvt.Ltd
3. Vazirani, V N, Chaondola, S P., Transportation Engineering Vol. I & II, Khanna Publishers. Delhi
4. Yoder, E J, Principles of Pavement Design, Wiley India Pvt Ltd.
5. Bindra, S P., Highway Engineering, Dhanpat Rai Publications (P) Ltd
6. Kumar R S, Pavement Evaluation and Maintenance Management system, University Press (India), Pvt. Ltd.
7. Sharma S K, Principles, Practice and Design of Highway Engineering, S Chand, New Delhi.

Course outcomes:

After competing 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

- Definition of Green Building, Benefits of Green building, Components/features of Green Building, Site selection, Energy Efficiency, Water efficiency, Material Efficiency, Indoor Air Quality.
- 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
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Unit–II Energy Audit and Environmental Impact Assessment (EIA)

- Energy AudiT: Meaning, Necessity, Procedures, Types, Energy Management Programs
- Environmental Impact Assessment(EIA): Introduction, EIA regulations, Steps in environmental impact assessment process, Benefits of EIA, Limitations of EIA, Environmental clearance for the civil engineering projects.

Unit– III Energy and Energy conservation

- Renewable Energy Resources: Solar Energy, Wind Energy, Ocean Energy, Hydro Energy, Biomass Energy
- Non-renewable Energy Resources: Coal, Petroleum, Natural Gas, Nuclear Energy, Chemical Sources of Energy, Fuel Cells, Hydrogen, Biofuels.
- 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:

1. Kibert, C.J., Sustainable construction: Green Building design and Delivery, John Wiley Hoboken, New Jersey.
2. Chauhan, D S Sreevasthava, S K., Non-conventional Energy Resources, New Age International Publishers, New Delhi.
3. O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi
4. Jagadeesh, K S, Reddy Venkatta Rama & Nanjunda Rao, K S., Alternative Building Materials and Technologies, New Age International Publishers, Delhi.
5. Sam Kubba., Handbook of Green Building Design and Construction, Butterworth-Heinemann.
6. Means R S, Green Building - Project Planning and Cost Estimating, John Wiley & Sons
7. Sharma K V, Venkataseshaiah P., Energy Management and Conservation, IK International.

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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Course Code	:	CEPE311
Course Title	:	Building Services 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 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.
2. Mantri and Sandeep., The A to Z of Practical Building Construction and its Management, Satya Prakashan, New Delhi.
3. Bag S P, Fire Services in India: History, Detection, Protection, Management, Mittal Publications, New Delhi.
4. Deolalikar,S. G., Plumbing Design and Practice, McGraw-Hill,
5. Akhil Kumar Das., Principles of Fire Safety Engineering: Understanding Fire and Fire Protection, PHI Learning Pvt. Ltd, New Delhi.
6. Shraman N L, Solar panel installation guide & user manual, The Memory Guru of India.
7. Gupta M K, Practical handbook on building maintenance - Civil works, Nabhi Publications.
8. BIS., National Building Code Part1, 4, 8, 9., Bureau of Indian Standard, New Delhi
9. BIS., IS 12183(Part 1):1987 Code of practice for plumbing in multistoried buildings., 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.
- Filtration - mechanisation of filtration, classification of filters: slow sand filter, rapid sand filter, pressure filter. Construction and working of slow sand filter and rapid sand filter, operational problems in filtration. Disinfection: Objects, methods of disinfection, Chlorination- Application of chlorine, forms of chlorination, types of chlorination practices, residual chlorine and its importance, Flow diagram of water treatment plants.
- 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: **N**ecessity of sanitation, Necessity to treat domestic sewage, Definitions - Sewage, sullage, types of sewage. Definition of the terms related to Building Sanitation-

Water pipe, Rain water pipe, Soil pipe, Sullage pipe, Vent pipe. Building Sanitary fittings-Water closet – Indian and European type, flushing cistern, wash basin, sinks, Urinals. Traps-types, qualities of good trap. Systems of plumbing - one pipe, two pipe, single stack, choice of system. Principles regarding design of building drainage, inspection and junction chambers, their necessity, location, size and shape.

- 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

- Analysis of sewage: Characteristics of sewage, B.O.D., C.O.D. and its significance., Central Pollution Control Board Norms for discharge of treated sewage, Objects of sewage treatment and flow diagram of conventional sewage treatment plant.
- Treatment of Sewage: Screening, Types of screens, Grit removal, Skimming, Sedimentation of sewage, Aerobic and anaerobic process, Sludge digestion, trickling filters, Activated sludge process, Disposal of sewage, Oxidation pond, Oxidation ditch. Septic tank, Recycling and Reuse of domestic waste.

Suggested learning resources

1. Sharma S.C, Environmental Engineering, Khanna Publishing House, New Delhi
2. Garg, S.K., Environmental Engineering Vol. I and Vol. II, Khanna Publishers
3. Birdie, G. S. and Birdie, J. S.Water Supply and Sanitary Engineering, Dhanpat Rai
4. Gupta, O.P., Elements of Environmental Pollution Control, Khanna Publishing House, Delhi
5. Rao, C.S., Environmental Pollution Control Engineering, New Age International
6. Punmia, B C, Environmental Engineering, vol. I and II, Laxmi Publishers
7. Peavy H S, Rowe D R, and Tchobanoglous G, Environmental Engineering, McGraw
8. Basak N N, Environmental Engineering, McGraw Hill Publishers.

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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Course Code	:	CEPC304
Course Title	:	Public Health 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 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
10	Determine B.O.D. of given sample of sewage.
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.
14	Determine C.O.D. of given sample of sewage.
15	Prepare a report of a field visit to sewage treatment plant

Suggested learning resources:

1. Sharma S.C, Environmental Engineering, Khanna Publishing House, New Delhi
2. Garg, S.K., Environmental Engineering Vol. I and Vol. II, Khanna Publishers
3. Birdie, G. S. and Birdie, J. S.Water Supply and Sanitary Engineering, Dhanpat Rai
4. Gupta, O.P., Elements of Environmental Pollution Control, Khanna Publishing House, Delhi
5. Rao, C.S., Environmental Pollution Control Engineering, New Age International
6. Punmia, B C, Environmental Engineering, vol. I and II, Laxmi Publishers
7. Peavy H S, Rowe D R, and Tchobanoglous G, Environmental Engineering, McGraw
8. Basak N N, Environmental Engineering, McGraw Hill Publishers.

Course outcomes:

After competing 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.

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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:

1. Gahlot, P. S., Sharma, S., Building Repair and Maintenance Management, CBS Publishers & Distributors Pvt. Ltd., New Delhi
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 competing 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.

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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:

1. Shah, V. L., and Gore, V., Limit State Design of Steel Structures, Structures Publications, Pune.
2. Dayarathnam, P., Design of Steel Structures, S. Chand and Company, New Delhi.
3. Subramanian N., Design of Steel Structures, Oxford University Press.
4. Sairam, K.S., Design of Steel Structures, Pearson Publication, Chennai, Delhi.
5. Shah, V. L., and Karve, S.R., Limit State Theory and Design of Reinforced Concrete Structures, Structures Publications, Pune.
6. Sinha N.C., and Roy S.K., Fundamentals of Reinforced Concrete, S. Chand & Co.,
7. Krishna Raju, and N.Pranesh, R.N., Reinforced Concrete Design Principles and Practice, New Age International, Mumbai.
8. Pillai, S.U., and Menon, Devdas, Reinforced concrete Design, McGraw Hill
9. Varghese, P. C., Limit State Design of Reinforced Concrete, Prentice Hall India Learning Private Limited, Delhi.

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.

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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

- Definition of contract, objects of contract, requirements of contract, overview of Indian Contract Act.
- 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.
- E -Tendering System – Online procedure of submission and opening of bids (Technical and Financial).
- 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

- Various account forms and their uses – Measurement Books, E- Measurement book (E-MB), Nominal Muster Roll(NMR), Imprest Cash, Indent, Invoice, Bill, Vouchers, Hand receipt Cash Book, Temporary Advance. Heads of 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.
- Depreciation, Obsolescence, Sinking Fund, Methods of Calculation of Depreciation – Straight Line Method, Sinking Fund Method, Constant Percentage Method.
- 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:

1. Datta, B. N., Estimating and Costing in Civil engineering, UBS Publishers Pvt. Ltd., New Delhi
2. Raina, V. K., Construction Management and Contract Practices, Shroff Publishers & Distributers Pvt. Ltd.
3. Rangawala, S. C., Estimating and Costing, Charotar Publishing House PVT. LTD., Gujrat
4. Birdie, G. S., Estimating and Costing, Dhanpat Rai Publishing Company(P) Ltd., New Delhi
5. Patil, B. S., Civil Engineering Contracts and Estimates, Orient Longman, Mumbai
6. Chakraborti, M., Estimating and Costing, Specification and Valuation in Civil Engineering, Monojit Chakraborti, Kolkata.

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]

S. No.	Course Code	Course Title	Hours per Week			Credits (L+T+P)	Semester
			L	T	P		
1.	EEPC201	Introduction to Electric Generation Systems	3	0	0	3	III
2.	EEPC203	Introduction to Electric Generation Systems Laboratory	0	0	2	1	III
3.	EEPC205	Electrical Circuits	2	1	0	3	III
4.	EEPC207	Electrical Circuits Laboratory	0	0	2	1	III
5.	EEPC209	Electrical and Electronic Measurements	2	1	0	3	III
6.	EEPC211	Electrical and Electronic Measurements Laboratory	0	0	2	1	III
7.	EEPC213	Electric Motors and Transformers	2	1	0	3	III
8.	EEPC215	Electric Motors and Transformers Laboratory	0	0	2	1	III
9.	EEPC217	Renewable Energy Power Plants	3	0	0	3	III
10.	EEPC219	Renewable Energy Power Plants Laboratory	0	0	2	1	III
11.	EEPC202	Fundamentals of Power Electronics	3	0	0	3	IV
12.	EEPC204	Fundamentals of Power Electronics Laboratory	0	0	2	1	IV
13.	EEPC206	Electric Power Transmission and Distribution	3	0	0	3	IV
14.	EEPC208	Electric Power Transmission and Distribution Laboratory	0	0	2	1	IV
15.	EEPC210	Induction, Synchronous and FHP Machines	2	1	0	3	IV
16.	EEPC212	Induction, Synchronous and FHP Machines Laboratory	0	0	2	1	IV
17.	EEPC301	Microcontroller Applications	3	0	0	3	V
18.	EEPC303	Microcontroller Applications Laboratory	0	0	2	1	V
19.	EEPC305	Energy Conservation and Audit	3	0	0	3	V
20.	EEPC307	Energy Conservation and Audit Laboratory	0	0	2	1	V
21.	EEPC302	Building Electrification	3	0	0	3	VI
22.	EEPC304	Building Electrification Laboratory	0	0	2	1	VI
		Total	**29**	**4**	**22**	**44**	

4.2 List of Program Elective Courses [PE]

S. No.	Course Code	Course Title	Hours per Week			Credits (L+T+P)	Semes-ter
			L	T	P		
1.	EEPE***	Industrial Instrumentation and Condition Monitoring	3	0	0	3	
2.	EEPE***	Industrial Instrumentation and Condition Monitoring Laboratory	0	0	2	1	
3.	EEPE***	Industrial Automation & Control	3	0	0	3	
4.	EEPE***	Industrial Automation & Control Labora-tory	0	0	2	1	
5.	EEPE***	Industrial Drives	3	0	0	3	
6.	EEPE***	Industrial Drives Laboratory	0	0	2	1	
7.	EEPE***	Communication Technologies	3	0	0	3	
8.	EEPE***	Communication Technologies Laboratory	0	0	2	1	
9.	EEPE***	Electrical Testing and Commissioning	3	0	0	3	
10.	EEPE***	Electrical Testing and Commissioning Laboratory	0	0	2	1	
11.	EEPE***	Electrical Estimation and Contracting	3	0	0	3	
12.	EEPE***	Electrical Estimation and Contracting Laboratory	0	0	2	1	
13.	EEPE***	Illumination Practices	3	0	0	3	
14.	EEPE***	Illumination Practices Laboratory	0	0	2	1	
15.	EEPE***	Switchgear and Protection	3	0	0	3	
16.	EEPE***	Switchgear and Protection Laboratory	0	0	2	1	
17.	EEPE***	Solar Power Technologies	3	0	0	3	
18.	EEPE***	Solar Power Technologies Laboratory	0	0	2	1	
19.	EEPE***	Wind Power Technologies	3	0	0	3	
20.	EEPE***	Wind Power Technologies Laboratory	0	0	2	1	
21.	EEPE***	Biomass and Micro-hydro Power Plants	3	0	0	3	
22.	EEPE***	Biomass and Micro-hydro Power Plants Laboratory	0	0	2	1	
23.	EEPE***	Electric Vehicles	3	0	0	3	
24.	EEPE***	Electric Vehicles Laboratory	0	0	2	1	
25.	EEPE***	Electric Traction	3	0	0	3	
26.	EEPE***	Electric Traction Laboratory	0	0	2	1	
Total			**39**	**0**	**26**	**52**	

4.3 Semester-wise Detailed Curriculum

Semester III

S.No.	Course Code	Course Title	Hours per Week			Total Contact Hours/ Week	Credits
			L	T	P		
1.	EEPC201	Introduction to Electric Generation Systems	3	0	0	3	3
2.	EEPC203	Introduction to Electric Generation Systems Laboratory	0	0	2	2	1
3.	EEPC205	Electrical Circuits	2	1	0	3	3
4.	EEPC207	Electrical Circuits Laboratory	0	0	2	2	1
5.	EEPC209	Electrical and Electronic Measurements	2	1	0	3	3
6.	EEPC211	Electrical and Electronic Measurements Laboratory	0	0	2	2	1
7.	EEPC213	Electric Motors and Transformers	2	1	0	3	3
8.	EEPC215	Electric Motors and Transformers Laboratory	0	0	2	2	1
9.	EEPC217	Renewable Energy Power Plants	3	0	0	3	3
10.	EEPC219	Renewable Energy Power Plants Laboratory	0	0	2	2	1
11.	SI201	Summer Internship - I	0	0	0	0	2
Total			**12**	**2**	**10**	**25**	**22**

Semester IV

S.No.	Course Code	Course Title	Hours per Week			Total Contact Hours/ Week	Credits
			L	T	P		
1.	EEPC202	Fundamentals of Power Electronics	3	0	0	3	3
2.	EEPC204	Fundamentals of Power Electronics Laboratory	0	0	2	2	1
3.	EEPC206	Electric Power Transmission and Distribution	3	0	0	3	3
4.	EEPC208	Electric Power Transmission and Distribution Laboratory	0	0	2	2	1
5.	EEPC210	Induction, Synchronous and Special Electrical Machines	2	1	0	3	3
6.	EEPC212	Induction, Synchronous and Special Electrical Machines Laboratory	0	0	2	2	1
7.	EEPE***	Elective I	3	0	0	3	3
8.	EEPE***	Elective I Laboratory	0	0	2	2	1
9.	EEPE***	Elective II	3	0	0	3	3
10.	EEPE***	Elective II Laboratory	0	0	2	2	1
11.	PR202	Minor Project	0	0	4	4	2
12.	AU202	Essence of Indian Knowledge and Tradition	2	0	0	2	0
		Total	**17**	**0**	**14**	**31**	**22**

Semester V

S. No.	Course Code	Course Title	Hours per Week			Total Contact Hours/ week	Credits
			L	T	P		
1.	EEPC301	Microcontroller Applications	3	0	0	3	3
2.	EEPC303	Microcontroller Applications Laboratory	0	0	2	2	1
3.	EEPC305	Energy Conservation and Audit	3	0	0	3	3
4.	EEPC307	Energy Conservation and Audit Laboratory	0	0	2	2	1
5.	EEPE3**	Elective III	3	0	0	3	3
6.	EEPE3**	Elective III Laboratory	0	0	2	2	1
7.	EEPE3**	Elective IV	3	0	0	3	3
8.	EEPE3**	Elective IV Laboratory	0	0	2	2	1
9.	OE3**	Open Elective I	3	0	0	3	3
10.	SI301	Summer Internship - II	0	0	0	0	3
11.	PR302	Major Project	0	0	2	2	^
Total			**15**	**0**	**10**	**25**	**22**

Semester VI

S. No.	Course Code	Course Title	Hours per Week			Total Contact Hours/ week	Credits
			L	T	P		
1.	EEPC302	Building Electrification	3	0	0	3	3
2.	EEPC304	Building Electrification Laboratory	0	0	2	2	1
3.	HS302	Entrepreneurship and Start -ups	3	1	0	4	4
4.	OE3**	Open Elective II	3	0	0	3	3
5.	OE3**	Open Elective III	3	0	0	3	3
6.	AU302	Indian Constitution	2	0	0	2	0
7.	PR302	Major Project	0	0	6	6	4^
8.	SE302	Seminar	1	0	0	1	1
Total			**15**	**1**	**10**	**24**	**19**

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

Semester III

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 Map of India: Global solar power radiation.

Solar Power Technology

a. Concentrated Solar Power (CSP) plants, construction and working of: Power Tower, Parabolic Trough, Parabolic Dish, Fresnel Reflectors

b. Solar Photovoltaic (PV) power plant: layout, construction, working.

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

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3. Gupta, B.R., Generation of Electrical Energy, S. Chand& Co. New Delhi,
4. Rachel, Sthuthi; Earnest, Joshua **–** Wind Power Technologies, PHI Learning, New Delhi, ISBN: 978-93-88028-49- 3; E-book 978-93-88028-50-9
5. Solanki, Chetan Singh, **–** Solar Photovoltaics: Fundamentals, Technologies and Applications, PHI Learning, New Delhi, ISBN: 9788120351110

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9. Gupta, J.B. A Course in Electrical Power– S. K Kataria and Sons, New Delhi. 2014,
10. Soni, Gupta, Bhatnagar, A Course in Electrical Power. – Dhanpatrai and Sons
11. System, S.Chand & Co. New Delhi, 2005, ISBN: 9788121924962

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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Course Code	:	EEPC203
Course Title	:	INTRODUCTION TO ELECTRIC GENERATION SYSTEMS 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 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 Ouctomes:

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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Course Code	:	EEPC205
Course Title	:	ELECTRIC CIRCUITS
Number of Credits	:	3 (L: 2, T: 1, 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 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

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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:

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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Course Code	:	EEPC207
Course Title	:	ELECTRIC CIRCUITS 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 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 a electric network by applying mesh analysis.
12. Use voltmeter, ammeter to determine current through the given branch of a 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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Course Code	:	EEPC209
Course Title	:	ELECTRICAL AND ELECTRONIC MEASUREMENTS
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:

- 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.

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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:

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 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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Course Code	:	EEPC213
Course Title	:	ELECTRIC MOTORS AND TRANSFORMERS
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 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.

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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:

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.

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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.
9. Perform open circuit and short circuit test on single phase transformer to determine equivalent circuit constants, voltage regulation and efficiency.
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.

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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 a Agro-chemical based (e.g. bio-diesel) power plant

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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:

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
9. Dismantle a horizontal axis small wind turbine.
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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Semester – IV

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-Capacitance 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.

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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:

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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Course Code	:	EEPC204
Course Title	:	FUNDAMENTALS OF POWER ELECTRONICS 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 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 andholding current using V-I characteristics of SCR.
5. Test the variation of R, C in R and RC triggering circuits onfiring 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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Course Code	:	EEPC206
Course Title	:	ELECTRIC POWER TRANSMISSION AND DISTRIBUTION
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 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.

Performance of medium line: representation, nominal 'T', nominal 'π' and end condenser methods.

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:

1. G.C. Garg, Utilization of Electric Power & Electric Traction, Khanna Book Publishing Co., New Delhi (ISBN: 978-93-86173-355)
2. Mehta, V.K., Principles of Power System, S. Chand and Co. New Delhi, ISBN: 9788121924962
3. Soni;Gupta; Bhatnagar, A Course in Electrical Power, Dhanpat Rai and Sons New Delhi, ISBN: 9788177000207
4. Gupta,J.B., A Course in Power Systems, S.K. Kataria and sons, New Delhi, ISBN: 9788188458523
5. Theraja, B.L.; Theraja, A.K., A Textbook of Electrical Technology Vol. III, S.Chand and Co. New Delhi, ISBN : 9788121924900
6. Uppal,S.L., A Course in Electrical Power, S.K.Khanna Publisher New Delhi, ISBN : 9788174092380
7. Sivanagaraju S.; Satyanarayana S., Electrical Power Transmission and Distribution, Pearson Education, New Delhi, , ISBN:9788131707913
8. Ned Mohan, Electrical Power System: A First Course, Wiley India Pvt. Ltd. New Delhi, ISBN:9788126541959
9. Gupta, B.R., Power System Analysis and Design, S. Chand and Co. New Delhi, ISBN: 9788121922388
10. Kamraju, V., Electrical Power Distribution System, Tata McGraw-Hill, New Delhi, ISBN:9780070151413

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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Course Code	:	EEPC208
Course Title	:	ELECTRIC POWER TRANSMISSION AND DISTRIBUTION 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 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.

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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.

Constructional details of 3 phase induction motors: Squirrel cage induction motor and Slip ring induction motor.

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:

1. P.S. Bimbhra, Electric Machines, Khanna Book Publishing Co., New Delhi (ISBN: 978-93-86173-294)
2. Mittle, V.N. and Mittle, Arvind., Basic Electrical Engineering, McGraw Hill Education New Delhi, ISBN :9780070593572

3. Kothari, D. P. and Nagrath, I. J., Electrical Machines, McGraw Hill Education. New Delhi, ISBN:9780070699670
4. Bhattacharya, S. K., Electrical Machines, McGraw Hill Education, New Delhi, ISBN:9789332902855
5. Theraja, B.L., Electrical Technology Vol-II (AC and DC machines), S.Chand and Co. Ltd., New Delhi, ISBN : 9788121924375
6. Sen, S. K., Special Purpose Electrical Machines, Khanna Publishers, New Delhi, ISBN: 9788174091529
7. Janardanan E. G, Special Electrical Machines, Prentice Hall India, New Delhi ISBN: 9788120348806
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.

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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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Course Code	:	EEPC301
Course Title	:	MICROCONTROLLER APPLICATIONS
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 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 Microcontroller8051

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:

1. Kenneth, Ayala, 8051 Microcontroller Architecture Programming and Application, PHI Learning, New Delhi,ISBN: 978-1401861582
2. Mazidi, Mohmad Ali; Mazidi, Janice Gelispe; MckinlayRoline D., The 8051 Microcontroller and Embedded system, Pearson Education, Delhi, ISBN 978-8177589030
3. Pal, Ajit, Microcontroller Principle and Application, PHI Learning, New Delhi, ISBN13: 978-81-203-4392-4
4. Deshmukh, Ajay, Microcontroller Theory and Application, McGraw Hill., New Delhi, ISBN- 9780070585959
5. Kamal, Raj, Microcontroller Architecture Programming, Interfacing and System Design, Pearson Education India, Delhi, ISBN: 9788131759905
6. Mathur; Panda, Microprocessors and Microcontrollers, PHI Learning, New Delhi, ISBN:978-81-203-5231-5
7. Krishna Kant, Microprocessors and Microcontrollers: Architecture programming and System Design, PHI Learning, New Delhi, ISBN:978-81-203-4853-0

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

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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 architype of types microcontrollers IC 8051
c) Maintain the program features of the Microcontroller based application
d) Develop assembly language program
e) Develop program to interface 8051 microcontrollers with LED/SWITCH

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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 Scenario: Primary and Secondary Energy, Energy demand and supply,

National scenario.

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 Conservation Equipment: Soft starters, Automatic star delta convertor, Variable Frequency Drives, Automatic p. f. controller (APFC), Intelligent p. f. controller (IPFC)

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:

1. Guide Books No. 1 and 3 for National Certification Examination for Energy Managers and Energy Auditors, Bureau of Energy Efficiency (BEE), Bureau of Energy Efficiency (A Statutory body under Ministry of Power, Government of India) (Fourth Edition 2015).
2. O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi
3. Henderson, P. D., India - The Energy Sector, University Press, Delhi, 2016. ISBN*: 978*-0195606539
4. Turner, W. C., Energy Management Handbook, Fairmount Press, 2012, ISBN 9781304520708
5. Sharma, K. V., Venkataseshaiah; P., Energy Management and Conservation, I K International Publishing House Pvt. Ltd; 2011 ISBN 9789381141298
6. Mehta ,V. K., Principles of Power System, S. Chand &Co.New Delhi, 2016, ISBN 9788121905947
7. Singh, Sanjeev; Rathore, Umesh, Energy Management, S K Kataria&Sons,New Delhi ISBN-13: 9789350141014.
8. Desai, B. G.; Rana, J. S.; A. Dinesh, V.; Paraman, R., Efficient Use and Management of Electricity in Industry, Devki Energy Consultancy Pvt. Ltd.
9. Chakrabarti, Aman, Energy Engineering And Management, e-books Kindle Edition

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.

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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.

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Semester – VI

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

Testing of wiring installation as per IS: 732-1982: Insulation resistance - between earth and conductors, between conductors, polarity test of single pole switches. Testing of earth continuity path.

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:

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2. Allagappan,N. S.Ekambarram, Electrical Estimating and Costing, New Delhi, ISBN-13: 9780074624784
3. Singh, Surjit, Electrical Estimating and Costing, Dhanpat Rai and Co. New Delhi, ISBN: 1234567150995
4. Gupta, J B: A Course in Electrical Installation Estimating and Costing, S K Kataria and Sons,New Delhi, ISBN:978-93-5014-279-0
5. Bureau of Indian Standard, IS: 732-1989, Code of practice for electrical wiring installation
6. Bureau of Indian Standard, SP 30 National Electrical Code 2010
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
   - http://www.electrical4u.com, assessed on 18th January 2016
   - https://www.youtube.com/watch?v=A9KSGAnjo2U, assessed on 18th January 2016
   - http://www.electricaltechnology.org/2015/09, assesed on 30 Jan 2016
   - www.slideshare.net/bawaparam/made-by-paramassesed on 30 Jan2016
   - www.electricaltechnology.org/2013/09/electrical-wiring.html assessed on 16 March 2016.

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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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

Course Code	:	EEPE***
Course Title	:	INDUSTRIAL INSTRUMENTATION AND CONDITION MONITORING
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:

- 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, toothed 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-AMPand 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:

1. Sawhney, A.K. Electric and Electronic Measurement and instrumentation, Dhanpat Rai and Co. Author, Nineteenth revised edition 2011 reprint, 2014, ISBN:10: 8177001000
2. Rangan, C.S. G.R.Sharma. andV.S.V.Mani, Instrumentation devices and system, Pen ram International *Publishing* India Pvt. Ltd. Fifth edition, ISBN:10: 0074633503
3. Mehta, V.K. Electronics and instrumentation, Third edition-S.Chand and company Pvt Ltd Reprint, 2010, ISBN:81-219-2729-3
4. Singh, S.K. Industrial instrumentation and control, Tata McGraw-Hill, 1987. ISBN: 007451914X, 9780074519141.
5. J.G. Joshi, Electronic Measurement and Instrumentation, Khanna Publishing House, New Delhi (ISBN: 978-93-86173-621)

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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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]I9KYI

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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Course Code	:	EEPE***
Course Title	:	INDUSTRIAL AUTOMATION AND CONTROL
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 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

I/O module selection criteria

Interfacing different I/O devices with appropriate I/O modules

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.

Drives: Specifications, Applications- Speed control of AC motor /DC Motor.

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:

1. Dunning, G., Introduction to Programmable Logic Controllers, Thomson /Delmar learning, New Delhi, 2005,ISBN 13 : 9781401884260
2. Jadhav, V. R., Programmable Logic Controller, Khanna publishers, New Delhi, 2017, ISBN : 9788174092281
3. Petruzella, F.D., Programmable Logic Controllers, McGraw Hill India, New Delhi, 2010, ISBN: 9780071067386
4. Hackworth, John; Hackworth, Federic, Programmable Logic Controllers, PHI Learning, New Delhi, 2003, ISBN : 9780130607188
5. Stenerson Jon, Industrial automation and Process control, PHI Learning, New Delhi, 2003, ISBN : 9780130618900
6. Mitra, Madhuchandra; Sengupta, Samarjit, Programmable Logic Controllers and Industrial Automation - An introduction, Penram International Publication, 2015, ISBN: 9788187972174
7. Boyar, S. A., Supervisory Control and Data Acquisition, ISA Publication, USA, ISBN: 978-1936007097

8. Bailey David ; Wright Edwin, Practical SCADA for industry, Newnes (an imprint of Elsevier), UK 2003, ISBN:0750658053

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 Code	:	EEPE***
Course Title	:	INDUSTRIAL AUTOMATION AND CONTROL 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 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.
9. Develop ladder program for Traffic light control system.
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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Course Code	:	EEPE***
Course Title	:	INDUSTRIAL DRIVES
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:

- 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:

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2. Saxena, S.B Lal ;Dasgupta, K., Fundamentals of Electrical Engineering, Cambridge university press pvt. Ltd., New Delhi, ISBN: 9781107464353
3. Theraja, B. L. ;Theraja, A. K., A Text Book of Electrical Technology Vol-II, S. Chand and Co. Ramnagar, New Delhi, ISBN :9788121924405
4. Mittle, V.N. ;Mittle, Arvind, Basic ElectricalEngineering, McGraw Hill Education, Noida, ISBN: 9780070593572
5. Sen P.C., Power Electronics, Mcgraw-Hill Publishing CompanyLimited, New Delhi. ISBN:9780074624005
6. Dubey Gopal K., Fundamentals of Electrical Drives, Second Edition, Narosa Publishing House, New Delhi.ISBN :9788173194283
7. Subrahmanyam, Vedam, Electrical Drives Concepts and Applications, Mcgraw-Hill Publishing CompanyLimited, New Delhi.ISBN:9780070701991
8. Agrawal , Jai P., Power Electronic Systems Theory and Design, Pearson Education, Inc. ISBN 9788177588859.
9. Deshpande M.V., Design and Testing of Electrical Machines, PHI Publication, ISBN: 9788120336452
10. Pillai, S.K., A first course on Electrical Drives, Wiley Eastern Ltd. New Delhi, ISBN :13: 978-0470213995

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 Code	:	EEPE***
Course Title	:	INDUSTRIAL DRIVES 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 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.
7. Effect on speed of given D.C. series motor by varying armature voltage using step down chopper.
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.

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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, wave-form, 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

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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:

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 Code	:	EEPE***
Course Title	:	COMMUNICATION 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:

- 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.
6. Test Pulse Code Modulation Signal.
7. Test Amplitude Shift Keying Signal
8. Test Frequency Shift Keying Signal
9. Test Phase 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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Course Code	:	EEPE***
Course Title	:	ELECTRICAL TESTING AND COMMISIONING
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:

- 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 three-phase Induction motor as per I.S.325 - 1970.

Testing of single-phase induction motor as per I.S.990-1965.

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:

1. Deshpande.M. V. PHI Learning Pvt. Ltd., 2010, Design and Testing of Electrical Machines ISBN No 8120336453, 9788120336452.
2. Rao, B V S Asia Club House, First Reprint, 2011, Operation and Maintenance of Electrical Equipment Vol-I, ISBN No 8185099022
3. Rosenberg. Mc GRAW-HILL, 1st Edition, May 2003, Maintenance and Repairs, ISBN No 9780071396035
4. Sharotri, S.K. Glencoe/ Mcgraw- Hill; 2ndEdition , June 1969; Preventive Maintenance of Electrical Apparatus, ISBN No 10: 007030839X 13: 978-0070308398

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.

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Course Code	:	EEPE***
Course Title	:	ELECTRICAL TESTING AND COMMISIONING 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:

- 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.
6. Determine efficiency of D.C. machine by Swinburne's test.
7. Determine efficiency of D.C. machine by Hopkinson's test.
8. Perform reduced voltage running up test on three-phase Induction motor as per I.S.325 -1967.
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.
11. Perform temperature rise test on single-phase transformer.
12. Find efficiency of M.G. set

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.

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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.

Transformer. Design, estimation and costing of outdoor and indoor 11 KV substation.

References:

1. Raina, K.B.; Dr. S. K. Bhattacharya New Age International Publisher First, Reprint 2010, Electrical Design Estimating and Costing ISBN: 978-81-224-0363-3
2. Allagappan,, N. S. Ekambarram, Tata Mc-Graw Hill Publishing Co. Ltd, Electrical Estimating and Costing, ISBN 13: 9780074624784
3. Singh, Surjit Ravi Deep Singh, Dhanpat Rai and Sons, Electrical Estimating and Costing, ISBN 13:1234567150995
4. Gupta, J.B. S.K. Katariaand Sons Reprint Edition, A Course in Electrical Installation Estimating and Costing ISBN 10: 935014279113: 978-9350142790.
5. Bureau of Indian Standard. IS: 732-1989, Code of Practice for Electrical Wiring Installation
6. Bureau of Indian Standard. SP-30:2011, National Electrical Code 2011

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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Course Code	:	EEPE***
Course Title	:	ELECTRICAL ESTIMATION AND CONTRACTING 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 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.
4. Design drawing, estimating and costing of hall / cinema theater / commercial installation Prepare report and draw sheet.
5. Design electrical installation scheme for any one factory / small industrial unit. Draw detailed wiring diagram. Prepare material schedule and detailed estimate. Prepare report and draw sheet.
6. Estimate with a proposal of the electrical Installation of streetlight scheme for small premises after designing.
7. Estimate with a proposal of the L.T. line installation. Prepare report and draw sheet.
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.

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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:

1. Lindsey, Jack L., Applied Illumination Engineering, The Fairmont Press Inc.
2. Simons, R. H., Bean, Robert; Lighting Engineering: Applied Calculations, Architectural Press. ISBN: 0750650516.
3. Casimer M Decusatis, Handbook of Applied Photometry, Springer, ISBN 1563964163.
4. Butterworths, Lyons Stanley, Handbook of Industrial Lighting, Butterworths
5. Simpson Robert S, Lighting Control Technology and Applications, Focal Press
6. Kao Chen, Energy Management in Illuminating Systems, CRC Press

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.
6. Measure illumination level with and without reflectors used in the various Luminaries.
7. Estimate and compare luminous efficiency of incandescent and compact fluorescent lamp.
8. Prepare light dimmer arrangement using the relevant dimmer type of transformer
9. Identify the given types of dimmer transformer and their parts
10. Build an electronic dimmer – Part I
11. Build another type of electronic dimmer – Part II
12. Build a single lamp control by single switch
13. Build a single lamp control by two switches
14. Build a single lamp control circuit for two-point method
15. Build a lamp control circuit for three-point method
16. 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 Code	:	EEPE***
Course Title	:	SWITCHGEAR AND PROTECTION
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 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

Faults. Short circuit protection, Overload protection, Single phase preventer.

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:

1. Mehta V. K ;Rohit Mehta, Principles of Power System, S .Chand and Co., New Delhi., ISBN: 978-81-2192-496-2.
1. Rao.Sunil S., Switchgear and Protection, Khanna Publishers, New Delhi, ISBN: 978-81-7409-232-3.
2. Singh, R. P., Switchgear and Power System Protection, PHI Learning, New Delhi, ISBN: 978-81-203-3660-5.
3. Gupta. J. B.. Switchgear and Protection, S. K. Kataria and Sons, New Delhi, ISBN: 978-93-5014-372-8.
4. Veerapan, N.,Krishnamurty, S. R., Switchgear and Protection, S .Chand and Co., New Delhi. ISBN: 978-81-2193-212-7.
5. Ram, Badri; Vishwakarma D. N., Power System Protection and Switchgear, McGraw-Hill, New Delhi. ISBN : 978-07-107774-X

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	:	EEPE***
Course Title	:	SWITCHGEAR AND PROTECTION 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:

- Maintain switchgear and protection schemes used in electrical power systems.

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.

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	:	EEPE
Semester	:	---
Course Title	:	SOLAR POWER TECHNOLOGIES
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 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:

1. Solanki, Chetan Singh, - Solar Photovoltaics: Fundamentals, Technologies and Applications, PHI Learning, New Delhi, ISBN: 9788120351110
1. Solanki, Chetan Singh, - Solar Photovoltaic Technology and Systems - A Manual For Technicians, Trainers and Engineers, PHI Learning, New Delhi, ISBN: 9788120347113
2. Kothari, D.P. et aL:Renewable Energy Sources and Emerging Technologies, PHI
3. David M. Buchla, Thomas E. Kissell, Thomas L. Floyd, - Renewable Energy Systems, Pearson Education New Delhi ,ISBN: 9789332586826
4. Rachel, Sthuthi, Earnest, Joshua; -Wind Power Technologies, PHI Learning
5. O.P. Gupta, Energy Technology, Khanna Publishing House, ISBN: 978-93-86173-683

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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Course Code	:	EEPE
Course Title	:	SOLAR POWER TECHNOLOGIES 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 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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Course Code	:	EEPE***
Course Title	:	WIND POWER 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:

- 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:

1. Hau, Erich: Wind TurbinesSpringer-Verlag, Berlin Heidelberg, Germany, ISBN: 978-3-642-27150-2
2. Rachel, Sthuthi, Earnest, Joshua; -Wind Power Technologies, PHI Learning, New Delhi, ISBN: 978-93-88028-49- 3; E-book 978-93-88028-50-9
3. Gipe, Paul: Wind Energy Basics, Chelsea Green Publishing Co; ISBN: 978-1603580304
4. Wizelius, Tore, Earnest, Joshua - Wind Power Plants and Project Development, PHI Learning, New Delhi, ISBN:978-8120351660
5. Bhadra, S.N., Kastha, D., Banerjee, S, Wind Electrical Systems installation; Oxford University Press, New Delhi, ISBN: 9780195670936
6. O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi (ISBN: 978-93-86173-683)

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.

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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.

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Course Code	:	EEPE***
Course Title	:	BIOMASS AND MICRO-HYDRO POWER PLANTS
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 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 Plantand their specifications
Coconut shell, coconut peat, coconut husk, Gasification Power Plantand their specifications
Bagasse/Sugar Cane Trash Gasification Power Plantand 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 turbineand their specifications
Construction and working of Medium head – Francis turbineand their specifications
Construction and working of Low head – Kaplan turbineand their specifications
Preventive and breakdown maintenance of microhydro power plants
Safe Practices for microhydro power plants.

References:

1. Khoiyangbam, R S Navindu; Gupta and Sushil Kumar; Biogas Technology :Towards Sustainable Development; TERI, New Delhi; ISBN: 9788179934043
2. David M. Buchla; Thomas E. Kissell; Thomas L. Floyd - Renewable Energy Systems, Pearson Education New Delhi , ISBN: 9789332586826,
3. Kothari, D.P. et aL: Renewable Energy Sources and Emerging Technologies, PHI
4. Rachel, Sthuthi, Earnest, Joshua; -Wind Power Technologies, PHI Learning
5. O.P. Gupta, Energy Technology, Khanna Publishing House, ISBN: 978-93-86173-683

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.

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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.

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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 Vehicles-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:

1. A.K. Babu, Electric & Hybrid Vehicles, Khanna Publishing House, New Delhi (Ed. 2018)
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,
4. Ehsani, M. *Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design*, CRC Press
5. Husain, I. *Electric and Hybrid Electric Vehicles*, CRC Press
6. Chan C. C. and K. T. Chau, *Modern Electric Vehicle Technology*, Oxford Science Publication,
7. Lechner G. and H. Naunheimer, *Automotive Transmissions: Fundamentals, Selection,Design and Application*, Springer
8. Rashid, M. H. *Power Electronics: Circuits, Devices and Applications*, 3rd edition, Pearson,
9. Moorthi, V. R. *Power Electronics: Devices, Circuits and Industrial Applications*, Oxford University Press
10. Krishnan, R. *Electric motor drives: modelling, analysis, and control*, Prentice Hall
11. Krause, O. P. ; C. Wasynczuk, S. D. Sudhoff, *Analysis of electric machinery*, IEEE Press

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 Code	:	EEPE***
Course Title	:	ELECTRIC VEHICLES 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 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 Code	:	EEPE
Course Title	:	ELECTRIC TRACTION
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 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:

1. G.C. Garg, Utlization of Electric Power & Electric Traction, Khanna Book Publishing Co., New Delhi (ISBN: 978-93-86173-355) Revised Ed. 2018
2. Gupta J.B., S.K.Kataria and Son, Utilization of Electric power and traction
3. Partab H., Dhanpat Rai and Co,' Art and Science of Utilization of Electrical Energy
4. Partab H., Dhanpat Rai and Co, Modern Electric Traction
5. Suryanarayana N.V., New Age International Publishers, Reprint 2010
6. Open Shaw Taylor, Orient Longman ltd., Utilisation of electrical energy.

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.

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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
10. Draw Power Circuit of AC Locomotive 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.

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CHAPTER

5

Mechanical Engineering Curriculum Structure

(III to VI Semesters)

5.1 List of Programme Core Courses [PC]

S. No	Code No.	Course Title	Hours per week			Semes-ter	Cred-its
			L	T	P		
1	MEPC201	Basic Mechanical Engineering	3	1	0	III	4
2	MEPC203	Computer Aided Machine Drawing Practice	0	0	4	III	2
3	MEPC205	Material Science & Engineering	3	0	0	III	3
4	MEPC207	Fluid Mechanics & Hydraulic Machinery	2	1	0	III	3
5	MEPC209	Manufacturing Engineering	3	0	0	III	3
6	MEPC211	Thermal Engineering - I	3	0	0	III	3
7	MEPC213	Manufacturing Engineering Lab-I	0	0	2	III	1
8	MEPC215	Fluid Mechanics & Hydraulic Machinery Lab	0	0	2	III	1
9	MEPC217	Thermal Engineering Lab-I	0	0	2	III	1
10	MEPC202	Measurements & Metrology	2	1	0	IV	3
11	MEPC204	Strength of Materials	2	1	0	IV	3
12	MEPC206	Thermal Engineering - II	2	1	0	IV	3
13	MEPC208	Material Testing Lab	0	0	3	IV	1.5
14	MEPC210	Measurements & Metrology Lab	0	0	2	IV	1
15	MEPC212	Thermal Engineering Lab-II	0	0	3	IV	1.5
16	MEPC301	Advanced Manufacturing Processes	3	0	0	V	3
17	MEPC303	Theory of Machines & Mechanisms	2	1	0	V	3
18	MEPC305	Industrial Engineering & Management	3	0	0	V	3
19	MEPC307	CAD/CAM Lab	0	0	2	V	1
20	MEPC309	Manufacturing Engineering Lab-II	0	0	2	V	1
21	MEPC302	Design of Machine Elements	2	1	0	VI	3
22	MEPC304	Production & Operations Management	3	0	0	VI	3
Total Credits							**55**

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5.2 List of Program Elective Courses [PE]

S.No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1	MEPE###	Tool Engineering	3	0	0	IV / V	3
2	MEPE###	Computer Integrated Manufacturing	3	0	0	IV / V	3
3	MEPE###	Computer Aided Design and Manufacturing	3	0	0	IV / V	3
4	MEPE###	Industrial Robotics & Automation	3	0	0	IV / V	3
5	MEPE###	Heat Transfer	3	0	0	IV / V	3
6	MEPE###	Refrigeration & Air-conditioning	3	0	0	IV / V	3
7	MEPE###	Automobile Engineering	3	0	0	IV / V	3
8	MEPE###	Power Plant Engineering	3	0	0	IV / V	3
9	MEPE###	Farm Equipment & Farm Machinery	3	0	0	IV / V	3
10	MEPE###	Material Handling Systems	3	0	0	IV / V	3
11	MEPE###	Hybrid Vehicles	3	0	0	IV / V	3
12	MEPE###	Mechatronics	3	0	0	IV / V	3
Total Credits							**12**

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Manufacturing Technology

S.No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1	MEPE###	Tool Engineering	3	0	0	IV / V	3
2	MEPE###	Computer Integrated Manufacturing	3	0	0	IV / V	3
3	MEPE###	Computer Aided Design and Manufacturing	3	0	0	IV / V	3
4	MEPE###	Industrial Robotics & Automation	3	0	0	IV / V	3

Thermal Engineering

S.No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1	MEPE###	Heat Transfer	3	0	0	IV / V	3
2	MEPE###	Refrigeration & Air-conditioning	3	0	0	IV / V	3
3	MEPE###	Automobile Engineering	3	0	0	IV / V	3
4	MEPE###	Power Plant Engineering	3	0	0	IV / V	3

Applied Courses in Mechanical Engineering

S.No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1	MEPE###	Farm Equipment & Farm Machinery	3	0	0	IV / V	3
2	MEPE###	Material Handling Systems	3	0	0	IV / V	3
3	MEPE###	Hybrid Vehicles	3	0	0	IV / V	3
4	MEPE###	Mechatronics	3	0	0	IV / V	3

Note: MEPE### to be assigned as per the course offered in a particular semester

5.3 Semester-wise Detailed Curriculum
Semester III

Sl. No	Category	Code No.	Course Title	Hours per week L	T	P	Total contact hrs/ week	Credits
1	Program core course	MEPC201	Basic Mechanical Engineering	3	1	0	4	4
2	Program core course	MEPC203	Computer Aided Machine Drawing Practice	0	0	4	4	2
3	Program core course	MEPC205	Material Science & Engineering	3	0	0	3	3
4	Program core course	MEPC207	Fluid Mechanics & Hydraulic Machinery	2	1	0	3	3
5	Program core course	MEPC209	Manufacturing Engineering	3	0	0	3	3
6	Program core course	MEPC211	Thermal Engineering - I	3	0	0	3	3
7	Program core course	MEPC213	Manufacturing Engineering Lab-I	0	0	2	2	1
8	Program core course	MEPC215	Fluid Mechanics & Hydraulic Machinery Lab	0	0	2	2	1
9	Program core course	MEPC217	Thermal Engineering Lab-I	0	0	2	2	1
10	Summer Internship-I (4 weeks) after IInd Sem	SI201	Internship	0	0	0	0	2
Total				**14**	**2**	**10**	**26**	**23**

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Semester IV

Sl. No	Category	Code No.	Course Title	Hours per week L	T	P	Total contact hrs/ week	Credits
1	Program core course	MEPC202	Measurements & Metrology	2	1	0	3	3
2	Program core course	MEPC204	Strength of Materials	2	1	0	3	3
3	Program core course	MEPC206	Thermal Engineering - II	2	1	0	3	3
4	Program Elective course	MEPE###	Any one Programme Elective	3	0	0	3	3
5	Program Elective course	MEPE###	Any one Programme Elective	3	0	0	3	3
6	Program core course	MEPC208	Material Testing Lab	0	0	3	3	1.5
7	Program core course	MEPC210	Measurements & Metrology Lab	0	0	2	2	1
8	Program core course	MEPC212	Thermal Engineering Lab-II	0	0	3	3	1.5
9	Minor Project	PR202		0	0	4	4	2
10	Mandatory Course	AU202	Essence of Indian Knowledge and Tradition	2	0	0	2	0
Total				**14**	**3**	**12**	**29**	**21**

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Semester V

Sl. No	Category	Code No.	Course Title	Hours per week L	T	P	Total contact hrs	Credits
1	Program core course	MEPC301	Advanced Manufacturing Processes	3	0	0	3	3
2	Program core course	MEPC303	Theory of Machines & Mechanisms	2	1	0	3	3
3	Program core course	MEPC305	Industrial Engineering & Management	3	0	0	3	3
4	Program Elective course	MEPE###	Any one Programme Elective	3	0	0	3	3
5	Program Elective course	MEPE###	Any one Programme Elective	3	0	0	3	3
6	Open Elective	**OE###	Any one Open Elective	3	0	0	3	3
7	Program core course	MEPC307	CAD/CAM Lab	0	0	2	2	1
8	Program core course	MEPC309	Manufacturing Engineering Lab-II	0	0	2	2	1
9	Summer Internship-II (6 weeks) after IVth Sem	SI301		0	0	0	0	3
10	Major Project	PR302		0	0	2	2	^
Total				17	1	6	24	20+3

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Semester VI

Sl. No	Category	Code No.	Course Title	Hours per week L	T	P	Total contact hrs	Credits
1	Program core course	MEPC302	Design of Machine Elements	2	1	0	3	3
2	Program core course	MEPC304	Production & Operations Management	3	0	0	3	3
3	Humanities and Social Science course	HS302	Entrepreneurship and Start-ups	3	1	0	4	4
4	Open Elective	**OE###	Any one Open Elective	3	0	0	3	3
5	Open Elective	**OE###	Any one Open Elective	3	0	0	3	3
6	Mandatory Course	AU302	Indian Constitution	2	0	0	2	0
7	Major Project	PR302		0	0	6	6	4^
8	Seminar	SE302		1	0	0	1	1
Total				**17**	**2**	**6**	**25**	**21**

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

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Semester III

Course Code	:	MEPC201
Course Title	:	BASIC MECHANICAL ENGINEERING
Number of Credits	:	4 (L: 3, T: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

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: Introduction to Thermodynamics - Role of Thermodynamics in Engineering and Science, Types of Systems, Thermodynamic Equilibrium, Properties, State, Process and Cycle, Elementary introduction to Zeroth, First and Second laws of thermodynamics, Heat and Work Interactions for various non-flow and flow processes; Concept of Heat Engine, Heat Pump & Refrigerator, Efficiency/ COP; Kelvin-Planck and Clausius Statements, Carnot Cycle, Carnot Efficiency, T-S and P-V Diagrams, Concept of Entropy (Definition only).

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.

Unit-IV: Materials and Manufacturing Processes: Engineering Materials, Classification and their Properties; Metal Casting, Moulding, Patterns, Metal Working: Hot Working and Cold Working, Metal Forming: Extrusion, Forging, Rolling, Drawing, Gas Welding, Arc Welding, Soldering, and Brazing.

Unit-V: Machine Tools and Machining Processes: Machine Tools: Lathe Machine and types, Lathe Operations, Milling Machine and types, Milling Operations, Shaper and Planer Machines: Differences, Quick-Return Motion Mechanism, Drilling Machine: Operations, Grinding Machine: Operations

Reference Books:

1. Basic Mechanical Engineering – M.P. Poonia & S.C. Sharma, Khanna Publishing House, Delhi
2. Elements of Mechanical Engineering – M. L. Mathur, F. S. Mehta and R. P. Tiwari, Jain Brothers, New Delhi
3. Engineering Heat Transfer – Gupta & Prakash, Nem Chand & Brothers, New Delhi
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

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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:

S.No.	Topics for practice
I	Introduction to CAD software.
II	Drawing aids and editing commands.
III	Basic dimensioning, hatching, blocks and views.
IV	Isometric drawing, printing and plotting
V	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 exrcises). 1) Sleeve & Cotter Joint 2) Spigot & 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.

Reference Books:

1. Bhatt, N.D., Machine Drawing, Charotar Publishing House, 2003.
2. Sidheswar, N., Kannaiah, P. and Sastry, V.V.S., Machine Drawing, Tata McGraw Hill Book Company, New Delhi, 2000.
3. Kannaih, P., Production Drawing, New Age International , 2009

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.

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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-III: Non-ferrous metals and its Alloys: Properties and uses of aluminium, copper, tin, lead, zinc, magnesium and nickel; Copper alloys: Brasses, bronzes – composition, properties and uses; Aluminium alloys: Duralumin, hindalium, magnelium – composition, properties and uses; Nickel alloys: Inconel, monel, nicPerome – composition, properties and uses. Anti-friction/Bearing alloys: Various types of bearing bronzes - Standard commercial grades as per BIS/ASME.

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:

1. A Text Book of Material Science & Metallurgy – O.P. Khanna, Dhanpath Rai and Sons, New Delhi. 2003.
2. Material Science & Engineering – R.K. Rajput, S.K. Kataria & Sons, New Delhi, 2004.
3. Material Science – R.S. Khurmi, S. Chand & Co. Ltd., New Delhi, 2005.

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.

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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:

1. Fluid Mechanics & Hydraulic Machines, S.S. Rattan, Khanna Publishing House, New Delhi
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
4. One Thousand Solved Problems in Fluid Mechanics – K. Subramanya, Tata McGraw Hill.
5. Hydraulic, fluid mechanics & fluid machines – S. Ramamrutham, Dhanpat Rai and Sons, New Delhi
6. Fluid Mechanics and Hydraulic Machines – R. K. Bansal, Laxmi Publications, 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.

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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:

1. Manufacturing technology – P N Rao, Tata McGraw-Hill Publications
2. Elements of workshop Technology (Volume I & II) – S. K. Hajra Chaudary, Bose & Roy, Media Promoters and Publishers Limited.
3. Production Technology (Volume I & II) – O. P. Khanna & Lal, Dhanpat Rai Publications.
4. Fundamental of metal cutting and machine tools– B. L. Juneja, New age international limited.
5. Manufacturing Technology, Metal Cutting & Machine tools– P. N. Rao, Tata McGraw-Hill Publications
6. Production Technology – R.B. Gupta, Satya Prakashan, New Delhi

Course outcomes:

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

CO1	Know and identify basic manufacturing processes for manufacturing different components.
CO2	Operate & control different machines and equipments.
CO3	Produce jobs as per specified dimensions and inspect the job for specified dimensions.
CO4	Select the specific manufacturing process for getting the desired type of output.
CO5	Adopt safety practices while working on various machines.

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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-

sors 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 concentrating collectors & its applications (Solar Water Heater, Photovoltaic Cell, Solar Distillation); Wind Energy; Tidal Energy; Ocean Thermal Energy; Geothermal Energy; Biogas, Biomass, Bio-diesel; Hydraulic Energy, Nuclear Energy; Fuel cell.

Unit-II: Internal Combustion Engines: Assumptions made in air standard cycle analysis; Brief description of Carnot, Otto and Diesel cycles with P-V and T-S diagrams; Internal and external combustion 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; Comparison 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 Zenith carburettors; 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 system 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, qualitative 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 B,P., I.P. and F.P.; Simple numerical problems on performance of I.C. engines.

Unit-V: Air Compressors: Functions of air compressor; Uses of compressed air; Types of air compressors; Single stage reciprocating air compressor - its construction and working (with line diagram) using P-V diagram; Multi stage compressors – Advantages over single stage compressors; Rotary compressors: Centrifugal compressor, axial flow type compressor and vane type compressors.

Refrigeration & Air-conditioning: Refrigeration; Refrigerant; COP; Air Refrigeration system: components, working & applications; Vapour Compression system: components, working & applications; Air conditioning; Classification of Air-conditioning systems; Comfort and Industrial Air-Conditioning; Window Air-Conditioner; Summer Air-Conditioning system, Winter Air-Conditioning system, Year-round Air-Conditioning system.

Reference Books:

1. Introduction to Renewable Energy – Vaughn Nelson, CRC Press
2. Thermal Engineering – P.L. Ballaney, Khanna Publishers, 2002
3. A Course in Thermal Engineering – S. Domkundwar & C.P. Kothandaraman, Dhanpat Rai.
4. Thermal Engineering – R.S. Khurmi and J.K. Gupta, 18th Edition, S. Chand & Co, NewDelhi.
5. Thermal Engineering – R. K. Rajput,8th Edition, Laxmi publications Pvt Ltd, New Delhi.

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.

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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:

S.No.	Topics for practice
I	Moulding & casting of (i) Connecting rod (ii) Solid bearing (iii) V-Pulley/Gear Pulley
II	Arc welding (i) Lap Joint (ii) Butt Joint (iii) T- Joint
III	Gas welding (i) Lap Joint (ii) Butt Joint
IV	Spot welding (i) Lap Joint
V	Turning Exercise (i) Facing, Step Turning & Chamfering (ii) Step Turning & Taper Turning (iii) Step Turning & Groove Cutting (iv) Step Turning & & Knurling (v) Step Turning & Thread Cutting (vi) Turning and Drilling
VI	Grinding the Lathe Cutting tools to the required angles
VII	Study of Lathe, Drilling machine, shaping machine and slotting machine
VIII	The dismantling some of the components of lathe and then assemble the same
IX	List the faults associated with lathe and its remedies
X	The routine and preventive maintenance procedure for lathe

Reference Books:

1. Elements of Workshop Technology (Volume I & II) – Hajra Chowdry & Bhattacharaya, Media Promoters, 11th Edition, 2007
2. Introduction of Basic Manufacturing Processes and Workshop Technology – Rajendersingh, New age International (P) Ltd. NewDelhi, 2006
3. Workshop Technology – Raghuwanshi, Khanna Publishers. Jain &Gupta, New Delhi, 2002
4. Production Technology – Jain & Gupta, Khanna Publishers, New Delhi, 2006.
5. Production Technology – HMT, 18th edition, Tata McGraw Hill, New Delhi
6. Manufacturing process – Myro N Begman, 5 th edition, Tata McGraw Hill, New Delhi

Course outcomes:

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

CO1	Prepare a mould sand mix and molten metal and calculate the amount of metal to be poured in the mould
CO2	Centre the job and select the proper tool to perform the job on lathe machine.
CO3	Calculate the taper angle and practice different taper turning methods on lathe.
CO4	Prepare the edges for welding and select the suitable electrode, voltage and current.
CO5	Operate the welding transformer and generator to perform various weld joint operations.

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Course Code	:	MEPC215
Course Title	:	FLUID MECHANICS & HYDRAULIC MACHINERY LAB
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	Fluid Mechanics & Hydraulic Machinery(MEPC203)
Course Category	:	PC

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:

S.No.	**Topics for practice**
I	Verification of Bernoulli's theorem.
II	Determination of Coefficient of Discharge of Venturimeter.
III	Determination of Coefficient of Discharge, coefficient of contraction and coefficient of velocity of Orificemeter.
IV	Determination of coefficient of friction of flow through pipes.
V	Determination of force exerted by the jet of water on the given vane.
VI	Determination of minor losses of flow through pipes.
VII	Calibration of pressure gauge using dead weight pressure gauge tester.
VIII	Trial on centrifugal pump to determine overall efficiency.
IX	Trial on reciprocating pump to determine overall efficiency.
X	Trial on Pelton wheel to determine overall efficiency.
XI	Trial on Francis/Kaplan turbine to determine overall efficiency.

Reference Books: N. Kumara Swamy, Fluid Mechanics and Machinery Laboratory Manual, Charotar Publishing House Pvt. Ltd., ANAND 388 001, Ed. 2008

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	Understand the need and importance of calibration of pressure gauges.
CO4	Describe the construction and working of turbines and pumps.
CO5	Test the performance of turbines and pumps and Plot characteristics curves.

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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:

S.No.	Topics for practice
I	Flash & Fire point tests using Able's/Cleveland/Pensky Martin Apparatus
II	Viscosity measurement usi/Saybolt viscometer
III	Calorific value tests using Bomb Calorimeter (Solid and Liquid fuels) and Junkers Gas Calorimeter (Gaseous fuels)
IV	Carbon residue test using Conradson's apparatus.
V	Assembling and disassembling of I.C. Engines
VI	Port timing diagram of Petrol engine
VII	Port timing diagram of Diesel engine
VIII	Valve timing diagram of Petrol engine
IX	Valve timing diagram of Diesel engine
X	Study of petrol and diesel engine components and Models

Reference Books:

1. Thermal Engineering – P.L. Ballaney, Khanna Publishers, 2002
2. A Course in Thermal Engineering – S. Domkundwar & C.P. Kothandaraman, Dhanpat Rai & Publication New Delhi
3. Thermal Engineering – R.S. Khurmi and J.K. Gupta, 18th Edition, S. Chand & Co, NewDelhi

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.

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SEMESTER IV

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: Sphygmo monometer.

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; Coaxiallity; roundness; run out; alignment testing of machine tools as per IS standard procedure.

Reference Books:

1. Mechanical measurements – Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed., 2006.
2. Metrology & Measurement – Anand K Bewoor,Vinay kulakarni, Tata McGraw Hill, New Delhi, 2009
3. Principles of Industrial instrumentation and control systems – Channakesava. R. Alavala, DELMAR cenage learning, 2009.
4. Principles of Engineering Metrology – Rega Rajendra, Jaico publishers, 2008
5. Dimensional Metrology – Connie Dotson, DELMAR, Cenage learning, 2007
6. Instrumentation measurement and analysis – B.C. Nakara, K.K. Chaudary, second edition, Tata cgraw Hill, 2005.
7. Engineering Metrology – R.K. Jain, Khanna Publishers, New Delhi, 2005.
8. A text book of Engineering Metrology – I.C. Gupta, Dhanpat Rai and Sons, New Delhi, 2005
9. Metrology for Engineers – J.F.W. Galyer and C. R. Shotbolt, ELBS
10. Engineering Metrology – K. J. Hume, Kalyani publishers

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 $T/J=f_s/R=G\theta/L$; 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:

1. Strength of Materials – D.S. Bedi, Khanna Book Publishing Co. (P) Ltd., Delhi, 2017
2. Strength of Materials – B.C.Punmia, Ashok Kumar Jain & Arun Kumar Jain, Laxmi Publications, New Delhi, 2013
3. Strength of Materials – S. Ramamrutham, Dhanpat Rai & Publication New Delhi
4. Strength of Materials – R.S. Khurmi, S.Chand Company Ltd. Delhi
5. A Text Book strength of Material– R.K. Bansal, Laxmi Publication New Delhi

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.

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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; Comparison 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:

1. A Course in Thermal Engineering – S. Domkundwar & C.P. Kothandaraman, Dhanpat Rai & Publication, New Delhi
2. Thermal Engineering – R.K. Rajput, Laxmi Publication New Delhi
3. Thermal Engineering – P.L. Ballaney, Khanna Publishers, 2002
4. Treatise on Heat Engineering in MKS and SI Units – V.P. Vasandani & D.S. Kumar, Metropolitan Book Co. Pvt. Ltd, New Delhi.

Course outcomes:

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

CO1	Explain the working cycle of gas turbines, and the working of Jet and Rocket Engines apart from identifying the fuels used for Jet and Rocket propulsion.
CO2	Compute the work done, enthalpy, internal energy and entropy of steam at given conditions using steam tables and Mollier chart.
CO3	Distinguish between water tube and fire-tube boilers and explain the function all the mountings and accessories.
CO4	Calculate Velocity of steam at the exit of nozzle in terms of heat drop analytically and by using Mollier chart.
CO5	State the necessity of governing and compounding of a turbine.
CO6	Explain the principle of working of a steam turbine and distinguish between the impulse turbines and reaction turbines.

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Course Code	:	MEPC208
Course Title	:	MATERIAL TESTING LAB
Number of Credits	:	1.5 (L: 0, T: 0, P: 3)
Prerequisites	:	Material Science & Engineering (MEPC201) Strength of Materials (MEPC204)
Course Category	:	PC

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:

S.No.	Topics for practice
I	Prepare a specimen and examine the microstructure of the Ferrous and Non- ferrous metals using the Metallurgical Microscope.
II	Detect the cracks in the specimen using (i) Visual inspection and ring test (ii) Die penetration test (iii) Magnetic particle test.
III	Determination of Rockwell's Hardness Number for various materials like mild steel, high carbon steel, brass, copper and aluminium.
IV	Finding the resistance of materials to impact loads by Izod test and Charpy test.
V	Torsion test on mild steel – relation between torque and angle of twist determination of shear modulus and shear stress.
VI	Finding Young's Modulus of Elasticity, yield points, percentage elongation and percentage reduction in area, stress strain diagram plotting, tests on mild steel.
VII	Determination of modulus of rigidity, strain energy, shear stress and stiffness by load deflection method (Open & Closed coil spring)
VIII	Single or double Shear test on M.S. bar to finding the resistance of material to shear load.

Reference Books:

1. Measurement system (Application and Design) – Ernest O Doebelin.
2. Strength of Materials – R.S. Khurmi, S.Chand Company Ltd. Delhi
3. A Text Book strength of Material– R.K. Bansal, Laxmi Publication New Delhi

Course outcomes

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

CO1	Identify the given specimen by viewing the micro structure using metallurgical microscope
CO2	Identify the cracks in the specimen using different techniques
CO3	Determine the various types of stress and plot the stress strain diagram for mild steel.
CO4	Determine the torsion, bending, impact and shear values of given materials
CO5	Determine the modulus of rigidity, strain energy, shear stress and stiffness of coil spring

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Course Code	:	MEPC210
Course Title	:	MEASUREMENTS & METROLOGY LAB
Number of Credits	:	1 (L:0, T:0 , P:2)
Prerequisites	:	Measurements & Metrology (MEPC202)
Course Catergory	:	PC

Course Objectives:

- To understand techniques for precise measurement of the dimensions of various objects and shapes.

Course Content:

S.No.	Topics for practice
I	Measure the diameter of a wire using micrometre and compare the result with digital micrometre
II	Measure the angle of the machined surface using sine bar with slip gauges.
III	Measure the angle of a V-block / Taper Shank of Drill / Dovetail using universal bevel protractor.
IV	Measure the dimensions of ground MS flat/cylindrical bush using Vernier Caliper compare with Digital/Dial Vernier Caliper.
V	Measure the geometrical dimensions of V-Thread using thread Vernier gauge.
VI	Measure the thickness of ground MS plates using slip gauges

Reference Books:

1. Engineering Metrology – R. K. Jain
2. Engineering precision metrology – R. C. Gupta
3. A Hand book of Industrial Metrology – ASME

Course outcomes:

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

CO1	Measure various component of linear measurement using Vernier calipers and Micrometre.
CO2	Measure various component of angle measurement using sine bar and bevel Protractor
CO3	Measure the geometrical dimensions of V-thread and spur gear

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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:

S.No.	Topics for practice
I	Study of high pressure boiler with model
II	Study of boiler mountings and accessories
III	Conduct performance test on VCR test rig to determine COP of the refrigerator
IV	Conduct performance test on multi stage reciprocating compressor
V	Conduct Morse test to determine the indicated power of individual cylinders
VI	Conduct Performance test on 2-S CI/SI engine.
VII	Conduct Performance test on 4-S CI/SI engine.
VIII	Conduct Heat balance test on CI/SI engine..
IX	Conduct Economical speed test on 4-S CI/SI engine.
X	Thermal conductivity test on 1) Thick slab 2) Composite wall 3) Thick cylinder
XI	Leak detection of refrigeration equipment
XII	Conduct performance test on A/C test rig to determine COP of the refrigerator

Reference Books:

1. Thermal Engineering – P.L. Ballaney, Khanna Publishers, 2002
2. A Course in Thermal Engineering – S. Domkundwar & C.P. Kothandaraman, Dhanpat Rai & Publication New Delhi
3. Thermal Engineering – R.S. Khurmi and J.K. Gupta, 18th Edition, S. Chand & Co, NewDelhi

Course outcomes

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

CO1	Evaluate the performance characteristics of single cylinder diesel/petrol engine at different loads and draw the heat balance sheet.
CO2	Find the indicated power of individual cylinders of an engine by using morse test.
CO3	Evaluate the performance characteristics Multi stage air compressor
CO4	Evaluate the co efficient of performance of refrigerator
CO5	Find the thermal conductivity of material

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SEMESTER V

Course Code	:	MEPC301
Course Title	:	ADVANCED MANUFACTURING PROCESSES
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	Basic Mechanical Engineering (MEPC102) Manufacturing Engineering (MEPC207)
Course Category	:	PC

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.

(B) 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.

Maintenance of Machine Tools: Types of maintenance, Repair cycle analysis, Repair complexity, Maintenance manual, Maintenance records, Housekeeping. Introduction to Total Productive Maintenance (TPM).

Reference Books:

1. Production Technology – HMT, Banglore, Tata Mc-Graw Hill
2. CNC machines – Pabla B. S. & M. Adithan, New Age international limited.
3. Non conventional Machining – P. K. Mistra, Narvasa Publishining House
4. Manufacturing Processes – Begman & Amsted, John Willey and Sons.
5. Advanced manufacturing technology – David L. Goetsch
6. Exploring Advanced Manufacturing Technologies – Stephen F. Krar & Arthur Gil, Industrial Press

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.

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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:

1. Theory of machines – S.S .Rattan ,Tata McGraw-Hill publications.
2. Theory of machines – R.K.Bansal ,Laxmi publications
3. Theory of machines – R.S. Khurmi & J.K.Gupta , S.Chand publications.
4. Dynamics of Machines – J B K Das, Sapna Publications.
5. Theory of machines – Jagdishlal, Bombay Metro – Politan book Ltd.

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	:	MEPC305
Course Title	:	INDUSTRIAL ENGINEERING & MANAGEMENT
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

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 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; Numerial 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:

1. Industrial Engineering & Management, S.C. Sharma, Khanna Book Publishing Co. (P) Ltd., Delhi
2. Industrial Engineering and Management, O.P. Khanna, Revised Edition, Dhanpat Rai Publications (P) Ltd., New Delhi – 110002.
3. Management, A global perspective, Heinz Weihrich, Harold Koontz, 10th Edition, McGraw Hill International Edition 1994.
4. Essentials of Management, 4th Edition, Joseph L.Massie, Prentice-Hall of India, New Delhi 2004.
5. Principles and Practices of Management, Premvir Kapoor, Khanna Publishing House, N. Delhi

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

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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:

S.No.	Topics for practice
PART-A	**Introduction:** 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.
PART-B	**CNC Programming and Machining:** 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.
	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.
	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:

1. Machine Drawing – P.S. Gill S. K. Kataria & Sons, Delhi., 17th Revised edition, 2001
2. Mechanical Draughtsmanship - G.L. Tamta Dhanpat Rai & Sons, Delhi, 1992
3. Inside AutoCAD – D. Raker and H. Rice, BPB Publications, New Delhi, 1985
4. CAD/CAM/CIM – P. Radhakrishnan, S. Subramaniyan & V. Raju, New Age International Pvt. Ltd., New Delhi, 3rd Edition,
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

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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:

S.No.	Topics for practice
I	Drilling Exercise (Three different sized holes for different materials maintaining uniform distance between them)
II	Milling-square-hexagon from round bars with indexing and without indexing
III	Generation of spur gear teeth on a round bar
IV	Simple planning exercise cutting ‘T’ slots (one model)
V	Shaping a Hexagon on a round bar, key ways, grooves splines
VI	Shaping step block cut dovetail to angles 60, 90, 120 degrees
VII	Cylindrical grinding of external surface and internal surface using universal grinding machines
VIII	Grinding Cutting tools to the required angles
IX	Grinding of milling cutters etc, on a tool and cutter grinder

X	Grinding flat surface on a surface grinder using magnetic chuck and clamping devices
XI	Dismantling some of the components of drilling machine and service, assemble the same
XII	Dismantling some of the components of shaper head and then assemble the same
XIII	Dismantling some of the components of Milling machines and service, assemble the same
XIV	Servicing of universal grinding machine

Reference Books:

1. Elements of Workshop Technology (Volume I & II) – Hajra Chowdry & Bhattacharaya, Media Promoters, 11th Edition, 2007
2. Introduction of Basic Manufacturing Processes and Workshop Technology – Rajendersingh, New age International (P) Ltd. NewDelhi, 2006
3. Production Technology – HMT, 18^{th} edition, Tata McGraw Hill, New Delhi
4. Manufacturing process – Myro N Begman, 5^{th} edition, Tata McGraw Hill, New Delhi

Course outcomes:

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

CO1	Dismantle and assemble the components on drilling, shaping, milling and grinding machines.
CO2	Perform operations on drilling, shaping, milling and grinding machines.
CO3	Produce articles of industrial application such as Spur gear, square headed bolt, V- block
CO4	Make use of various measuring instruments for taking dimensions

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SEMESTER VI

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:

1. Machine Design – Sadhu Singh, Khanna Book Publishing Co., Delhi (ISBN: 978-9382609-575)
2. Machine Design Data Book – Sadhu Singh, Revised Edition, Khanna Book Publishing Co., Delhi (ISBN: 978-9382609-513)
3. Introduction to Machine Design – V.B.Bhandari, Tata Mc- Graw Hill, New Delhi.
4. Mechanical Engineering Design – Joseph Edward Shigley, Tata Mc- Graw Hill, New Delhi.
5. Machine design – Pandya & Shah, Dhanpat Rai & Son, New Delhi.
6. Machine design – R.K.Jain, Khanna Publication, New Delhi.
7. Design Data Book – PSG Coimbtore, PSG Coimbtore.
8. Hand Book of Properties of Engineering Materials & Design Data for Machine Elements – Abdulla Shariff, Dhanpat Rai & Sons, New Delhi.

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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Course Code	:	MEPC304
Course Title	:	PRODUCTION & OPERATIONS MANAGEMENT
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

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-I: Process Planning and Process Engineering: Process Planning: Introduction, Function, Pre-requisites and steps in process planning, Factors affecting process planning, Make or buy decision, plant capacity and machine capacity. Process Engineering: Preliminary Part Print Analysis: Introduction, Establishing the General Characteristics of work piece, determining the principal Process, Functional surfaces of the work piece, Nature of the work to be Performed, Finishing and identifying operations. Dimensional Analysis: Introduction, types of dimensions, measuring the Geometry of form, Baselines, Direction of specific dimensions. Tolerance Analysis: Causes of work piece variation, Terms used in work piece dimensions, Tolerance stacks. Work piece Control: Introduction, Equilibrium Theories, Concept of location, Geometric Control, Dimensional control, Mechanical control.

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:

Introduction, Objectives in scheduling, Loading, Sequencing, Monitoring, Advanced Planning and Scheduling Systems, Theory of Constraints, Employee 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:

1. Production and Operations Management – K.Aswathappa, K.Shridhara Bhat, Himalaya Publishing House, 2014.
2. Production and Operations Management – Shailendra Kale, McGraw Hill Educations(India) Private Limited,2013.
3. Production and Operations Management – R.Paneerselvam, PHI Learning Private Limited, 2013.

4. Operations Management – Joseph Monk, TMH Publishers, New Delhi, 2004.
5. Modern Production /Operations Management – Buffa Elwood S, John Wiley Publishers, Singapore, 2002.

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.

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Course Code	:	MEPE###
Course Title	:	TOOL ENGINEERING
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PE

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 of wear; 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; notching; 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:

1. Tool Design - Donaldson Anglin, Tata McGraw Hill.
2. Production Technology- H.M.T.Jain, Tata McGraw Hill.
3. A Text Book of Production engineering – P.C. Sharma, S.Chand & Co.
4. Production Technology, R.K.Jain, Khanna Publishers.

Course outcomes:

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

CO1	Understand concepts, principles and procedures of tool engineering
CO2	Classify and explain various tools and tool operations
CO3	Select proper tool and a die for a given manufacturing operation to achieve highest productivity
CO4	Estimate tool wear and tool life

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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:

1. CAD, CAM, CIM - P.Radhakrishnan and S.Subramanyan, New Age International Publishers.
2. Computer Integrated Manufacturing - Paul G. Rankey, Prentice Hall.
3. Robotics Technology and Flexible Automation – S.R. Deb, Tata McGraw Hill.

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 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

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Course Code	:	MEPE###
Course Title	:	COMPUTER AIDED DESIGN AND MANUFACTURING
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	Computer Aided Machine Drawing Practice (MEPC104)
Course Category	:	PE

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
2. Computer Aided Design and Manufacturing, Groover M.P. & Zimmers Jr, Prentice hall of India
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.

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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 effecter 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:

1. Introduction to Robotics: Analysis, Systems, Applications – Saeed B. Niku, Pearson Education Inc. New Delhi 2006.
2. Industrial Robotics: Technology, Programming and Applications – M.P. Groover, Tata McGraw Hill Co, 2001.
3. Robotics Control, Sensing, Vision and Intelligence – Fu.K.S. Gonzalz.R.C and Lee C.S.G, McGraw Hill Book Co, 1987.
4. Robotics for Engineers – Yoram Koren, McGraw Hill Book Co, 1992.
5. A Text book on Industrial Robotics – Ganesh S. Hedge, Laxmi Publications Pvt. Ltd., New Delhi, 2008.
6. Robotics Technology and Flexible Automation – S.R. Deb & Sankha Deb, Tata McGraw-Hill, 2010.
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:

CO1	Explain the robot anatomy, classification, characteristics of robot, advantages and disadvantages.
CO2	Explain the various robotic actuators on hydraulic, pneumatic and electrical drives.
CO3	Explain about various types of sensors and concepts on robot vision system.
CO4	Explain the concepts of robot programming languages and various methods of robot programming.
CO5	Explain the various applications of robots.

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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-II: Fins: rectangular and pin fins. Fin effectiveness and efficiency. Critical thickness of insulation. Lumped parameter approach and physical significance of time constant, Biot number, Validity of lumped parameter approach. Introduction to Heissler Chart.

Unit-III: Convection: Introduction, Newton's law of cooling; Momentum and energy equations in two dimensions; nondiemnsionalisation, 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.

Unit-IV: Radiation : Physical mechanism of thermal radiation, laws of radiation, dfeinition of black body, emissive power, intensity of radiation, emissivity, reflectivity, transmittivity, irradiation, radiosity. Radiation exchange between black bodies, concept of Gray-Diffuse Isotropic (GDI) surface. Radiation exchange between GDI surfaces by radiation network and radiosity matrix method. Radiation shielding.

Unit-V: Heat exchangers: Types of heat exchangers, parallel and counterflow types, Introduction to LMTD. Correction factors, fouling factor. NTU method for heat exchangers.

Reference Books:

1. Fundamentals of Heat and Mass Transfer by F.P.Incropera and D.P.Dewitt, 4th ed., John Wiley & Sons.
2. Heat Transfer - A Basic Approach by M.N.Ozisik, McGrawhill.
3. Heat Transfer by J.P.Holman, 8th ed., McGrawhill.
4. Elements of Heat & Mass Transfer by Vijay Gupta, 2nd ed., New Age International Publishers.

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 absorbtion 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:

1. Refrigeration and Air Conditioning – Sadhu Singh, Khanna Book Publishing Co., New Delhi
2. Refrigeration and Air Conditioning – S. Domakundawar, Dhanpat Rai publications.
3. Refrigeration and Air Conditioning – A.S.Sarao & G.S. Gabi, 6th edition, Satya Prakashan publications, New Delhi, 2004.
4. Principles of Refrigeration – Roy J.Dossat, 5th edition, Pearson Publications, 2001.
5. Refrigeration and Air Conditioning – M.Zakria Baig, Premier/ Radiant Publishing House.
6. Refrigeration and Air Conditioning – C.P Arora, Tata McGraw Hill Education, 2000.

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 Absorbtion 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.

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Course Code	:	MEPE###
Course Title	:	AUTOMOBILE ENGINEERING
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PE

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; Fly-wheel and Governer.

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 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:

1. Automobile Engineering Vol I, II, Kirpal Singh, Standard Publishers Distributors, Delhi. 2012.
2. Automobile Mechanics, A.K. Babu, S.C. Sharma, Khanna Publications, New Delhi
3. Automotive Mechanics: Principles and Practices, Joseph Heitner, East West Press
4. Automotive Mechanics, S. Srinivasan, 2nd Edition, Tata McGraw Hill
5. Automobile Engineering Vol I and Vol II, K. M. Gupta, Umesh Publications.
6. Automotive Engineering, Jain and Asthana, Tata McGraw Hill.

Course outcomes

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

CO1	Identify the components of an automobile with their working
CO2	Explain the concepts of cooling and lubricating systems.
CO3	Explain the concepts of Ignition and Transmission and steering systems.
CO4	Identify different suspension systems and their applications.
CO5	Differentiate the special vehicles according to the usage.

****

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:

1. Power plant Engineering-P.K. Nag 4th edition, Tata McGraw Hill Education, 2014.
2. Power plant Engineering – Frederick T. Morse, Litton Educational Publishing Inc. 1953.
3. A Course in Power Plant Engineering – Subhash C. Arora, S. Domakundwar, Dhanpat Rai, 1984.
4. Power Plant Engineering – P.C. Sharma, S.K.Kataria & sons, 2009.
5. Power System Engineering – R.K. Rajput, Firewell Media,2006.

Course outcomes

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

CO1	Familiarised with the present and future power scenario of India.
CO2	Enlist various load terminologies in power plants
CO3	Working and classifications in hydro power plant
CO4	Working principles of Diesel, Gas and Nuclear power plants.
CO5	Understand the issues and necessity of safety concepts of power plants.

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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.

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 - R.A. Kepner, Roy Bainer, and E. L. Berger
2. Farm Machinery and Equipment - H. P. Smith
3. Farm Machinery and equipment - C. P. Nakra
4. Engineering principles of Agril. Machines - Dr. Ajit K. Srivastav, Caroll E. Goering and Roger P. Rohrbach.

5. Farm Machinery – an Approach - S. C Jain & Grace Phillips
6. Agril. Engineering through worked out examples - Dr. R. Lal and Dr. A.C. Dutta
7. Farm Power and Machinery Engineering - Dr.R. Suresh and Sanjay Kumar

Course Outcomes:

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

CO1	Classify the Farm Machineries, equipment and materials
CO2	Describe the objectives of Farm mechanization.
CO3	Explain selection of the machineries
CO4	Discuss the forces acting on tillage tools and hitching systems
CO5	Understand the calibration, constructional features and working of various farm equipment.

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Course Code	:	MEPE###
Course Title	:	MATERIAL HANDLING SYSTEM
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

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.
2. Plant Layout & Materials Handling – Apple J. M., JohnWiley Publishers.
3. Material Handling Equipment – N. Rundenko, Peace Publisher, Moscow.
4. Material Handling Equipment – M. P. Alexandrov, MIR Publisher, Moscow.
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

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Course Code	:	MEPE###
Course Title	:	HYBRID VEHICLES
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PE

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
2. Electric & Hybrid Vehicles – Design Fundamentals - Iqbal Hussain, Second Edition, CRC Press, 2011.
3. Electric Vehicle Technology Explained - James Larminie, John Wiley & Sons, 2003.
4. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals - Mehrdad Ehsani, Yimin Gao, Ali Emadi, CRC Press, 2010.
5. Electric Vehicle Battery Systems - Sandeep Dhameja, Newnes, 2000.

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.

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Course Code	:	MEPE###
Course Title	:	MECHATRONICS
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites (Course code)	:	NIL
Course Category	:	PE

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.

System Model: Engineering.Systems: Rotational, Translational Systems; Electro-Mechanical System; Hydro-Mechanical System.

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:

1. Mechatronics – W. Bolton, Pearson Education India.
2. A Text Book on Mechatronics – R.K.Rajput, S.Chand& Co, New Delhi.
3. Mechatronics – M.D.Singh & Joshi, Prentice Hall of India.
4. Mechatronics – HMT, Tata McGraw Hill, New Delhi.
5. Mechatronics System – Devadas Shetty, PWS Publishing
6. Exploring Programmable Logic Controllers with applications – Pradeep Kumar Srivatsava, BPB Publications.

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.

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CHAPTER

6

Production Engineering Curriculum Structure

(III to VI Semesters)

6.1 List of Programme Core Courses [PC]

S.No.	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1.	PEPC201	Basic Mechanical Engineering	3	1	0	III	4
2.	PEPC203	Computer Aided Machine Drawing Practical	0	0	4	III	2
3.	PEPC205	Metrology & Measurements	3	0	0	III	3
4.	PEPC207	Fluid Mechanics & Hydraulic Machinery	2	1	0	III	3
5.	PEPC209	Industrial Production Technology-I	3	0	0	III	3
6.	PEPC211	Heat Power Engineering	2	1	0	III	3
7.	PEPC213	Production Drawing Lab	0	0	2	III	1
8.	PEPC215	Industrial Production Technology Lab-I	0	0	3	III	1.5
9.	PEPC217	Precision Metrology Lab	0	0	2	III	1
10.	PEPC219	Heat Power Engineering Lab	0	0	3	III	1.5
11.	PEPC202	Industrial Production Technology-II	3	0	0	IV	3
12.	PEPC204	Strength of Materials	2	1	0	IV	3
13.	PEPC206	Theory of Machines and Mechanisms	2	1	0	IV	3
14.	PEPC208	Industrial Production Technology Lab-II	0	0	3	IV	1.5
15.	PEPC210	CAD/CAM Lab	0	0	2	IV	1
16.	PEPC212	Strength of Materials & Hydraulic Machinery Lab	0	0	3	IV	1.5
17.	PEPC301	Mechatronics and Robotics	3	0	0	V	3
18.	PEPC303	Industrial Engineering & Management	3	0	0	V	3
19.	PEPC305	Automation & CNC Machines	3	0	0	V	3
20.	PEPC302	Tool Engineering	3	0	0	VI	3
21.	PEPC304	Industrial Equipment Maintenance	3	0	0	VI	3
Total Credits							**54**

6.2 List of Program Elective COURSES [PE]

S.No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1	PEPE###	CAD/CAM	3	0	0	IV / V	3
2	PEPE###	Advanced Sensors for Engineering Applications & NDT	3	0	0	IV / V	3
3	PEPE###	Flexible Manufacturing Systems	3	0	0	IV / V	3
4	PEPE###	Material Handling Systems	3	0	0	IV / V	3
5	PEPE###	Supply Chain Management	3	0	0	IV / V	3
6	PEPE###	Computer Integrated Manufacturing	3	0	0	IV / V	3
7	PEPE###	Advanced Manufacturing Processes	3	0	0	IV / V	3
8	PEPE###	Total Quality Management	3	0	0	IV / V	3
9	PEPE###	Power Plant Engineering	3	0	0	IV / V	3
10	PEPE###	Farm Equipment & Farm Machinery	3	0	0	IV / V	3
11	PEPE###	Production Planning and Control	3	0	0	IV / V	3
12	PEPE###	Operations Research	3	0	0	IV / V	3
Total Credits							**12**

Manufacturing Technology

S.No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1	PEPE###	CAD/CAM	3	0	0	IV / V	3
6	PEPE###	Computer Integrated Manufacturing	3	0	0	IV / V	3
3	PEPE###	Flexible Manufacturing Systems	3	0	0	IV / V	3
7	PEPE###	Advanced Manufacturing Processes	3	0	0	IV / V	3

Industrial Engineering

S.No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
5	PEPE###	Supply Chain Management	3	0	0	IV / V	3
8	PEPE###	Total Quality Management	3	0	0	IV / V	3
11	PEPE###	Production Planning and Control	3	0	0	IV / V	3
12	PEPE###	Operations Research	3	0	0	IV / V	3

Allied Courses in Production Engineering

S.No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
4	PEPE###	Material Handling Systems	3	0	0	IV / V	3
2	PEPE###	Advanced Sensors for Engineering Applications & NDT	3	0	0	IV / V	3
9	PEPE###	Power Plant Engineering	3	0	0	IV / V	3
10	MEPE###	Farm Equipment & Farm Machinery	3	0	0	IV / V	3

Note: PEPE### to be assigned as per the course offered in a particular semester

6.3 Semester-wise Detailed Curriculum

Semester III

Sl. No	Category	Code No.	Course Title	Hours per week			Total contact hrs/ week	Credits
				L	T	P		
1.	Program core course	PEPC201	Basic Mechanical Engineering	3	1	0	4	4
2.	Program core course	PEPC203	Computer Aided Machine Drawing Practical	0	0	2	2	1
3.	Program core course	PEPC205	Metrology & Measurements	3	0	0	3	3
4.	Program core course	PEPC207	Fluid Mechanics & Hydraulic Machinery	2	1	0	3	3
5.	Program core course	PEPC209	Industrial Production Technology-I	3	0	0	3	3
6.	Program core course	PEPC211	Heat Power Engineering	2	1	0	3	3
7.	Program core course	PEPC213	Production Drawing Lab	0	0	2	2	1
8.	Program core course	PEPC215	Industrial Production Technology Lab-I	0	0	3	3	1.5
9.	Program core course	PEPC217	Precision Metrology Lab	0	0	2	2	1
10.	Program core course	PEPC219	Heat Power Engineering Lab	0	0	3	3	1.5
11.	Summer Internship-I (4 weeks) after IInd Sem	SI201	Internship	0	0	0	0	2
Total				**13**	**3**	**12**	**28**	**22+2**

Semester IV

Sl. No	Category	Code No.	Course Title	Hours per week L	T	P	Total contact hrs/ week	Credits
1.	Program core course	PEPC202	Industrial Production Technology-II	3	0	0	3	3
2.	Program core course	PEPC204	Strength of Materials	2	1	0	3	3
3.	Program core course	PEPC206	Theory of Machines and Mechanisms	2	1	0	3	3
4.	Program Elective course	MEPE###	Any one Programme Elective	3	0	0	3	3
5.	Program Elective course	MEPE###	Any one Programme Elective	3	0	0	3	3
6.	Program core course	PEPC208	Industrial Production Technology Lab-II	0	0	3	3	1.5
7.	Program core course	PEPC210	CAD/CAM Lab	0	0	2	2	1
8.	Program core course	PEPC212	Strength of Materials & Hydraulic Machinery Lab	0	0	3	3	1.5
9.	Minor Project	PR.202		0	0	4	4	2
10.	Mandatory Course	AU202	Essence of Indian Knowledge and Tradition	2	0	0	2	0
Total				**15**	**2**	**12**	**29**	**21**

Semester V

Sl. No	Category	Code No.	Course Title	Hours per week L	T	P	Total contact hrs/ week	Credits
1.	Program core course	PEPC301	Mechatronics and Robotics	3	0	0	3	3
2.	Program core course	PEPC303	Industrial Engineering & Management	3	0	0	3	3
3.	Program core course	PEPC305	Automation & CNC Machines	3	0	0	3	3
4.	Program Elective course	MEPE###	Any one Programme Elective	3	0	0	3	3
5.	Program Elective course	MEPE###	Any one Programme Elective	3	0	0	3	3
6.	Open Elective	**OE###	Any one Open Elective	3	0	0	3	3
7.	Summer Internship-II (6 weeks) after IVth Sem	SI301		0	0	0	0	3
8.	Major Project	PR.302		0	0	2	2	^
Total				**18**	**0**	**2**	**20**	**18+3**

Semester VI

Sl. No	Category	Code No.	Course Title	Hours per week L	T	P	Total contact hrs/ week	Credits
1.	Program core course	PEPC302	Tool Engineering	3	0	0	3	3
2.	Program core course	PEPC304	Industrial Equipment Maintenance	3	0	0	3	3
3.	Humanities and Social Science course	HS302	Entrepreneurship and Start-ups	3	1	0	4	4
4.	Open Elective	**OE###	Any one Open Elective	3	0	0	3	3
5.	Open Elective	**OE###	Any one Open Elective	3	0	0	3	3
6.	Mandatory Course	AU302	Indian Constitution	2	0	0	2	0
7.	Major Project	PR.302		0	0	6	6	4^
8.	Seminar	SE302		1	0	0	1	1
Total				**15**	**1**	**6**	**22**	**21**

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

Semester III

Course Code	:	PEPC201
Course Title	:	BASIC MECHANICAL ENGINEERING
Number of Credits	:	4 (L: 3, T: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

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-I: Introduction to Thermodynamics - Role of Thermodynamics in Engineering and Science, Types of Systems, Thermodynamic Equilibrium, Properties, State, Process and Cycle, Elementary introduction to Zeroth, First and Second laws of thermodynamics, Heat and Work Interactions for various non-flow and flow processes; Concept of Heat Engine, Heat Pump & Refrigerator, Efficiency/COP; Kelvin-Planck and Clausius Statements, Carnot Cycle, Carnot Efficiency, T-S and P-V Diagrams, Concept of Entropy (Definition only).

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.

Unit-IV: Materials and Manufacturing Processes: Engineering Materials, Classification and their Properties; Metal Casting, Moulding, Patterns, Metal Working: Hot Working and Cold Working, Metal Forming: Extrusion, Forging, Rolling, Drawing, Gas Welding, Arc Welding, Soldering, and Brazing.

Unit-V: Machine Tools and Machining Processes: Machine Tools: Lathe Machine and types, Lathe Operations, Milling Machine and types, Milling Operations, Shaper and Planer Machines: Differences, Quick-Return Motion Mechanism, Drilling Machine: Operations, Grinding Machine: Operations

Reference Books:

1. Basic Mechanical Engineering – M.P. Poonia & S.C. Sharma, Khanna Publishing House
2. Elements of Mechanical Engineering – M. L. Mathur, F. S. Mehta and R. P. Tiwari, Jain Brothers, New Delhi
3. Engineering Heat Transfer – Gupta & Prakash, Nem Chand & Brothers, New Delhi
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

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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:

1. Bhatt, N.D., Machine Drawing, Charotar Publishing House, 2003.
2. Sidheswar, N., Kannaiah, P. and Sastry, V.V.S., Machine Drawing, Tata McGraw Hill Book Company, New Delhi, 2000.
3. Kannaih, P., Production Drawing, New Age International, 2009

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.

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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: Sphygmo monometer.

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; Coaxiallity; roundness; run out; alignment testing of machine tools as per IS standard procedure.

Reference Books:

1. Mechanical measurements – Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed., 2006.
2. Metrology & Measurement – Anand K Bewoor,Vinay kulakarni, Tata McGraw Hill, New Delhi, 2009
3. Principles of Industrial instrumentation and control systems – Channakesava. R. Alavala, DELMAR cenage learning, 2009.
4. Principles of Engineering metrology – Rega Rajendra, Jaico publishers, 2008
5. Dimensional Metrology – Connie Dotson, DELMAR, cenage learning, 2007
6. Instrumentation measurement and analysis – B.C. Nakara, K.K. chaudary, second edition, Tata cgraw Hill, 2005.
7. A text book of Engineering metrology – I.C. Gupta, Dhanpat Rai and Sons, New Delhi, 2005
8. Metrology for Engineers – J.F.W. Galyer and C. R. Shotbolt, ELBS
9. Engineering Metrology – K. J. Hume, Kalyani publishers

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	:	PEPC207
Course Title	:	FLUID MECHANICS & HYDRAULIC MACHINERY
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

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-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:

1. Fluid Mechanics & Hydraulic Machines, S.S. Rattan, Khanna Book Publishing Co., Delhi
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
4. One Thousand Solved Problems in Fluid Mechanics – K. Subramanya, Tata McGraw Hill.
5. Hydraulic, fluid mechanics & fluid machines – S. Ramamrutham, Dhanpat Rai and Sons

6. Fluid Mechanics and Hydraulic Machines – R. K. Bansal, Laxmi Publications, 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.

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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

Patterns: Definition – types of pattern – solid piece – split piece – loose piece – match plate – sweep – skeleton – segmental – shell – pattern materials – pattern allowances.

Moulding: Moulding sand – constituents – types – properties of moulding sand – moulding sand preparation – moulding tools – moulding boxes – types of moulds – green sand mould – dry sand mould – loam sand mould – methods of moulding – Moulding machines – Jolting – Squeezing – sand slinger Construction and working principle. Cores: Essential qualities of core – materials – core sand preparation – core binders – core boxes – CO2 process core making – types of core. Metallurgy: Introduction – Iron-carbon diagram. Melting furnaces: Blast furnace – Cupola furnace – Crucible furnace – types – Pit furnace – Coke fired – Oil fired – Electric furnace – types – Direct arc – Indirect arc – Induction furnace –working principles.

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

Arc Welding: Definition – arc welding equipment – electrode types – filler and flux materials – arc welding methods – Metal arc – Metal Inert gas (MIG) – Tungsten inert gas (TIG) - Submerged arc - Electro slag welding – Resistance welding – Spot welding – Butt welding – Seam welding – Plasma arc welding – Thermit welding – Electron beam welding – Laser beam welding – Friction welding – Ultrasonic welding – Induction welding – working principle – applications – Advantages and disadvantages.

Gas welding: Oxy-acetylene welding – advantages – limitations – gas welding equipment –three types of flames – welding techniques – filler rods. – Flame cutting – soldering – brazing – difference between soldering and brazing. Types of welded joints –Selection of welding rod and type of flame for gas welding of ferrous metals- merits and demerits of welded joints – Inspection and testing of welded joints – destructive and non-destructive types of tests – magnetic particle test – radiographic and ultrasonic test - defects in welding – causes and remedies.

UNIT-IV: Forming Technology

Forging: Hot working, cold working – advantages of hot working and cold working – hot working operations – rolling, forging, smith forging, drop forging, upset forging, press forging – roll forging. Press Working: Types of presses – mechanical and hydraulic presses – press tools and accessories – press working operations – bending operations – angle bending – channel bending – curling – drawing – shearing operations – blanking, piercing, trimming – notching – lancing.

UNIT-V: Powder Metallurgy: Methods of manufacturing metal powders – atomization, reduction and electrolysis deposition – compacting – sintering – sizing – infiltration – mechanical properties of parts made by powder metallurgy – design rules for the power metallurgy process.

Reference Books:

1. Elements of Workshop Technology Volume I & II, Hajra Chowdry & Bhatt Acharaya, Media Promoters, 11th Edition, 2007
2. Introduction of Basic Manufacturing Processes and Workshop Technology, Rajendersingh, New age International (P) Ltd. New Delhi- 110002, 2006
3. Manufacturing Process Begeman, Tata McGraw Hill, New Delhi.
4. Workshop Technology- Volume I, II, & III, WAJ Chapman Viva Books Pvt. Ltd., New Delhi

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-I: Basics of Thermodynamics and Thermodynamic Processes of Perfect Gases: Introduction – definitions and units of mass, weight, volume, density, specific weight, specific gravity and specific volume – pressure – units of pressure – temperature - absolute temperature – S.T.P and N.T.P conditions – heat - specific heat capacity at constant volume and at constant pressure – work – power – energy – types - law of conservation of energy – thermodynamic system – types – thermodynamic equilibrium - properties of systems – intensive and extensive properties –State of System- process – cycle – point and path functions - zeroth , first and second laws of thermodynamics – problems Perfect gases – laws of perfect gases – Boyle's, Charles' , Joule's, Regnault's and Avogadro's laws –General Gas Equation- characteristic gas equation – relation between specific heats and gas constant – universal gas constant - problems –Thermodynamic Processes-Change in Internal Energy- enthalpy – change in enthalpy – entropy – change in entropy – general equations for change in entropy. Constant volume, constant pressure, isothermal(hyperbolic) , isentropic (reversible adiabatic), polytropic, – p-V and T-s diagrams, work done , change in internal energy , heat transfer , change in enthalpy , change in entropy for various processes – problems - Free expansion and throttling processes.

UNIT-II: Thermodynamic Air Cycles and Steady Flow Energy Equation & Applications: Air cycles – air standard efficiency – reversible and irreversible processes – assumptions in deriving air standard efficiency – Carnot cycle – Otto cycle – Joule cycle – Diesel cycle – comparison of Otto cycle and Diesel cycle - Comparison of ideal and actual p-V diagrams of Otto and Diesel cycles – problems - dual combustion cycle (description only). Steady flow system – control volume – steady flow energy equation – assumptions –Engineering applications – steam boiler – condenser – nozzles – steam and gas turbines – reciprocating and rotary compressors –Centrifugal pump – non flow energy equation – problems.

UNIT-III: Air Compressors: Uses of compressed air – classifications of Air compressor – reciprocating compressor - single stage reciprocating compressor – compression processes – power required to drive the compressor (Neglecting clearance Volume)– problems – clearance volume and its effects – volumetric efficiency – power required to drive the compressor with clearance volume – problems – multi stage compression –merits and demerits –Two stage compressor with imperfect cooling-with perfect inter cooling - work input – condition for minimum work input in multi stage compressor with perfect inter cooling – ratio of cylinder diameters for minimum work input - problems – rotary compressors – Roots blower - vane blowers – centrifugal and axial flow air compressors. Gas turbines –uses - classifications – merits and demerits of gas turbines - constant pressure combustion gas turbine – gas turbine with – intercooler – reheater - regenerator -effects – closed cycle gas turbines - merits and demerits of open and closed cycle gas turbines – jet propulsion -turbojet engines – merits and demerits – turbo propeller engines – merits and demerits - ramjet– merits and demerits –Rocket engines – applications of rockets.

UNIT-IV: Fuels & Combustion of Fuels and Internal Combustion Engines: Classifications of fuels - merits and demerits – requirements of a good fuel – combustion equations – stoichiometric air required for complete combustion of fuels – excess air – products of combustion – problems – analysis of exhaust gases- Orsat apparatus - calorific value of fuels – higher and lower calorific values – Dulong's formula – problems – determination of calorific value – Bomb and Junker's calorimeter – problems -Internal combustion engines. Classifications of I.C Engines – components of I.C Engines and functions material and method of manufacturing - four stroke cycle petrol and diesel engines – two stroke cycle petrol and diesel engines - comparison of four stroke and two stroke engines – Comparison of petrol and diesel engines - valve timing diagram for four stroke petrol and diesel engines – port timing diagram for two stroke petrol and diesel engines.

UNIT-V: Refrigeration and Air- Conditioning: Introduction - COP of Heat Pump and refrigerator, Tonnes of Refrigeration. Vapour compression system - Vapour compression refrigeration cycle, components of Vapour Compression Cycle. Applications- Water Cooler Domestic refrigerator, Ice plant & cold storage. Psychrometry - Properties of air, psychrometric chart & processes (No Numerical) Air conditioning systems - Definition of Air conditioning and classification of Air Conditioning Systems.

Reference Books:

1. Thermal Engg, R. K. Rajput,8th Edition, Laxmi publications Pvt. Ltd, New Delhi.
2. Applied Thermodynamics, P. K. Nag, 2nd Edition, TATA McGraw – Hill Publishing Company, New Delhi.
3. Thermal Engineering, R.S. Khurmi and J.K. Gupta, 18th Edition, S. Chand & Co,NewDelhi
4. Thermal Engineering, B. K. Sarkar, 3rd Edition, Dhanpat Rai & Sons New Delhi
5. Applied Thermodynamics, Domkundwar and C. P Kothandaraman, 2nd Edition, Dhanpat Rai & Sons, New Delhi.

Course outcomes:

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

CO1	Explain the basics of systems and laws of thermodynamics and thermodynamic processes. Explain different Air Cycles.
CO2	Apply steady flow energy equation for nozzles and condensers.
CO3	Familiarize the parts, functions and types of Air compressors and determine their efficiency. Describe the working of the gas turbines.
CO4	Explain different type of fuels and their combustion phenomenon.
CO5	Explain the types and functions of IC engines.

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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:

1. Bhatt, N.D., Machine Drawing, Charotar Publishing House, 2003.
2. Sidheswar, N., Kannaiah, P. and Sastry, V.V.S., Machine Drawing, Tata McGraw Hill Book Company, New Delhi, 2000.
3. Kannaih, P., Production Drawing, New Age International , 2009
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

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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

- o **Split pattern**

3. Bent Pipe with core print
4. T-pipes with core print
5. Tumbles

- o **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/MSSheet-3mm thickness)**

6. Profile cutting–circular profile

- **Spot welding: (GI/MS Sheet)**

7. Lap joint

Reference Books:

1. Elements of Workshop Technology Volume I & II, Hajra Chowdry & Bhatt Acharaya, Media Promoters, 11th Edition, 2007
2. Introduction of Basic Manufacturing Processes and Workshop Technology, Rajendersingh, New age International (P) Ltd. New Delhi- 110002, 2006
3. Manufacturing process Begeman Tata McGraw Hill, New Delhi 1981. 5th Edition, 1981
4. Workshop Technology- Volume I, II, & III, WAJ Chapman Viva Books Pvt. Ltd., New Delhi

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, sprit 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:

1. Measurement System (Application and Design) – Ernest O Doebelin.
2. Mechanical and Industrial measurements- R. K. Jain
3. Engineering precision metrology – R. C. Gupta
4. A text book of engineering of metrology- I. C. Gupta.
5. Hand book of Industrial Metrology – ASME

Course outcomes:

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

CO1	Measure various component of linear measurement using Vernier calipers and Micrometer
CO2	Measure various component of angle measurement using sine bar and bevel Protractor
CO3	Measure the geometrical dimensions of V-thread and spur gear

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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.
9. Load test (Performance test) on Four Stroke diesel Engine.
10. Morse test on Multi-cylinder petrol engine.

11. Heat balance test on Four Stroke Petrol engine.
12. Heat balance test on Four Stroke Diesel 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:

1. Fundamental of thermodynamics, by Richard E Snnatag, Claus Borgnakke, Gordon J Vanwylen, Wiley Student edition, 6th Ed.,
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.

Drilling Machines: Drills-Flat drills-Twist drills-Nomenclature-Types of drilling machines-Bench type-Floor type-Radial type-Gang drill-Multi-spindle type-Principle of operation in drilling-Speeds and feeds for various materials-drilling holes-methods of holding drill bit-drill chucks-socket and sleeve-drilling-operation-reaming-counter sinking-counter boring-spot facing-tapping-deep hole drilling.

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.

UNIT-III: Milling Machines: Types-column and knee type-plain-universal milling machine-vertical milling machine-specification of milling machines principles of operation-work and tool holding devices-arbor-stub arbor spring collet-adapter-milling cutters-cylindrical milling cutter-slitting cutter-side milling cutter-angle milling cutter-T-slot milling cutter-woodruff milling cutter-fly cutter-nomenclature of cylindrical milling cutter-milling process conventional milling-climb milling-milling operations-straddle milling-gang milling-vertical milling attachment.

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

UNIT-IV: Abrasive Process and Broaching: Abrasive Process: Types and classification-specifications-rough grinding – pedestal grinders- portable grinders- belt grinders-precision grinding cylindrical grinder- centerless grinders – surface grinder- tool and cutter grinder - planetory grinders-principles of operations-grinding wheels abrasives- natural and artificial diamond wheels-types of bonds-grit, grade and structure of wheels-wheel shapes and sizes-standard marking systems of 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

UNIT-V: Jigs & Fixtures: Definitions and concept of Jig and fixture-Advantages of jigs and fixtures-elements of jigs and fixtures-locating devices-'V' locators-fixed stop locators-adjustable stop locators-clamping devices strap clamp, screw clamp-cam action clamp-types of jigs-box drill jig indexing drill jig-types of fixtures-keyway milling fixture-string milling fixture.

Press Working: Types of presses-mechanical and hydraulic presses press tools and accessories-press working operations-bending operations angle bending-channel bending -curling-Drawing-shearing operations - blanking, piercing, trimming-notching-lancing-shaving-parting off.

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:

1. Elements of Workshop Technology- Vol. I & II, Hajra Choudry & Battacharya, , Ed. 11, published by Media Promoters and Publishers Pvt. Ltd.,
2. Production Technology, HMT, , Edn. 18, Tata McGraw Hill Publishing Co.
3. Manufacturing process, Myro N Begman, Edn. 5, Tata McGraw Hill Publishing Co. Ltd.
4. Workshop Tech Vol I,II, III, WAJ. Chapman, published by Viva Books Pvt. Ltd. New Delhi
5. Production processes, NITTTR, published by 5, Tata McGraw Hill Publishing Co. Ltd.

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:

1. Strength of Materials, R. S. Khurmi, , S. Chand & Co., Ram Nagar, New Delhi – 2002
2. Strength of Materials, D.S. Bedi, Khanna Book Publishing Co., Delhi
3. Strength of Materials, S. Ramamrutham, 15 th Edn 2004, Dhanpat Rai Pub. Co., New Delhi.
4. Strength of Materials ,R.K. Bansal, Laxmi Publications Pvt. Ltd., New Delhi, 3rd Edition, 2010.
5. Strength of Materials, S. S. Rattan, Tata Mcgraw hill, New Delhi, 2008, ISBN 9780070668959
6. Strength of Materials, B K Sarkar, I Edition, 2003 Tata Mcgraw Hill, New Delhi.

7. Engineering mechanics, R.K. Bansal, Laxmi Publications Pvt. Ltd., New Delhi, 2nd Edition, 2007

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.

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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:

1. Theory of machines – S.S .Rattan ,Tata McGraw-Hill publications.
2. Theory of machines – R.K.Bansal ,Laxmi publications
3. Theory of machines – R.S. Khurmi & J.K.Gupta , S.Chand publications.
4. Dynamics of Machines – J B K Das, Sapna Publications.
5. Theory of machines – Jagdishlal, Bombay Metro – Politan book Ltd.
6. Theory of machines – P.L.Ballaney, Khanna Publications

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:

1. Elements of Workshop Technology- Vol. I & II, Hajra Choudry & Battacharya, Ed. 11th, Media Promoters and Publishers Pvt. Ltd.
2. Production Technology, HMT, , Ed. 18th, Tata McGraw Hill Publishing Co. Manufacturing Process, Myro N Begman, Ed. 5th, Tata McGraw Hill Publishing Co. Ltd.

Course outcomes:

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

CO1	Identify the parts of a center lathe and types of tools used.

CO2	Make use of lathe for machining various cylindrical components
CO3	Identify the parts of a drilling machine and types of tools used.
CO4	Make use of drilling machine for drilling, reaming and tapping operations
CO5	Make use of drilling machine for counter sink and counter bore operations

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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

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 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
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.

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:

1. Machine Drawing P.S. Gill S. K. Kataria & Sons, Delhi., 17th Revised edition 2001
2. Mechanical Draughtsmanship, G.L. Tamta Dhanpat Rai & Sons, Delhi, 1992
3. Inside AutoCAD D. Raker and H. Rice, BPB Publications, New Delhi, 1985
4. CAD/CAM/CIM P. Radhakrishnan, S. Subramaniyan & V. Raju, New Age International Pvt. Ltd., New Delhi, 3rd Edition, 2008

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

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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:

1. Strength of materials by R.S. Khurmi.
2. Strength of Materials by D.S. Bedi.
3. Applied Mechanics & Strength of Materials by S. Ramamrutham.
4. Hydraulic and Pneumatic Controls by K. S. Sundaram.
5. Fluid Power with Applications by Anthony Esposito.

Course outcomes:

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

CO1	Determine the various types of stress and plot the stress strain diagram for mild steel.
CO2	Determine the Rockwell hardness for various materials.
CO3	Determine the torsion, bending, impact and shear values of given materials
CO4	Determine the Cd of orifice meter, venturi meter, orifice, mouth piece and pipe friction factor
CO5	Determine performance of pumps and turbines

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SEMESTER V		
Course Code	:	PEPC301
Course Title	:	MECHATRONICS AND ROBOTICS
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

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 robot, 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: Measurement of mechanical and process parameters. Measurement of force, torque, temperature, pressure and flow. Measurement of displacement velocity and acceleration. Measurement of noise and vibration

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: Robot – Definition – Co-ordinate Systems, Work Envelope, types and classification – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Basic robot motions - Point to point control, Continuous path control. Robot Parts and Their Functions – Need for Robots – Different Applications. Robot drive systems and end effectors: Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of all these Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations

UNIT-IV: Sensors and Machine Vision: Requirements of a sensor, Principles and Applications of the following types of sensors – Position of sensors (Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders), Range Sensors (Triangulation Principle, Structured, Lighting Approach, Laser Range Meters), Proximity Sensors (Inductive, Capacitive, and Ultrasonic), Touch Sensors, (Binary Sensors, Analog Sensors), Wrist Sensors, Compliance Sensors, Slip Sensors. Camera, Frame Grabber, Sensing and Digitizing Image Data – Signal Conversion, Image Storage, Lighting Techniques.

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 effecter commands, and Simple Programs Industrial Applications: Application of robots in machining, welding, assembly, and material handling.

Reference Books:

1. Mechatronics W. Bolton, Pearson Education, Asia 2007
2. A Text Book on Mechatronics, R. K. Rajput, S. Chand & Co, New Delhi 2011
3. K.S. Fu., R.C.Gonalez, C.S.G.Lee, " Robotics Control sensing ", Vision and Intelligence, McGraw Hill International Edition, 1987.
4. M. P. Groover, "Industrial Robotics – Technology, Programming and Applications", McGraw-Hill, 2001
5. Fu. K. S. Gonzalz. R. C., and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw-Hill Book Co., 1987
6. Yoram Koren, "Robotics for Engineers", McGraw-Hill Book Co., 1992
7. Janakiraman. P. A., "Robotics and Image Processing", Tata McGraw-Hill, 1995
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.

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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 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:

1. Industrial Engineering & Management, S.C. Sharma, Khanan Book Publishing Co (P) Ltd., New Delhi
2. Industrial Engineering and Management, O.P. Khanna, Revised Edition, Dhanpat Rai Publications (P) Ltd., New Delhi – 110002.
3. Management, A global perspective, Heinz Weihrich, Harold Koontz, 10^{th} Edition, McGraw Hill International Edition 1994.
4. Essentials of Management, 4th Edition, Joseph L.Massie, Prentice-Hall of India, New Delhi 2004.
5. Principles and Practices of Management, Premvir Kapoor, Khanna Publishing House, N. Delhi

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

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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 devices – 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.

UNIT-IV: CNC Machine and Components: CNC Machines: Numerical control – definition – components of NC systems – development of NC – DNC – Adaptive control systems – working principle of a CNC system – Features of CNC machines - advantage of CNC machines – difference between NC and CNC – Construction and working principle of turning centre – Construction and working principle of machining centers – machine axes conventions turning centre and machining centre – design considerations of NC machine tools. CNC EDM machine – Working principle of die sinking and wire EDM machines - Coordinate Measuring Machines: construction and working principles.

Drives: spindle drive – dc motor – Feed drives – dc servo motor and stepper motor – hydraulic systems – Slide ways – requirement – types – friction slide ways and anti-friction slide ways - linear motion bearings – recirculation ball screw – ATC – tool magazine – feedback devices – linear and rotary transducers – Encoders - in process probing.

UNIT-V: Part Programming: NC part programming – methods – manual programming – conversational programming – APT programming - Format: sequential and word address formats - sequence number – coordinate system – types of motion control: point-to-point, paraxial and contouring – Datum points: machine zero, work zero, tool zero NC dimensioning – reference points – tool material – tool inserts - tool offsets and compensation - NC dimensioning – preparatory functions and G codes, miscellaneous functions and M codes – interpolation: linear interpolation and circular interpolation - CNC program procedure. Part Program – macro – sub-program – canned cycles: stock – mirror images – thread cutting – Sample programs for lathe: Linear and circular interpolation - Stock removal turning – Peck drilling – Thread cutting and Sample programs for milling: Linear and circular interpolation – mirroring – sub program – drilling

Reference Books:

1. Anthony Esposito, “Fluid Power with Application”, 5th Edition, Pearson Education (2003).
2. Majumdar S R, “Oil Hydraulic System”, Tata McGraw Hill (2001).
3. Bolton W, “Mechatronics”, 2nd Edition, Pearson Education, New Delhi (1999).
4. Necsulelscu Dan, “Mechatronics”, Pearson Education, New Delhi (2002).
5. Geoffrey Boothroyd, “Assembly Automation and Product Design”, Marcel Dekker Inc (1991).
6. CNC Programming, S. K. Sinha, Galgotia Publications Pvt. Ltd.
7. Computer Control of Manufacturing Systems, Yoram Koren, McGraw Hill Book.

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

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SEMESTER VI

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-III: Press working: tools, blanking and piercing tools, load variation during blanking-Calculation of press tonnage for blanking and piercing. Types of dies, simple, compound, combination and progressive dies- Design of compound and progressive dies. Bending and drawing dies: Bending allowances, bending methods. Bending pressure-calculation of blank size and press tonnage for drawing, metal flow during drawing operations - Fine blanking, Embossing and Coining.

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

UNIT-V: CAD for tooling: Turret press FMS-Computer applications (CAD / CAM) in short metal press work – Quick die change method – Single minute exchange of dies- group tooling –Design of single point tools – Plastic as a tooling materials – Fluidized bed fixturing.

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
6. Fundamentals of tool design – ASTME & Edward G. Hoffman
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:

CO1	Select cutting tools and its material using data book and manufacturer's catalogue.
CO2	Estimate tool wear and tool life.
CO3	Use press tools and dies effectively.
CO4	Design strip layout for given component.
CO5	Decide appropriate cutting fluid for machining process improvement.

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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-I: Introduction: Maintenance, Need of Maintenance Management, Maintenance Policies, Strategies and options in Maintenance management. Maintenance forms/actions and their inter relationships, Brief descriptions of various Maintenance actions.

UNIT-II: Maintenance Organizations: Prerequisities, 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-III: Maintenance practices on production machines: Lathe, Drilling, Milling, Welding, Shaper. Use of computer in maintenance, Machine Reconditioning. Evaluation of Maintenance Management: Need for evaluation a to z objectives, criterion of evaluation.

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:

1. Maintenance Management Policies, Strategies and Options: July 27–29, 2000, Lecture notes MACT, Bhopal.
2. Maintenance & Spare Parts Management, P. Gopal Krishnan & A.K. Banerji
3. Hand Book of Reliability Engineering & Management: W. Grant Ireson and Clyde F McGraw Hill
4. Maintenance Planning & Control: Anthony Kelley – East West Press.

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

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Course Code	:	PEPE###
Course Title	:	CAD/CAM
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PE

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
2. Computer Aided Design and Manufacturing, Groover M.P. & Zimmers Jr, PHI
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.

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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-III: Non Destructive Testing: Introduction, classification of NDT techniques; Visual examination: Bore-scopes, video devices; Magnetic particle testing: Operating principle, magnetising technique.

Unit-IV: Liquid Penetrating technique: Principle, process description; Ultrasonic Testing: Definition, advantages and applications, inspection methods; Radiography: Electromagnetic radiation sources, process description.

Unit-V: Thermography: Infrared theory, contact, non-contact methods; Accoustic emission testing, eddy current testing; Leak testing: Bubble emission testing, Air leak testing; Case studies on defects in casting, welding.

Reference Books:

1. Non-Destructive Testing by Warren J.Mcgomnagle, McGrawhill.
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

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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-I: Understanding of FMS: Evolution of Manufacturing Systems, FMS: Definition, objective and Need, FMS: components, Merits, Demerits and Applications, Flexibility in Pull and Push type.

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-III: MHS; An introduction: Material Handling System Conveyor, Robots, Automated Guided Vehicle (AGV), Automated Storage Retrieval System (ASRS).

UNIT-IV: Management Technology: Tool Management, tool magazine, Tool preset, identification, Tool monitoring and fault detection, FMS: Configuration planning and routing, FMS: Production Planning and Control, FMS: Scheduling and loading.

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:

1. William W Luggen, "Flexible Manufacturing Cells and System" Prentice Hall of Inc New Jersey, 1991
2. Reza A Maleki "Flexible Manufacturing system" Prentice Hall of Inc New Jersey, 1991
3. John E Lenz "Flexible Manufacturing" marcel Dekker Inc New York, 1989.
4. Groover, M.P "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India Pvt.Ltd. New Delhi 2009

Course outcomes:

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

CO1	Classify and distinguish FMS and other manufacturing systems.
CO2	Analyze processing stations and material handling systems used in FMS environments.
CO3	Design and analyze FMS using simulation and analytical techniques.
CO4	Develop management and control systems for tools, material handling and configurations in FMS
CO5	Analyze the production management problems in planning, loading, scheduling, routing and breakdown in a typical FMS.

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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, 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.
2. Plant Layout & Materials Handling – Apple J. M., John Wiley Publishers.
3. Material Handling Equipment – N. Rundenko, Peace Publisher, Moscow.
4. Material Handling Equipment – M. P. Alexandrov, MIR Publisher, Moscow.
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

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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-I: Strategic Framework: Introduction to Supply Chain Management, Decision phases in a supply chain, Process views of a supply chain: push/pull and cycle views, Achieving Strategic fit, Expanding strategic scope.

UNIT-II: Supply Chain Drivers and Metrics: Drivers of supply chain performance, Framework for structuring Drivers, Obstacles to achieving strategic fit.

UNIT-III: Designing Supply Chain Network: Factors influencing Distribution Network Design, Design options for a Distribution network, E-Business and Distribution network, Framework for Network Design Decisions, Models for Facility Location and Capacity Allocation.

UNIT-IV: Forecasting in SC: Role of forecasting in a supply chain, Components of a forecast and forecasting methods, Risk management in forecasting.

UNIT-V: Aggregate Planning and Inventories in SC: Aggregate planning problem in SC, Aggregate Planning Strategies, Planning Supply and Demand in a SC, Managing uncertainty in a SC: Safety Inventory.

Reference Books:

- Sunil Chopra and Peter Meindl, 'Supply Chain Management - Strategy, Planning and Operation', 6th Edition, Pearson Education Asia, 2016.
- David Simchi-Levi, Philp Kamintry and Edith Simchy Levy, 'Designing and Managing the Supply Chain - Concepts Strategies and Case Studies', 3nd Edition, Tata-McGraw Hill, 2016.
- John J Coyle, et.al., 'Managing Supply Chains A Logistics Approach', 9th Edition, Cengage Learning, 2013.
- Jeremy F Shapiro, 'Modeling the Supply Chain', 2nd Edition, Cengage Learning, 2007.

Course outcomes:

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

CO1	Understand the decision phases and apply competitive and supply chain strategies.
CO2	Understand individual processes and drivers of supply chain performance.
CO3	Analyze factors influencing network design.
CO4	Analyze the role of forecasting in a supply chain
CO5	Understand the role of aggregate planning, inventory, IT and coordination in a supply chain.

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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:

1. CAD, CAM, CIM by P. Radhakrishnan and S. Subramanyan, New Age International Publishers.
2. Computer Integrated Manufacturing by Paul G. Rankey, Prentice Hall.
3. Robotics Technology and Flexible Automation – S.R. Deb, TMH

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.

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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-I: Introduction: Unconventional machining Process – Need – classification – Brief overview.

UNIT II: Mechanical Energy Based Processes: Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining.(AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – MRR- Applications.

UNIT III: Electrical Energy Based Processes: Electric Discharge Machining (EDM)- working Principle – equipments – Process Parameters – Surface Finish and MRR- electrode / Tool – Power and control Circuits – Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications.

UNIT IV: Chemical and Electro-Chemical Energy Based Processes: Chemical machining and Electro-Chemical machining (CHM and ECM)-Etchants – Maskant techniques of applying maskants - Process Parameters – Surface finish and MRR-Applications . Principles of ECM equipments-Surface Roughness and MRR Electrical circuit-Process Parameters ECG and ECH – Applications.

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:

1. Vijay.K. Jain “Advanced Machining Processes” Allied Publishers Pvt. Ltd., New Delhi, 2007
2. Pandey P.C. and Shan H.S. “Modern Machining Processes” Tata McGraw-Hill, New Delhi, 2007.

3. Benedict. G.F. "Non-Traditional Manufacturing Processes", Marcel Dekker Inc., New York, 1987.
4. Mc Geough, "Advanced Methods of Machining", Chapman and Hall, London, 1998.
5. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, "Material and Processes in Manufacturing" Prentice Hall of India Pvt. Ltd., 8thEdition, New Delhi , 2001

Course outcomes:

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

CO1	Understand various classifications of manufacturing processes
CO2	Understand working principles of mechanical energy based processes
CO3	Understand working principles of electrical energy based processes
CO4	Understand working principles of chemical and electro-chemical energy based processes
CO5	Understand working principles of thermal energy based processes

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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:

1. Total Quality Management, M.P. Poonia & S.C. Sharma, Khanna Publishing House, 2018.
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 implement able solutions to those.
CO5	Emerging concepts for quality and Taguchi optimization technique for off-line

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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 factor 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 lay out; 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:

1. Power plant Engineering-P.K.Nag Tata McGraw Hill.
2. Power plant Engineering-Morse.
3. Power plant Engineering-Domkundawar, Dhanpat Rai Publications.

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

CO4	Understand the working of nuclear power plant and various environmental aspects related to power plant.
CO5	Understand and appreciate the safety aspects related to power plant

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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
4. Engineering principles of Agril. Machines by Dr. Ajit K. Srivastav, Caroll E. Goering and Roger P. Rohrbach.
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:

CO1	Describe the objectives of Farm mechanization.
CO2	Classify the Farm Machineries, equipment and materials.
CO3	Explain selection of the machineries.
CO4	Discuss the forces acting on tillage tools and hitching systems.
CO5	Understand the calibration, constructional features and working of various farm equipment.

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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-IV: Design of Production Planning and Control Systems: System Design for continuous and intermittent Production Systems; Integration of Master Production, Material Requirement and Shop Scheduling Systems.

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
2. Modern Production / Operations Management by Elwood S. Buffa, Rakesh K. Sarin, 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:

CO1	Ability to use and compare various statistical forecasting models
CO2	Understand the plant layout and material handling from plant to warehouse.

CO3	Understand basic sequencing and scheduling techniques, dispatching rules minimize the cost.
CO4	Develop materials requirements for a system including inventory levels, ordering policies, lot-sizes, material costs, and material demand
CO5	Apply management of capacity and demand methodologies in developing and improving the inventory planning and control systems

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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

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-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:

1. Operations Research: an introduction, Hamdy A. Taha, Pearson Education.
2. Operations. Research: theory and application, J.K. Sharma, Macmillan Publishers.
3. Introduction to Operations Research: concept and cases, Frederick S. Hillier and Gerald J. Lieberman, Tata McGraw-Hill

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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CHAPTER 7

Computer Engineering Curriculum Structure

(III to VI Semesters)

7.1 List of Programme Core Courses [PC]

Sl. No	Code No.	Course Title	Hours per week L	T	P	Semester	Credits
1.	COPC201	Computer Programming	2	0	0	III	2
2.	COPC203	Scripting Languages (Python, Perl, etc – any one)	2	0	0	III	2
3.	COPC205	Data Structures	2	0	0	III	2
4.	COPC207	Computer System Organisation	3	1	0	III	4
5.	COPC209	Algorithms	3	1	0	III	4
6.	COPC211	Computer Programming Lab	0	0	4	III	2
7.	COPC213	Scripting Languages Lab	0	0	4	III	2
8.	COPC215	Data Structures Lab	0	0	2	III	1
9.	COPC202	Operating Systems	2	0	0	IV	2
10.	COPC204	Introduction to DBMS	2	0	0	IV	2
11.	COPC206	Computer Networks	2	0	0	IV	2
12.	COPC208	SSAD/Software Engineering	3	0	0	IV	3
13.	COPC210	Web Technologies	2	0	0	IV	2
14.	COPC212	Operating Systems Lab	0	0	2	IV	1
15.	COPC214	Introduction to DBMS Lab	0	0	2	IV	1
16.	COPC216	Computer Networks Lab	0	0	2	IV	1
17.	COPC218	Web Technologies Lab	0	0	2	IV	1
18.	COPC301	Introduction to e-Governance	2	1	0	V	3
19.	COPC303	IoT	2	1	0	V	3
Total Credits							**40**

7.2 List of Program Elective Courses [PE]

S.No	Code No.	Course Title
1	COPE301/302	Mobile Computing (3-0-2-4)
2	COPE303/304	Multimedia Technologies (3-0-2-4)
3	COPE305/306	Fundamentals of AI (3-1-0-4)
4	COPE307/308	Advance Computer Networks (3-0-2-4)
5	COPE309/310	Information Security (3-0-2-4)
6	COPE311/312	Network Forensics (3-0-2-4)
7	COPE313/314	Data Sciences: Data Warehousing and Data Mining (3-1-0-4)
8	COPE315/316	FOSS (Free and Open Source Software) (3-0-2-4)
9	COPE317/318	Software Testing (3-0-2-4)

More courses may be added to the list above.

7.3 Semester-wise Detailed Curriculum

Semester III

Sl. No	Category	Code No.	Course Title	Hours per week			Total contact hrs/ week	Cred-its
				L	T	P		
1.	Program core course	COPC201	Computer Programming	2	0	0	2	2
2.	Program core course	COPC203	Scripting Languages (Python, Perl, etc – any one)	2	0	0	2	2
3.	Program core course	COPC205	Data Structures	2	0	0	2	2
4.	Program core course	COPC207	Computer System Organisation	3	1	0	4	4
5.	Program core course	COPC209	Algorithms	3	1	0	4	4
6.	Summer Internship-I (4 weeks) after IInd Sem	SI201	Summer Internship-1					2
7.	Program core course	COPC211	Computer Programming Lab	0	0	4	4	2
8.	Program core course	COPC213	Scripting Languages Lab	0	0	4	4	2
9.	Program core course	COPC215	Data Structures Lab	0	0	2	2	1
	Total Credits							**21**

Semester IV

Sl. No	Category	Code No.	Course Title	Hours per week L	Hours per week T	Hours per week P	Total contact hrs/ week	Credits
1.	Program core course	COPC202	Operating Systems	2	0	0	2	2
2.	Program core course	COPC204	Introduction to DBMS	2	0	0	2	2
3.	Program core course	COPC206	Computer Networks	2	0	0	2	2
4.	Program core course	COPC208	SSAD/Software Engineering	3	0	0	3	3
5.	Program core course	COPC210	Web Technologies	2	0	0	2	2
6.	Open Elective	**OE202	Open Elective-1					4
7.	Minor Project	Proj.202	Minor Project	0	0	4	4	2
8.	Program core course	COPC212	Operating Systems Lab	0	0	2	2	1
9.	Program core course	COPC214	Introduction to DBMS Lab	0	0	2	2	1
10.	Program core course	COPC216	Computer Networks Lab	0	0	2	2	1
11.	Program core course	COPC218	Web Technologies Lab	0	0	2	2	1
12.	Mandatory Course	AU202	Essence of Indian Knowledge and Tradition	2	0	0	2	0
	Total Credits							**21**

Semester V

Sl. No	Category	Code No.	Course Title	Hours per week			Total contact hrs/ week	Credits
				L	T	P		
1.	Program core course	COPC301	Introduction to e-Governance	2	1	0	3	3
2.	Program core course	COPC303	IoT	2	1	0	3	3
3.	Program Elective course	COPE###	Program Elective-1					4
4.	Program Elective course	COPE###	Program Elective-2					4
5.	Open Elective	**OE301	Open Elective-2	3	0	0	3	3
6.	Summer Internship-II (6 weeks) after IVth Sem	SI301	Summer Internship-2					3
7.	Major Project	PR302		0	0	2	2	^
	Total Credits							20

Semester VI

Sl. No	Category	Code No.	Course Title	Hours per week			Total contact hrs/ week	Credits
				L	T	P		
1.	Program Elective course	COPE###	Program Elective-3					4
2.	Program Elective course	COPE###	Program Elective-4					4
3.	Humanities and Social Science course	HS302	Entrepreneurship and Start-ups	3	1	0	4	4
4.	Open Elective	**OE###	Open Elective-3	3	0	0	3	3
5.	Mandatory Course	AU302	Indian Constitution	2	0	0	2	0
6.	Major Project	PR302		0	0	6	6	4^
7.	Seminar	SE302		1	0	0	1	1
	Total Credits							**20**

^1 credit is carried forward from the Vth semester major project evaluation.

Semester III

Course Code	:	COPC201
Course Title	:	Computer Programming
Number of Credits	:	2 (L:2; T:0; P:0)
Prerequisites	:	-
Course Category	:	PC

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
3. C Programming Absolute Beginner's Guide, Dean Miller and Greg Perry
4. The C Programming Language, Kernighan and Ritchie, Prentice Hall of India
5. Programming in ANSI C, E. Balagurusamy, Tata McGraw-Hill
6. C Programming & Data Structures, B. A. Fouruzan and R. F. Gilberg, CENGAGE Learning.
7. Outline of Programming with C, Byron Gottfried, Schaum, McGraw-Hill

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.

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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 andlist 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
3. Core Python Programming, Wesley J. Chun, Prentice Hall
4. Python Programming: Using Problem Solving Approach, Reema Thareja, Oxford University
5. Introduction to Computation and Programming Using Python. John V. Guttag, MIT Press.
6. Beginning Python using Python 2.6 and Python 3, James Payne, Wrox publishing
7. Practical Programming: An Introduction to Computer Science using Python 3, Paul Gries, The Pragmatic Bookshelf

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.

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Course Code	:	COPC205
Course Title	:	Data Structures
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Prerequisites	:	-
Course Category	:	PC

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:

Linked Lists: Singly Linked List, Representation in Memory, Operations on a Single Linked List, Circular Linked Lists, Doubly Linked Lists, Linked List Representation and Operations of Stack, Linked List Representation and Operations of Queue.

UNIT 4:

Non Linear Data Structures - Trees: Basic Terminologies, Definition and Concepts of Binary Trees, Representations of a Binary Tree using Arrays and Linked Lists, Operations on a Binary Tree-Insertion, Deletion, Traversals, Types of Binary Trees.

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
2. Data Structures Using C, Reema Thareja, Oxford University Press India.
3. Classic Data Structures, Samanta Debasis, Prentice Hall of India.
4. Fundamentals of Data Structure in C, Horowitz, Ellis, Sahni, Sartaj, Anderson-Freed, Susan, University Press, India.
5. Data Structures: A Pseudo code approach with C, Richard F. Gilberg, Behrouz A. Forouzan, CENGAGE Learning, India.
6. Data Structures and Algorithms: Concepts, Techniques and Applications, G. A. V. Pai, McGraw-Hill Education, India.

Course outcomes:

Have a good understanding of Data Structures and its applications in algorithms.

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Course Code	:	COPC207
Course Title	:	Computer System Organisation
Number of Credits	:	4 (L: 3, T: 1, P: 0)
Prerequisites	:	-
Course Category	:	PC

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 Microproccessor 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:

1. Computer System Architecture, M. Moris Mano, Pearson/PHI, India.
2. Microprocessors Interface, Douglas V.Hall, Tata McGraw-Hill.
3. Computer Organization, Carl Hamacher, Zvonks Vranesic, SafeaZaky, McGraw-Hill
4. Advanced Microprocessors and Peripherals- Architecture, Programming and interfacing, A.K.Ray, K.M.Bhurchandi, Tata McGraw-Hill, New Delhi, India.
5. Computer Organization and Design: A Hardwar/Software Interface (MIPS Edition) by Patterson and Hennessy

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.

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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

Programming Models. Data Abstraction. Sets, Multisets, Stacks, Queues. Asymptotic and worst-case analysis of algorithms.

UNIT 2: Sorting

The sorting problem. Bubble sort, Selection sort, Insertion sort, Mergesort, Quicksort.

UNIT 3: Searching

Symbol Tables, Binary Search Trees, Balanced Search Trees. Hash Tables.

UNIT 4: Graphs

Definition of a directed and undirected graph. Paths, Cycles, spanning trees. Directed Acyclic Graphs. Topological Sorting. Minimum Spanning Tree algorithms. Shortest Path algorithms: Dijkstra's algorithm. Flow-based algorithms.

UNIT 5: Strings

String Sort. Tries. Substring Search. Regular Expressions. Elementary Data compression.

Reference Books:

1. Algorithms, Sedgewick and Wayne, Pearson
2. Introduction to Algorithms, Cormen, Leiserson, Rivest and Stein. MIT Press
3. Introduction to Theory of Computation, Sipser Michael, Cengage Learnng.
4. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House

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.

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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:

S.No.	Topics for Practice
1	Familiarization with programming environment (Editor, Compiler, etc.)
2	Programs using I/O statements and various operators
3	Programs using expression evaluation and precedence
4	Programs using decision making statements and branching statements
5	Programs using loop statements
6	Programs to demonstrate applications of n dimensional arrays
7	Programs to demonstrate use of string manipulation functions
8	Programs to demonstrate parameter passing mechanism
9	Programs to demonstrate recursion
10	Programs to demonstrate use of pointers
11	Programs to demonstrate command line arguments
12	Programs to demonstrate dynamic memory allocation
13	Programs to demonstrate file operations

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
3. C Programming Absolute Beginner's Guide, Dean Miller and Greg Perry
4. The C Programming Language, Kernighan and Ritchie, Prentice Hall of India
5. Programming in ANSI C, E. Balagurusamy, Tata McGraw-Hill
6. C Programming & Data Structures, B. A. Fouruzan and R. F. Gilberg, CENGAGE Learning.

Course outcomes:

Student should be able to write code snippets, and then compile, debug and execute them.

****

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 '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:

S.No.	Topics for Practice
1	Practice basic coding syntax
2	Write and execute scripts based on data types
3	Write and execute Python scripts with conditionals and loops
4	Write and execute Scripts based on Functions and Modules
5	File Processing scripts
6	Write and execute Regular Expressions
7	Write and execute SQL Queries
8	Write and execute scripts using DBI
9	Develop a simple web application

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
3. Core Python Programming, Wesley J. Chun, Prentice Hall
4. Python Programming: Using Problem Solving Approach, Reema Thareja, Oxford University Press
5. Introduction to Computation and Programming Using Python. John V. Guttag, MIT Press.
6. Beginning Python using Python 2.6 and Python 3, James Payne, Wrox publishing
7. Practical Programming: An Introduction to Computer Science using Python 3, Paul Gries, The Pragmatic Bookshelf

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.

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Course Code	:	COPC215
Course Title	:	Data Structures 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 '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:

S.No.	Topics for Practice
1	Write a program using recursive and non-recursive functions to perform search operation in a given list of integers using linear search technique
2	Search operation in a given list of integers using binary search technique
3	Write a program to implement insertion sorting for a given random data
4	Write a program to implement bubble sorting for a given random data
5	Write a program to implement quick sorting for a given random data
6	Write a program to implement selection sorting for a given random data
7	Write a program to implement heap sorting for a given random data
8	Write a program to implement Hashing tables
9	Write a program to implement single linked list
10	Write a program to implement double linked list
11	Write a program to implement circular linked list
12	Write a program to Implement Stack operations using array and linked list
13	Write a program to Implement Queue operations using array and linked list.
14	Write a program to implement Breadth First Search (BFS)
15	Write a program to implement Depth First Search (DFS)
16	Write a program to implement a binary tree of integers
17	Write a program to find the minimum depth of a binary tree

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
2. Data Structures Using C, Reema Thareja, Oxford University Press India.
3. Classic Data Structures, Samanta Debasis, Prentice Hall of India.
4. Fundamentals of Data Structure in C, Horowitz, Ellis, Sahni, Sartaj, Anderson-Freed, Susan, University Press, India.
5. Data Structures: A Pseudo code approach with C, Richard F. Gilberg, Behrouz A. Forouzan, CENGAGE Learning, India.
6. Data Structures and Algorithms: Concepts, Techniques and Applications, G. A. V. Pai, McGraw-Hill Education, India.

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.

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SEMESTER IV

Course Code	:	COPC202
Course Title	:	Operating Systems
Number of Credits	:	2 (L:2, T:0, P;0)
Pre-requisites	:	COPC205
Course Category	:	PC

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, Multithreaded 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
3. Operating Systems, Internals and Design Principles, Stallings, Pearson Education, India
4. Operating System Concepts, Ekta Walia, Khanna Publishing House
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:

1. Fundamentals of Database Systems, Elmasri & Navathe, Pearson Education
2. Database Management Systems, Raghurama Krishnan, Johannes Gehrke, Tata McGraw-Hill.
3. Database System Concepts, Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill, New Delhi, India.
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.

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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, Addision Wesley
3. Data and Computer Communications, William Stallings, PHI
4. An Engineering Approach to Computer Networking, S. Keshav, Addision 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.

******

Course Code	:	COPC208
Course Title	:	SSAD/Software Engineering
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	-
Course Category	:	PC

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:

Introduction to Software Engineering, Lifecycle, Process Models - Traditional v/s Agile processes.

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:

Project Management - Project management concepts, Configuration and Release Management, Version Control and its tools (Git), Release Planning, Change Management, Software Maintenance, Project Metrics.

Reference Books:

1. Software Engineering – A Practitioner's Approach, 7th Edition, Roger Pressman.
2. Software engineering, Ian Sommerville, Pearson Education
3. An Integrated Approach to Software Engineering, Pankaj Jalote, Springer Verlag
4. Software Engineering, Nasib Singh Gill, Khanna Book Publishing Co. India.
5. Software Engineering, K. K. Agarval, Yogesh Singh, New Age International Publishers

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.

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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, eventsand 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 keycomponents, DTD and Schemas, XML with application, XSL and XSLT.

Introduction to Web Services

UNIT 5: PHP

server side scripting, Arrays, function andforms,advance PHP Databases :Basic command with PHP examples, Connection to server,creating database, selecting a database, listing database, listing tablenames creating a table, inserting data,altering tables, queries, deletingdatabase, 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
4. Web Applications: Concepts and Real World Design, Knuckles.

Course Outcomes:

Student will be able to develop/build a functional website with full features.

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Course Code	:	COPC212
Course Title	:	Operating Systems Lab
Number of Credits	:	1 (L:0, T:0, P:2)
Prerequisites	:	COPC205
Course Category	:	PC

Course Learning Objectives:

This Lab course is intended to practice and do experiment on concepts taught in theory class of 'Operating Systems' and gain insight into functioning of the Operating Systems.

Course Content:

S.No.	Topics for Practice
1	Revision practice of various commands like man, cp, mv, ln, rm, unlink, mkdir, rmdir, etc and many more that were learnt in IT Workshop course and later.
2	Implement two way process communication using pipes
3	Implement message queue form of IPC
4	Implement shared memory and semaphore form of IPC
5	Simulate the CPU scheduling algorithms - Round Robin, SJF, FCFS, priority
6	Simulate Bankers algorithm for Deadlock Avoidance and Prevention

7	Simulate all FIFO Page Replacement Algorithm using C program
8	Simulate all LRU Page Replacement Algorithms using C program
9	Simulate Paging Technique of Memory Management
10	Practice various commands/utilitiessuch as catnl, uniq, tee, pg, comm, cmp, diff, tr, tar, cpio, mount, umount, find, umask, ulimit, sort, grep, egrep,fgrep cut, paste, join, du, df , ps, who, etc and many more.

This is a skill course. More student practice and try to find solution on their own, better it will be.

Reference Books:

1. Operating System Concepts, Silberschatz, Abraham and Galvin, Peter, Wiley India Limited
2. UNIX Concepts and Applications, Sumitabha Das, McGraw-Hill Education
3. Operating System Concepts, Ekta Walia, Khanna Publishing House

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, and become an advance user of operating system.

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Course Code	:	COPC214
Course Title	:	Introduction to DBMS Lab
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	COPC211
Course Category	:	PC

Course Learning Objectives:

This Lab course is intended to practice whatever is taught in theory class of 'Introduction to DBMS'. A few sample case studies are listed with some suggested activities. More case studies may be added to this list. You need to develop these case studies, apply all relevant concepts learnt in theory class as the course progress, identify activities/operations that may be performed on the database. It will be a good idea to also use concepts learnt in the course on Software Engineering/SSAD.

Course Content:

S.No.	Topics for Practice
1	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.
2	Case Study-2: Visitor Management database
3	Case Study-3: Students Academic database
4	Case Study-4: Inventory Management System database
5	Case study-5: Bank Operations database
6	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.

This is a skill course. More student practice and try to find solution on their own, better it will be.

Reference Books:

1. Elmasri & Navathe, Fundamentals of Database Systems, Pearson Education
2. Raghurama Krishnan, Johannes Gehrke, Database Management Systems, Tata McGraw-Hill, New Delhi, India.

3. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Database System Concepts, McGraw-Hill, New Delhi, India.
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.

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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:

S.No.	Topics for Practice
1	Showing various types of networking cables and connectors, identifying them clearly
2	Looking at specifications of cables and connectors of various companies on Internet, find out differences.
3	Making patch cords using different types of cables and connectors - crimping, splicing, etc
4	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
5	Configuring computing devices (PC, Laptop, Mobile, etc) for network, exploring different options and their impact – IP address, gateway, DNS, security options, etc
6	Showing various networking devices – NICs, Hub, Switch, Router, WiFi access point, etc.
7	Looking at specifications of various networking devices various companies on Internet, find out differences.
8	Network simulation tool (e.g. Cisco Packet Tracer)
9	Setting up a small wired LAN in the Lab
10	Setting up a small wireless LAN in the Lab

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 Code	:	COPC218
Course Title	:	Web Technologies 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 'Web Technologies'. Some of the things that should necessary be covered in lab are listed below:

Course Content:

S.No.	Topics for Practice
1	Coding Server Client Programs
2	Developing Web Application using HTML, JavaScript
3	Developing Advanced Web Application Programs using CSS
4	Practicing PHP : Basics
5	Practicing PHP : Web Application Development
6	Practicing PHP: MySql - tiered Applications
7	Developing a fully functional Web Service Application using all the technologies learned in this course.

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,
2. "Internet & World Wide Web How To Program", Deitel, Deitel, Goldberg, Pearson Education
3. "Web programming- Building Internet Application", Chris Bales
4. Web Applications: Concepts and Real World Design, Knuckles

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.

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Semester V / VI

Course Code	:	COPC301
Course Title	:	Introduction to e-Governance
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	-----
Course Category	:	PC

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:

1. Managing Transformation –Objectives to Outcomes. J Satyanarayana, Prentice Hall India
2. The State, IT and Development. Kenneth Kenniston, RK Bagga and Rohit Raj Mathur, Sage Publications India Pvt Ltd.
3. e-Government -The Science of the Possible. J Satyanarayana, Prentice Hall, India
4. http://www.csi-sigegov.org/publications.php
5. https://negd.gov.in
6. https://www.nisg.org/case-studies-on-e-governance-in-india

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.

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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
2. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
3. Internet of Things by Dr. Jeeva Jose, Khanna Publishing House (Edition 2017)
4. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press)
5. *Internet of Things: Architecture and Design Principles, Raj Kamal,* McGraw Hill
6. Research papers

Course outcomes:

Students will have good understanding of various aspect of IoT, know some tools and have basic implementation skills.

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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:

A brief history of Mobile, Types of mobile phone generations, The Mobile Ecosystem, Types of Mobile Applications, Mobile Information Architecture Android Versions, Features of Android, Android Architecture, Installing Android SDK Tools, Configuring Android in Eclipse IDE, Android Development Tools (ADT), Creating Android Virtual Devices (AVD)

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:

1. Wei-Meng Lee, Beginning Android 4 Application Development, Wiley Publishing, Inc.
2. Pradeep Kothari, "Android Application Development Black Book", DreamTech Press
3. James C.Sheusi, "Android Application Development for Java Programmers", Cengage Learning
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
2. Fundamentals of Multimedia, Prentice Hall/Pearson, Ze-Nian Li & Mark S. Drew.
3. Multimedia and Animation, V.K. Jain, Khanna Publishing House, Edition 2018
4. Fundamentals of Multimedia, Ramesh Bangia, Khanna Book Publishing Co., N. Delhi (2007)

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.

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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

Randomized Search: Simulated Annealing, Genetic Algorithms, Ant Colony Optimization.

UNIT 3:

Finding Optimal Paths: Branch and Bound, A*, IDA*, Divide and Conquer approaches, Beam Stack Search.

Problem Decomposition: Goal Trees, AO*, Rule Based Systems, Rete Net.

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/
3. Stefan Edelkamp and Stefan Schroedl. Heuristic Search, Morgan Kaufmann.
4. Pamela McCorduck, Machines Who Think: A Personal Inquiry into the History and Prospects of Artificial Intelligence, A K Peters/CRC Press
5. Elaine Rich and Kevin Knight. Artificial Intelligence, Tata McGraw Hill.
6. Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach, Prentice Hall
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.

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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)
2. Communication Networking – An Analytical Approach, Anurag-Manjunath-Joy
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

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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:

Introduction to Information Security, Various aspects of information security (PAIN), Security Features of Operating Systems – Authentication, Logs, Audit Features, File System Protection, User Privileges, RAID options, Anti-Virus Software, etc.

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)
3. Various Acts, Laws and Standards (IT Act, ISO27001 Standard, IPR and Copyright Laws, etc.)
4. Security Guideline documents of Operating Systems (OS Manual, Man Pages, etc)
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.

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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/
4. https://www.cert-in.org.in/
5. Handbook of Digital Forensics and Investigation, Eoghan Casey, Elsevier Academic Press
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.

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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.

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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**
9. Philosophy of GNU URL: http://www.gnu.org/philosophy/.
10. Linux Administration URL: http://www.tldp.org/LDP/lame/LAME/linux-admin-made-easy/.
11. Version control system URL: http://git-scm.com/.
12. Samba: URL : http://www.samba.org/.
13. Libre office: http://www.libreoffice.org/.

Course outcomes:

Student will be able to work with FOSS tools, find and evaluate FOSS alternatives for any software requirement.

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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:

1. Software Engineering – A Practitioner's Approach, 7th Edition, Roger Pressman.
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.

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CHAPTER
8

Chemical Engineering Curriculum Structure

(III to VI Semesters)

8.1 List of Programme Core Courses [PC]

Sl. No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1.	CHPC201	Introduction to Chemical Engineering	3	0	0	III	3
2.	CHPC203	Industrial Chemistry	3	0	0	III	3
3.	CHPC205	Chemical Process Calculations	2	1	0	III	3
4.	CHPC207	Momentum Transfer	2	1	0	III	3
5.	CHPC209	Mechanical Operations	2	1	0	III	3
6.	CHPC211	Engineering Thermodynamics	3	0	0	III	3
7.	CHPC213	Momentum Transfer Lab	0	0	2	III	1
8.	CHPC215	Mechanical Operations Lab	0	0	2	III	1
9.	CHPC202	Process Heat Transfer	2	1	0	IV	3
10.	CHPC204	Mass Transfer – I	2	1	0	IV	3
11.	CHPC206	Chemical Engineering Thermodynamics	2	1	0	IV	3
12.	CHPC202	Chemical Technology	3	0	0	IV	3
13.	CHPC204	Heat Transfer Lab	0	0	2	IV	1
14.	CHPC209	Chemical Engineering Drawing	0	0	4	IV	2
15.	CHPC301	Mass Transfer – II	2	1	0	V	3
16.	CHPC303	Chemical Reaction Engineering	2	1	0	V	3
17.	CHPC305	Process Control & Instrumentation	2	1	0	V	3
18.	CHPC307	Mass Transfer Lab	0	0	2	V	1
19.	CHPC309	Chemical Reaction Engineering Lab	0	0	2	V	1
20.	CHPC302	Project Engineering	2	0	0	VI	2
Total Credits							**48**

8.2 List of Program Elective Courses [PE]

Sl. No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1.	CHPE ###	Material Science and Technology	3	0	0	4/5	3
2.	CHPE ###	Petroleum Refining & Petrochemical Technology	3	0	0	4/5	3
3.	CHPE ###	Food Technology	3	0	0	4/5	3
4.	CHPE ###	Instrumental Method of Analysis	3	0	0	4/5	3

Plant Operations & Management

Sl. No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1.	CHPE ###	Safety in Chemical Process Industries	3	0	0	4/5	3
2.	CHPE ###	Plant Utilities	3	0	0	4/5	3
3.	CHPE ###	Petroleum Engineering	3	0	0	4/5	3
4.	CHPE ###	Energy Engineering	3	0	0	4/5	3

Advanced Chemical Engineering Topics

Sl. No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1.	CHPE ###	Modern Separation Techniques	3	0	0	5/6	3
2.	CHPE ###	Waste management	3	0	0	5/6	3
3.	CHPE ###	Process Equipment Design	3	0	0	5/6	3
4.	CHPE###	Computer Applications in Chemical Engineering	3	0	0	5/6	3

8.3 Semester-wise Detailed Curriculum

SEMESTER – III

Sl. No	Code No.	Course Title	Hours per week			Total contact hrs/ week	Cred-its
			L	T	P		
1.	CHPC201	Introduction to Chemical Engineering	3	0	0	3	3
2.	CHPC203	Industrial Chemistry	3	0	0	3	3
3.	CHPC205	Chemical Process Calculations	2	1	0	3	3
4.	CHPC207	Momentum Transfer	2	1	0	3	3
5.	CHPC209	Mechanical Operations	2	1	0	3	3
6.	CHPC211	Engineering Thermodynamics	3	0	0	3	3
7.	CHPC213	Momentum Transfer Lab	0	0	2	2	1
8.	CHPC215	Mechanical Operations Lab	0	0	2	2	1
Total Credits							**20**

SEMESTER – IV

Sl. No	Code No.	Course Title	Hours per week			Total contact hrs/ week	Credits
			L	T	P		
1.	CHPC202	Process Heat Transfer	2	1	0	3	3
2.	CHPC204	Mass Transfer – I	2	1	0	3	3
3.	CHPC206	Chemical Engineering thermody-namics	2	1	0	3	3
4.	CHPC208	Chemical Technology	3	0	0	3	3
5.	CHPC210	Heat Transfer Lab	0	0	2	2	1
6.	CHPC212	Chemical Engineering Drawing	0	0	4	4	2
7.	CHPExxx	Programme Elective 1	3	0	0	3	3
8.	PR 202	Minor Project	0	0	4	4	2
9.	AU202	Essence of Indian Knowledge and Tradition	2	0	0	2	0
Total Credits							**20**

SI301	Summer Internship – II (6 weeks) after IV Sem					3

SEMESTER – V

Sl. No	Code No.	Course Title	Hours per week L	T	P	Total contact hrs/ week	Credits
1.	CHPC301	Mass Transfer - II	2	1	0	3	3
2.	CHPC303	Chemical Reaction Engineering	2	1	2	5	4
3.	CHPC305	Process Control & Instrumenta- tion-	2	1	0	3	3
4.	CHPC307	Mass Transfer Lab	0	0	2	2	1
5.	CHPC309	Chemical Reaction Engineering Lab	0	0	2	2	1
6.	CHPExxx	Programme Elective 2	3	0	0	3	3
7.	CHPExxx	Programme Elective 3	3	0	0	3	3
8.	CHOExxx	Open Elective - I	3	0	0	3	3
9.	PR302	Major Project	0	0	2	2	1^
Total Credits							**21**

SEMESTER – VI

Sl. No	Code No.	Course Title	Hours per week L	T	P	Total contact hrs/ week	Credits
1.	HS302	Entrepreneurship and Start- ups	3	1	0	4	4
2.	CHPC302	Project Engineering	2	0	0	2	2
3.	CHPExxx	Programme Elective 4	3	0	0	3	3
4.	CHOExxx	Open Elective - II	3	0	0	3	3
5.	CHOExxx	Open Elective - III	3	0	0	3	3
6.	PR302	Major Project	0	0	6	6	4^
7.	SE302	Seminar	1	0	0	1	1
8.	AU302	Indian Constitution	2	0	0	2	0
Total Credits							**20**

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

SEMESTER III

Course Code	:	CHPC201
Course Title	:	Introduction to Chemical Engineering
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	Nil
Course Category	:	PC

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:

1. *S. K. Ghosal, S. K., Sanyal and S. Datta, "Introduction to Chemical Engineering", Tata McGraw Hill Education Pvt. Ltd., New Delhi.*
2. *Pushpavanam.S., "Introduction to Chemical Engineering", PHI Learning Pvt. Ltd., New Delhi,*
3. *Badger W.L. and Banchero J.T., "Introduction to Chemical Engineering", 6th Edition, Tata McGraw Hill, 1997.*
4. *Dryden, C.E., "Outlines of Chemicals Technology", Edited and Revised by Gopala Rao, M. and M.Sittig, 2nd Edition, Affiliated East-West press, 1993.*

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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Course Code	:	CHPC203
Course Title	:	Industrial Chemistry
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	BS105
Course Type	:	PC

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-II: Classification of organic compounds, aliphatic Compounds, closed chain compounds, unsaturated. Alkanes, alkenes, alkyans, cycloalkanes. Halogenations, saturated halogenation Reaction of alkenes, oxidation, halogenation, Nitration, pyrolysis, isomerisation, dehydrogenation, Structures and reactivity of alkanes, cyclo alkanes. Alkenes, preparation, properties and reactions, Action of ozone, hydrogenation, halogenation, action of halogen acids, sulphuric acid, polymerization, uses of alkenes.

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

UNIT -V: Adsorption Definition, nature of adsorption, types of adsorption, Langmuir adsorption isotherm, Freundlich adsorption Isotherm, application, Solutions and Indicators Ideal solution, non-ideal solution, Azeotropric Mixture, and theory of indicators.

REFERENCE BOOKS:

1. R. T. Morrison, R. N. Boyd and S.K Bhattachrajee, 'Organic Chemistry" Pearson.

2. *V Raghavan, "Material Science & Engineering" PHI Learning Pvt. Ltd.,*
3. *P.L. Soni and H.M.Chawla, "Text book of organic Chemistry", Sultan Chand & Sons – Tb*
4. *B.R.Puri, L.R.Sharma and M.S.Pathania, "Principles of physical chemistry" Vikas Publishing House Pvt Ltd.,*
5. *K. S.Tewari, S. N Mehrotra, N. K. Vishnoi , "Textbook of organic 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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Course Code	:	CHPC205
Course Title	:	CHEMICAL PROCESS CALCULATIONS
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	-----
Course Type	:	PC

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.

UNIT-II: Stoichiometric principles – composition relations, density and specific gravity. Behaviour of Ideal gases - application of ideal gas law - gaseous mixtures - volume changes with change in composition.

UNIT-III: Vapour pressure - effect of Temperature on vapour pressure - vapour pressure plots – vapour pressure of immiscible liquids - solutions. Humidity and Solubility: Humidity - saturation -vaporization - wet and dry bulb thermometry.

UNIT-IV: Material Balance - Processes involving chemical reaction - Combustion of coal, fuel gases and sulphur - Recycling operations - bypassing streams - Degree of conversion – excess reactant -limiting reactant. Unsteady state problems

UNIT-V: Energy Balance: Thermo chemistry - Hess's law of summation - heat of formation, reaction, combustion and mixing - mean specific heat - Theoretical Flame Temperature.

REFERENCE BOOKS

1. K.V. Narayanan and B. Lekshmikutty, "Stoichiometry and Process Calculations", Prentice Hall of India Ltd, New Delhi..

2. V.Venkataramani, N.Anantharaman and K.M. Meera Sheriffa Begum, 'Process Calculations' Prentice Hall of India Ltd, New Delhi.

3. B. I. Bhatt, "Stoichiometry", Tata McGraw Hill Publishers Ltd., New Delhi.

4. C. M. Narayanan & B. C Bhattacharya, 'Unit operations and Processes' Vol-I, CBS Publishers & Distributors.

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 Code	:	CHPC207
Course Title	:	MOMENTUM TRANSFER
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	-----
Course Type	:	PC

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-I: Properties of fluids and concept of pressure: Introduction - Nature of fluids - physical properties of fluids - types of fluids. Fluid statics: Pressure - density - height relationships. Pressure measurement. Dimensional analysis. Similarity - forces arising out of physical similarity - dimensionless numbers.

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.

UNIT-IV: Flow of Fluids through Solids: Form drag - skin drag - Drag co-efficient. Flow around solids and packed beds. Friction factor for packed beds. Ergun's Equation - Motion of particles through fluids - Terminal settling velocity. Fluidisation - Mechanism, types, general properties – applications

UNIT-V: Transportation and Metering: Measurement of fluid flow: Orifice meter, Venturi meter, Pitot tube, Rotameter, weirs and notches Wet gas meter and dry gas meter. Hot wire and hot film anemometers. Transportation of fluids: Fluid moving machinery performance. Selection and specification. Positive displacement pumps, Rotary and Reciprocating pumps, Centrifugal pumps and characteristics, Introduction to Fans, Blowers & Compressors

REFERENCE BOOKS

1. A. K. Mohanty, "Fluid Mechanics", Prentice Hall of India Ltd, New Delhi.

2. W. L. McCabe, J.C. Smith and P. Harriott, "Unit operations of Chemical Engineering",

McGraw Hill, International Edn.,

3. J. M. Coulson and J. F. Richardson, "Chemical Engineering", Vol 1, Butterworth Heinemann.

4. C. M. Narayanan & B. C Bhattacharya, 'Unit operations and Processes' Vol-I, CBS Publishers & Distributors.

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.

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Course Code	:	CHPC209
Course Title	:	MECHANICAL OPERATIONS
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	-----
Course Type	:	PC

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-I: Characteristics of Particulate Material: Properties and characterisation of particulate solids, Flow properties of particulates.

UNIT-II: Introduction to size reduction equipment, energy and power requirement in milling operations

UNIT-III: Separation of solids, Solid – Solid Separation Equipments

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

1. Anup. K.Swain, Hemlata Patra, G.K.Roy., "Mechanical Operations", McGraw Hill Education.

2. McCabe and J.C.Smith," Unit Operation of Chemical Engineering", McGraw Hill., New York.

3. M. Coulson and J.F. Richardson, "Chemical Engineering", Vol. II, Butterworth- Heinemann.

4. Badger and Banchero, "Introduction to Chemical Engineering", McGraw Hill, New York.

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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Course Code	:	CHPC211
Course Title	:	Engineering Thermodynamics
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Type	:	PC

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-III: Second Law of Thermodynamics: Equilibrium and the second law - Heat engines - Kelvin-Planck statement - Reversible and irreversible processes - Carnot principle - Clausius inequality-Entropy –Third Law of Thermodynamics

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

1. Nag, P. K., "Engineering Thermodynamics", Tata McGraw Hill Publishing Co. Ltd., New Delhi.

2. Arora, C.P., "Thermodynamics", Tata McGraw Hill Publishing Co. Ltd., New Delhi.

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.

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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
2. *W. L. McCabe, J.C. Smith and P. Harriott, "Unit operations of Chemical Engineering", McGraw Hill, International Edn.*
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 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.

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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
2. *W. L. McCabe, J.C. Smith and P. Harriott, "Unit operations of Chemical Engineering", McGraw Hill, International Edn.,*
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

Course Code	:	CHPC202
Course Title	:	PROCESS HEAT TRANSFER
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	NIL
Course Type	:	PC

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:

1. DC. Sikdar, "Process Heat Transfer and Chemical Equipment Design", Revised Ed., Khanna Publishing House

2. W. L. McCabe and J. C. Smith, "Unit Operations In Chemical Engineering", 7th Edn.,McGraw Hill Publishing Co.

3. Binay K. Dutta, "Heat Transfer Principles and applications" Prentice Hall of India Pvt. Ltd.

4. C. M. Narayanan & B. C Bhattacharya, 'Unit operations and Processes' Vol-I, CBS Publishers & Distributors, 2006

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.

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Course Code	:	CHPC204
Course Title	:	MASS TRANSFER - I
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	NIL
Course Type	:	PC

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:

1. Binay. K.Dutta " Principles of Mass Transfer and Separation Processes"., PHI Learning

2. R.E. Treybal, "Mass Transfer Operations", McGraw Hill Book Co., New York.

3. N. Anantharaman and K.M.Meera Sheriffa Begum, "Mass Transfer Theory and Practice", Printice Hall of India Pvt. Ltd., New Delhi.

4. J. M. Coulson and J. F. Richardson, "Chemical Engineering", Vol. II, Butterworth Heinemann, New York.

5. W.L. McCabe, J.C. Smith and P. Harriot, "Unit Operations of Chemical Engineering", McGraw Hill Book Co., New York.

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.

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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-I: Introduction to Basic laws and Terminologies in Thermodynamics- Statement of First law, P-V-T behavior of pure fluids - Heat effects accompanying chemical Reactions - Statements of second law- Clausius Inequality-Mathematical Statement of Second law-Third Law of Thermodynamics.

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 Clapyeron 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:

1. J.M. Smith, Hendrick Van Ness, Michael M. Abbott, Introduction to Engineering Thermodynamics, McGraw Hill, New York.

2. K.V.Narayanan, A Textbook of Chemical Engineering Thermodynamics, PHI Learning, New Delhi.

3. S. Sundaram, Chemical Engineering Thermodynamics, Ahuja Publishers, New Delhi.

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.

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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-III: Alkalies and Acids: Chlor - alkali Industries: Manufacture of Soda ash, Manufacture of caustic soda and chlorine - common salt. Sulphur and Sulphuric acid: Mining of sulphur and manufacture of sulphuric acid. Manufacture of hydrochloric acid.

UNIT-IV: Cement Gases, Water and Paints: Types and Manufacture of Portland cement, Glass: Industrial gases: Carbon dioxide, Nitrogen, Hydrogen, Oxygen and Acetylene - Manufacture of paints - Pigments

UNIT-V: Fertilisers: Nitrogen Fertilisers; Synthetic ammonia, nitric acid, Urea, Phosphorous Fertilisers: Phosphate rock, phosphoric acid, super phosphate and Triple Super phosphate

REFERENCE BOOKS:

1. R. Gopal and M. Sittig, " Dryden's Outlines of Chemical Technology: For The 21st Century" Third Edition, Affiliated East-West Publishers.

2. G.T. Austin, "Shreve's Chemical Process Industries", McGraw Hill, NewYork.

3. O.P. Gupta, "Chemical Process Technology", Khanna Publishing House

4. W.V.Mark, S.C. Bhatia "Chemical Process Industries volume I and II" CBS Publishers & Distributors

5. S. D. Shukla and G. N. Pandey, "Text book of Chemical Technology" Vol 2, Vikash

Publishing Company.

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.

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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*
2. *W. L. McCabe, J.C. Smith and P. Harriott, "Unit operations of Chemical Engineering", McGraw Hill, International Edn.,*
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.

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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-I: P & ID symbols – Line numbering – line scheduling – Typical P & ID diagrams, Different types of valves, Pumps, Gland & Stuffing box

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:

1. *D.C. Sikdar, "Process Heat Transfer & Chemical Equipment Design", Revised Ed. Khanna Publishing House*
2. *V. V.Mahajani and S. B. Umarjii, "Joshi's Process Equipment Design", Mac Millan Publishers India Limited, New Delhi,*
3. *R. K. Sinnott, "Chemical Engineering Design", Coulson and Richardson's Chemical Engineering Series, Volume-6, Fourth Edition, Butterwoth-Heinemann, Elsevier, NewDelhi, 2005.*
4. *R. H. Perry, "Chemical Engineers' Handbook", 7th Edn., McGraw Hill , NewYork, 1998.*
5. *B.C. Bhattacharyya, "Introduction to Chemical Equipment Design Mechanical Aspects", CBS Publishers & Distributors, 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

Course Code	:	CHPC301
Course Title	:	MASS TRANSFER - II
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	CHPC204
Course Category	:	PC

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 skill 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:

1. R. E. Treybal, "Mass Transfer Operations", 3rd Edn., McGraw Hill Book Co., New York, 1981.

2. N. Anantharaman and K.M.Meera Sheriffa Begum, "Mass Transfer Theory and Practice", Printice Hall of India Pvt. Ltd., New Delhi, 2013.

3. M. Coulson and J. F. Richardson, "Chemical Engineering.", Vol - II, 5th Edn., Pergamon Press, New York, 2002.

4. W. L. Mccabe, J. C. Smith and P. Harriot, "Unit Operations in Chemical Engg.",7th Edn., McGraw Hill Book Co., New York, 2004.

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.

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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-III: Reactors for Multiple Reactions. Size comparison of single reactors for single reactions. Multiple Reactor system for single reactions. Reactions in parallel, reactions in series and series - parallel reactions of first order. Recycle reactor, auto catalytic reactions.

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:

1. *K. A. Gavhane Chemical Reaction Engineering -I, Nirali Prakashan Publications,Pune*
2. *S C Roy and C Guha, 'A Text book of Chemical Reaction Engineering' Dhanpat Rai & Co. (P) Ltd.,*
3. *O. Levenspiel, "Chemical Reaction Engineering", Wiley Easter Ltd., New York.*

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.

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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-IV: Transient analysis of control systems - block diagram algebra, overall transfer function of closed loop control systems, regulator and servo problems, transient response of first and second order systems with P, PI and PID controller. Definition of stability of control systems, Routh test, limitations of Routh test.

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:

1. *D.R. Coughanowr and S. E. LeBlanc, 'Process Systems Analysis and Control', Mc.Graw Hill, III Edition.*

2. *G. Stephanopoulous, 'Chemical Process Control – Theory and Practice', Prentice Hall of India Ltd.*

3. *D.C. Sikdar, "Instrumentation and Process Control", Khanna Publishing House*

4. *S. Sundaram, "Process Dynamics and Control" CENGAGE Learning.*

5. *K. Padmanabhan & S. Ananthi, "A Treatise on Instrumentation Engineering" I.K International Publishing Pvt. Ltd.*

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.

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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*
2. *G Chandrasekhar, Laboratory Experiments in Chemical and Allied Engineering: Emphasis on Low Cost Experiments, Penram International Publishing (India) Pvt. Ltd..*

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.

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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

Course Code	:	CHPC302
Course Title	:	PROJECT ENGINEERING
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Prerequisites (Course code)	:	NIL
Course Category	:	PC

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.

UNIT-III: Value of money, Equations for economic studies and equivalence. Amortization, Capital recovery and Depreciation. Project implementation steps, Feasibility studies, Capital requirements for process plants, Cost indices, Equipment cost, Service facilities.

UNIT-IV: Balance sheet, Variable cost, Fixed cost, Income statement, Economic production charts. Capacity factors, Taxes and Insurance, Cash flow analysis.

UNIT-V: Economics of Selecting Alternates: Annual cost method, Present worth method, Equivalent alternates, Rate of return and Pay out time. Overall Cost Analysis and Economic Trade Offs: Economic balance: Economic balance in batch operations, Overall cost analysis for the plant, Economic trade-offs.

REFERENCE BOOKS:

1. J.M. Coulson, JF Richardson, RK Sinnott Butterworth Heinman, Chemical Engineering

Volume 6, Revised Second Edition, Butterworth-Heinemann.

2. M. S. Peters & K. D. Timmerhaus, 'Plant design & Economics for Chemical Engg.' McGraw-Hill Science/Engineering/Math 5th Ed.

3. Industrial Boilers, and Heat recovery Steam Generators Design, Applications and calculations by V.Ganapathy, Marcel Dekker, Inc,.

4. Sivasubramanian V, "Process Economics and Industrial Management", Galgotia Publications Pvt Ltd..

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.

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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-I: Atomic Bonding: Classes of engineering materials - engineering requirement of materials - selection of materials - structure of atoms and molecules - Bonding in solids - types of bonds and comparison of bonds.

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

UNIT-III: Properties and Corrosion of Material: Mechanical, Electrical and magnetic properties of materials - Deformation of materials - Heat Treatment techniques - corrosion, theories of corrosion - control and prevention of corrosion.

UNIT-IV: Metals: Engineering materials - ferrous metals - Iron and their alloys Iron and steel Iron carbon equilibrium diagram. Non-ferrous metals and alloys - Aluminium, copper, Zinc, lead, Nickel and their alloys with reference to the application in chemical industries.

UNIT-V: Non Metals: Inorganic materials: Ceramics, Glass and refractories - organic materials: wood, plastics, and rubber and wood - Advanced materials (Biomaterials, nanomaterials and composites) with special reference to the applications in chemical Industries.

REFERENCE BOOKS:

1. *V. Raghavan, "Materials Science and Engineering- A First course", Prentice Hall of India Pvt. Ltd.*
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.

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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-I: Introduction & primary processing: Origin & formation of crude oil, Classification of crude, Characterization of crude, Distillation practise, Atmospheric distillation, Vacuum distillation.

UNIT-II: Secondary Processing: FCCU, Hydro cracking, Visbreaking, Coking, Reforming, Alkylation, Isomerisation and polymerization processes.

UNIT-III: Treatment Techniques: Physical & chemical impurities in petroleum fractions, General mechanisms for removal of Sulphur, Treatment of LPG, Gasoline, Kerosene, Diesel and Lube oils. Properties of ATF and Bitumen.

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*
2. *B. K. Bhaskara, "Modern Petroleum Refining Processes", Oxford and IBH*

Publishing Company, New Delhi.

3. *W.L. Nelson, "Petroleum Refinery Engineering", McGraw Hill, New York.*
4. *O.P. Gupta, "Elements of Petroleum Refinery Engineering", Khanna Publishing House*
5. *Saikat Maitra & O.P. Gupta, "Elements of Petrochemical Engineering", Khanna Publishing House, New Delhi*

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.

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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-I: Fundamentals of Food Process Engineering, Application of Quantitative methods of Material & Energy balances in Food Engineering Practices. Constituents of Food, Quality and Nutritive aspects, Food Adulterations, Deteriorative factors and Control

UNIT-II: Fluid Flow, Thermal Process Calculations, Refrigeration, Evaporation and Dehydration operations in Food Processing

UNIT-III: Fundamentals of Food Canning Technology, Heat Sterilization of Canned food, Containers – metal, Glass and Flexible packaging. Canning Procedures for Fruits, Vegetables, Meat, Poultry and Marine Products

UNIT-IV: Preservation by Heat and Cold, Dehydration, Concentration, Drying, Irradiation, Microwave heating, Sterilization and Pasteurization, Fermentation and Pickling, Packaging Methods

UNIT-V: Cereal, Grains, Pulses, Vegetables, Fruits, Spices, Fats and Oils, Bakery, Confectionary and Chocolate Products. Soft and Alcoholic Beverages, Dairy Products, Meat, Poultry and Fish Products.

REFERENCE BOOKS:

1. B Sivasankar, 'Food Processing and Preservation,' PHI Learning Pvt. Ltd.,

2. Rao D G, 'Fundamentals of Food Engineering', PHI Learning Private Ltd.,.

3. R Paul Singh, Dennis R Heldman, 'Introduction to Food Engineering,' 4/e, Elsevier,.

4. Da-Wen Sun, 'Emerging Technologies for Food Processing', 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.

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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:

UNIT-I: INTRODUCTION OF SPECTROMETRY: Properties of electromagnetic radiation- wave properties – components of optical instruments – Sources of radiation – wavelength selectors – sample containers – radiation transducers – Signal process and read outs – signal to noise ratio – sources of noise – Enhancement of signal to noise – types of optical instruments – Principle of Fourier Transform optical Measurements.

UNIT-II: MOLECULAR SPECTROSCOPY: Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beer's law – Instrumentation – Applications -Theory of fluorescence and Phosphorescence –Instrumentation – Applications – Theory of Infrared absorption spectrometry – IR instrumentation – Applications – Theory of Raman spectroscopy – Instrumentation – applications.

UNIT-III: MAGNETIC RESONANCE SPECTROSCOPY AND MASS SPECTROMETRY: Theory of NMR – environmental effects on NMR spectra – chemical shift- NMR spectrometers – applications of 1H and 13C NMR- Molecular mass spectra – ion sources – Mass spectrometer. Applications of molecular mass – Electron paramagnetic resonance- g values – instrumentation.

UNIT-IV: SEPARATION METHODS: General description of chromatography – Band broadening and optimization of column performance- Liquid chromatography – Partition chromatography – Adsorption chromatography – Ion exchange chromatography -size exclusion chromatography- Affinity chromatography-principles of GC and applications – HPLC- Capillary electrophoresis – Applications.

UNIT-V: ELECTRO ANALYSIS AND SURFACE MICROSCOPY: Electrochemical cells- Electrode potential cell potentials – potentiometryreference electrode – ion selective and molecular selective electrodes – Instrument for potentiometric studies – Voltametry – Cyclic and pulse voltametry- Applications of voltametry. Study of surfaces – Scanning probe microscopes – AFM and STM.

REFERENCE BOOKS:

1. D Muralidhara Rao, "Instrumental Method of Analysis", 1st edn., CBS Publishers & Distributors.

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

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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 safe-guarding personnel and safeguarding against water, land and air pollution in the above industries.

UNIT-V: Safety education and training - safety management, fundamentals of safety tenets, measuring safety performance, motivating safety performance, legal aspects of industrial safety, safety audit.

REFERENCE BOOKS:

1. Dr B.K. Bhaskara Rao, Er. R.K. Jain, and Vineet Kumar, "Safety in Chemical Plants/Industry and Its Management" Khanna Publishers.

2. S.C. Sharma, "Industrial Safety and Maintenance Management", Khanna Book Publishing Co. Private Limited, New Delhi

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.

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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-II: STEAM AND STEAM GENERATION: Properties of Steam, problems based on Steam, Types of Steam Generator such as Solid Fuel Fired Boiler, Waste Gas Fired Boiler and Fluidized Bed Boiler. Scaling and Trouble Shooting. Steam Traps and Accessories.

UNIT-III: REFRIGERATION: Refrigeration Cycles, Methods of Refrigeration used in Industry and Different Types of Refrigerants such as Monochlorodifluro Methane, Chlorofluro Carbons

and Brins. Refrigerating Effects and Liquefaction Processes.

UNIT-IV: COMPRESSED AIR: Classification of Compressor, Reciprocating Compressor, Single Stage and Two Stage Compressor, Velocity Diagram for Centrifugal Compressor, Silp Factor, Impeller Blade Shape. Properties of Air –Water Vapors and use of Humidity Chart. Equipments used for Humidification, Dehumidification and Cooling Towers.

UNIT-V: FUEL AND WASTE DISPOSAL: Types of Fuel used in Chemical Process Industries for Power Generation such as Natural Gas, Liquid Petroleum Fuels, Coal and Coke. Internal Combustion Engine, Petrol and Diesel Engine. Waste Disposal.

REFERENCE BOOKS:

1. P. L. Ballaney, "Thermal Engineering", Khanna Publisher New Delhi.

2. Perry R. H. Green D. W. "Perry's chemical Engineer's Handbook", McGraw Hill, New York,.

3. D B DHONE, "Plant utilities" Nirali Prakashan.

4. P. N. Ananthanarayan, "Basic Refrigeration & Air-Conditioning", Tata McGraw Hill, New Delhi.

5. Sadhu Singh, Refrigeration & Air-Conditioning, Khanna Publishing House. New Delhi

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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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-III: Logging techniques. Various types of logs. Formation parameters. Log applications. Formation evaluation. Well completion.

UNIT-IV: Petroleum exploration – well testing, production potential and well performances. Material balance, Artificial lift, Improved recovery methods.

UNIT-V: Surface equipments, processing of oil and gas. Transportation of oil and gas. Effluent treatment. Petroleum economics. Supply and demand trends.

REFERENCE BOOKS:

1. *Geology of Petroleum by Leverson A.L.- 2nd edition The AAPG foundation.*
2. *Principles of oil production by T.E.W Nind- 2nd edition Mc Graw-Hill.*
3. *Introduction to Petroleum Engineering by Geltin*
4. *Vikas Mahto, Objective Questions & Answers in Petroleum Engineering, Khanna Publishing House, New Delhi*
5. *Wellsite Geological Techniques for petroleum exploration, Oxford and IBH publishing Company.*

COURSE OUTCOMES

After completing the course, a student can able to understand the various processes involved in the upstream processes of petroleum Engineering.

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Course Code	:	CHPExxx
Course Title	:	ENERGY ENGINEERING
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PE

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:

1. *Gupta, "Energy Technology", Khanna Publishing House, New Delhi*
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.

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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:

1. Schoen H. M., New Chemical Engineering Separation Techniques, 2nd Edition, Inter Science Publications, New York.

2. Seader, J.D, and Henley E.J.,Separation 'Process Principles,' John Wiley & Sons, Inc..

3. Perry R.H. and. Green D.W.,Perry's Chemical Engineers Hand book, 6th Edition. McGraw Hill, New York, .

4. King C.J. 'Separation Processes', 4th Edition, Tata McGraw Hill, New Delhi,.

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

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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,

UNIT-II: Waste Sampling - Source Reduction of Wastes - Recycling and Reuse - Handling and Segregation of Wastes at Source - Storage and Collection of Municipal Solid Wastes - Analysis of Collection Systems - Need for Transfer and Transport - Transfer Stations - Labelling and Handling of Hazardous Wastes.

UNIT-III: Waste Processing - Processing Technologies - Biological and Chemical Conversion Technologies - Composting - Thermal Conversion Technologies - Energy Recovery - Incineration - Solidification and Stabilization of Hazardous Wastes - Treatment of Biomedical Wastes -

UNIT-IV: Disposal in Landfills - Site Selection - Design and Operation of Sanitary Landfills - Secure Landfills and Landfill Bioreactors - Leachate and Landfill Gas Management - Landfill Closure and Environmental Monitoring - Closure of Landfills - Landfill Remediation –

UNIT-V: Legislations on Management and Handling of Municipal Solid Wastes, Hazardous Wastes, and Biomedical Wastes - Elements of Integrated Waste Management.

REFERENCE BOOKS:

1. *O.P. Gupta, "Elements of Solid Waste Hazardous Management", Khanna Publishing House, New Delhi, 2018*
2. *George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, Integrated Solid Waste Management, McGraw-Hill, New York, 19932.*
3. *CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi.*

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

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Course Code	:	CHPExxx
Course Title	:	PROCESS EQUIPMENT DESIGN
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	CHPC209
Course Category	:	PE

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

1. R. H. Perry, "Chemical Engineers' Handbook", 7th Edn., McGraw Hill , New York.

2. R. K. Sinnott, "Chemical Engineering Design", Coulson and Richardson's Chemical Engineering Series, Volume-6, Fourth Edition, Butterwoth-Heinemann, Elsevier, New Delhi.

3. L. E. Brownell and E.H. Young, "Process Equipment Design - Vessel Design", Wiley Eastern Edn. New York.

4. B.C. Bhattacharyya, "Introduction to Chemical Equipment Design Mechanical Aspects", CBS Publishers & Distributors, New Delhi.

5. D.Q.Kern "Process Heat Transfer", Tata McGraw Hill Edn..

6. V. V.Mahajani and S. B. Umarjii, "Joshi's Process Equipment Design", 4th Edn., Mac Millan Publishers India Limited, New Delhi.

7. D. C. Dikdar, "Process Heat Transfer & Chemical Equipment Design", Khanna Publishing House, New Delhi

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.

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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.,

UNIT-IV: DATABASE: Design and developments of simple databases on Chemical and Physical properties of substances. Retrieval and Database in report, query and other formats, Interfacing with other software. Preparation of Material and energy Balances preparation of plant layout.

UNIT-V: MATHEMATICAL PROGRAMMING: Linear Programming, Transportation, Assignment, Dynamic Programming in Chemical Engineering, Formulation and solution through PC based programmes.

REFERENCE BOOKS:

1. Finlayson, B.A., "Introduction to Chemical Engineering Computing", 1st Edition, University of Washington.

2. S. Swapna Kumar and S. V. B. Lenina, "MATLAB: Easy Way of Learning", PHI Learning..

3. Singh, "Matlab Programming" Prentice Hall India Learning Private Limited.

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.

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CHAPTER

9

Electronics and Communication Engineering Curriculum Structure

(III to VI Semesters)

9.1 List of Programme Core Courses [PC]

Sl. No	Code No.	Course Title	Hours per week L	T	P	Semester	Credits
1.	ECPC201	Principles of Electronic Communication	3	0	0	3	3
2.	ECPC203	Principles of Electronic Communication Lab	0	0	2	3	1
3.	ECPC205	Electronic Devices and Circuits	3	0	0	3	3
4.	ECPC207	Electronic Devices and Circuits Lab	0	0	2	3	1
5.	ECPC209	Digital Techniques	2	0	0	3	2
6.	ECPC211	Digital Techniques Lab	0	0	2	3	1
7.	ECPC213	Electronic Measurements and Instrumentation	3	0	0	3	3
8.	ECPC215	Electronic Measurements and Instrumentation Lab	0	0	2	3	1
9.	ECPC217	Electric circuits and network	2	1	0	3	3
10.	ECPC202	Microcontroller and Applications	3	0	0	4	3
11.	ECPC204	Microcontroller and Applications Lab	0	0	2	4	1
12.	ECPC206	Consumer Electronics	3	0	0	4	3
13.	ECPC208	Digital Communication Systems	3	0	0	4	3
14.	ECPC210	Digital Communication Systems Lab	0	0	2	4	1
15.	ECPC301	Embedded Systems	3	0	0	3	3
16.	ECPC303	Embedded Systems Lab	0	0	2	2	1
17.	ECPC305	Mobile and Wireless Communication	3	0	0	3	3
18.	ECPC307	Mobile and Wireless Communication Lab	0	0	2	2	1
19.	ECPC302	Computer Networking and Data Communication	3	0	0	3	3
20.	ECPC304	Computer Networking and Data Communication Lab	0	0	2	2	1
	Total Credits						**41**

9.2 List of Program Elective Courses [PE]

Sl. No	Code No.	Course Title	Hours per week			Total hrs/ week	Cred-its
			L	T	P		
1.	ECPE201	Electronic Equipment Maintenance Or Simulation Software	0	0	4	4	2
2.	ECPE202	Linear Integrated Circuits	3	1	0	4	4
3.	ECPE203	Linear Integrated Circuits	0	0	2	4	1
4.	ECPE301	Industrial Automation or Control System and PLC	3	0	0	3	3
5.	ECPE302	Industrial Automation Lab or Control System and PLC Lab	0	0	2	2	1
6.	ECPE303	Microwave and RADAR or Optical Communication and networking	3	0	0	3	3
7.	ECPE304	Microwave and RADAR Lab or Optical Communication and networking Lab	0	0	2	2	1
Total Credits							**15**

9.3 Semester-wise Detailed Curriculum

Semester III

Sl. No	Category	Code No.	Course Title	Hours per week L	T	P	Total contact hrs/ week	Credits
1.	Program core course	ECPC201	Principles of Electronic Communication	3	0	0	3	3
2.	Program core course	ECPC203	Principles of Electronic Communication Lab	0	0	2	2	1
3.	Program core course	ECPC205	Electronic Devices and Circuits	3	0	0	3	3
4.	Program core course	ECPC207	Electronic Devices and Circuits	0	0	2	2	1
5.	Program core course	ECPC209	Digital Electronics	2	0	0	2	2
6.	Program core course	ECPC211	Digital Electronics Lab	0	0	2	2	1
7.	Program core course	ECPC213	Electronic Measurements and Instrumentation	3	0	0	3	3
8.	Program core course	ECPC215	Electronic Measurements and Instrumentation Lab	0	0	2	2	1
9.	Program core course	ECPC217	Electric circuits and network	2	1	0	3	3
10.	Summer Internship-I (4 weeks) after II Semester	SI201		0	0	0	0	2
	Total Credits							**20**

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Semester IV

Sl. No	Category	Code No.	Course Title	Hours per week L	T	P	Total contact hrs/week	Credits
1.	Program core course	ECPC202	Microcontroller and Applications	3	0	0	3	3
2.	Program core course	ECPC204	Microcontroller and Applications Lab	0	0	2	2	1
3.	Program core course	ECPC206	Consumer Electronics	3	0	0	3	3
4.	Program core course	ECPC208	Digital Communication Systems	3	0	0	3	3
5.	Program core course	ECPC210	Digital Communication Systems Lab	0	0	2	2	1
6.	Program Elective course	ECPE202	Electronic Equipment Maintenance	2	0	0	2	2
7.	Program Elective course	ECPE204	Linear Integrated Circuits	3	1	0	4	4
8.	Program Elective course	ECPE206	Linear Integrated Circuits Lab	0	0	2	2	1
9.	Minor Project	PR202		0	0	4	4	2
10.	Mandatory Course	AU202	Essence of Indian Knowledge and Tradition	2	0	0	0	0
	Total Credits							20

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Semester V

Sl. No	Category	Code No.	Course Title	Hours per week L	T	P	Total contact hrs/ Week	Credits
1.	Program core course	ECPC301	Embedded Systems	3	0	0	3	3
2.	Program core course	ECPC303	Embedded Systems Lab	0	0	2	2	1
3.	Program core course	ECPC305	Mobile and Wireless Communication	3	0	0	3	3
4.	Program core course	ECPC307	Mobile and Wireless Communication Lab	0	0	2	2	1
5.	Program Elective course	ECPE301	Industrial Automation or Control System and PLC	3	0	0	3	3
6.	Program Elective course	ECPE303	Industrial Automation Lab or Control System and PLC Lab	0	0	2	2	1
7.	Program Elective course	ECPE305	Microwave and RADAR or Optical Communication and networking	3	0	0	3	3
8.	Program Elective course	ECPE307	Microwave and RADAR Lab or Optical Communication and networking Lab	0	0	2	2	1
9.	Open Elective	ECOE301	Renewable Energy Technologies or Internet of Things	3	0	0	3	3
10.	Summer Internship-II(6 weeks) after IV Semester	SI301		0	0	0	0	3
11.	Major Project	PR302		0	0	2	2	^
	Total Credits							**22**

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Semester VI

Sl. No	Category	Code No.	Course Title	Hours per week L	T	P	Total contact hrs/week	Credits
1.	Program core course	ECPC302	Computer Networking and Data Communication	3	0	0	3	3
2.	Program core course	ECPC304	Computer Networking and Data Communication Lab	0	0	2	2	1
3.	Humanities and Social Science course	HS302	Entrepreneurship and Start-ups	3	1	0	4	4
4.	Open Elective	ECOE302	Robotics or Mechatronics	3	0	0	3	3
5.	Open Elective	ECOE303	Artificial Intelligence or Product Design	3	0	0	3	3
6.	Mandatory Course	AU302	Indian Constitution	2	0	0	2	0
7.	Major Project	PR302		0	0	6	6	4^
8.	Seminar	SE302		1	0	0	1	1
	Total Credits							**19**

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

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Semester III		
Course Code	:	ECPC 201
Course Title	:	Principles of Electronic Communication
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

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.

DIGITAL MODULATION: Baseband transmission: Line coding (RZ, NRZ), inter symbol interference (ISI), pulse shaping, Nyquist criterion for distortion free base band transmission, raised cosine spectrum. Pass band transmission: Geometric interpretation of signals, orthogonalization.

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
3. Communication Systems by Simon Haykin, John Wiley
4. Communication Systems (Analog and Digital) By R.P. Singh, S.D. Sapre, T.M.H.
5. Modern Digital & Analog Communication By B.P. Lathi, Oxford Publications
6. Digital & Analog Communication Systems By K.S. Shanmugam, John Wiley

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.

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Course Code	:	ECPC 203
Course Title	:	Principles of Electronic Communications Lab
Number of Credits	:	1 (L: 3, T: 0, P: 2)
Prerequisites	:	NIL
Course Category	:	PC

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.

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Course Code	:	ECPC 205
Course Title	:	Electronics Devices and Circuits
Number of Credits	:	3 (L:3, T:0, P:0)
Prerequisites	:	NIL
Course Category	:	PC

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

Common Base 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, MOSFET 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:

S. No.	Title of Book	Author	Publication
1.	Analog Circuits	A.K. Maini	Khanna Publishing House Ed. 2018 (ISBN: 978-93-86173-584)
2.	Electronic Devices and Circuits	S. Salivahanan and N. Suresh Kumar	McGraw Hill Education; Fourth edition (١ July ٢٠١٧) ISBN: 978-9339219505
3.	Electronics Devices and circuit theory	Boyestad & Nashelsky	Pearson Education India; 11 edition (2015) ISBN: 978-9332542600
4.	Electronic Principles	Albert Malvino & David Bates	Tata McGraw Hill Publication 2010 ISBN: 978-0070634244
5.	Electronics Devices & Circuits	Jacob Millman	McGraw Hill Education; 4 edition (2015) ISBN: 978-9339219543

SUGGESTED SOFTWARE/LEARNING WEBSITES:

a. https://www.electronics-tutorials.ws/
b. https://www.youtube.com/watch?v=Rx43l-QpeWQ
c. https://electronicsforu.com/resources/electronic-devices-and-circuit-theory

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Course Code	:	ECPC207
Course Title	:	Electronic Devices and Circuits 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.

S. No.	Practical Outcomes (PrOs)	Unit No.
1.	Construct the circuit and plot the VI characteristics of the PN Junction Diode , find the cut in voltage	1
2.	Construct the circuit and plot the characteristics of a Zener Diode. Find the breakdown voltage	1
3.	Construct a Half Wave Rectifier and obtain regulation characteristics – Without Filters and with Filters Compare the results	1
4.	Construct a Full Wave Rectifier and obtain regulation characteristics – Without Filters and with Filters Compare the results	1
5.	Construct a Bridge Rectifier and obtain regulation characteristics – Without Filters and with Filters	1
6.	Obtain the characteristics of DIAC and TRIAC	3
7.	Simulate half wave, full wave and bridge rectifier using simulation tool like PSpice/ Orcad/ Multisim.	3
8.	Develop a simulation model for Voltage Series and Voltage Shunt Feedback Amplifiers	5
9.	Develop circuits for Voltage Series and Voltage Shunt Feedback Amplifiers and obtain output plots. Compare the results with the simulation model.	5
10.	Develop a simulation model for Current Series and Current Shunt Feedback Amplifiers	5
11.	Develop circuits for Current Series and Current Shunt Feedback Amplifiers and obtain output plots. Compare the results with the simulation model.	
12.	**Total**	

Reference Books:

S. No.	Title of Book	Author	Publication
1.	Analog Circuits	A.K. Maini	Khanna Publishing House Ed. 2018 (ISBN: 978-93-86173-584)
2.	Electronic Devices and Circuits	S. Salivahanan and N. Suresh Kumar	McGraw Hill Education; Fourth edition (1 July 2017) ISBN: 978-9339219505
3.	Electronics Devices and circuit theory	Boyestad & Nashelsky	Pearson Education India; 11 edition (2015) ISBN: 978-9332542600
4.	Electronic Principles	Albert Malvino & David Bates	Tata McGraw Hill Publication 2010 ISBN: 978-0070634244
5.	Electronics Devices & Circuits	Jacob Millman	McGraw Hill Education; 4 edition (2015) ISBN: 978-9339219543

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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:

S.No.	Title of Book	Author	Publication
1.	Digital principles & Applications	Albert Paul Malvino & Donald P. Leach	McGraw Hill Education; Eighth edition ISBN: 978-9339203405
2.	Digital Electronics	Roger L. Tokheim Macmillian	McGraw-Hill Education (ISE Editions); International 2 Revised ed edition ISBN: 978-0071167963
3.	Digital Electronics – an introduction to theory and practice	William H. Gothmann	Prentice Hall India Learning Private Limited; 2 edition ISBN: 978-8120303485
4.	Fundamentals of Logic Design	Charles H. Roth Jr.	Jaico Publishing House; First edition ISBN: 978-8172247744
5.	Digital Electronics	R. Anand	Khanna Publications, New Delhi (Edition 2018) ISBN: 978-93-82609445

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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.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	To verify the truth tables for all logic fates – NOT OR AND NAND NOR XOR XNOR using CMOS Logic gates and TTL Logic Gates	1	02
2.	Implement and realize Boolean Expressions with Logic Gates	2	02
3.	Implement Half Adder, Full Adder, Half Subtractor, Full subtractor using ICs	3	02
4.	Implement parallel and serial full-adder using ICs	3	02
5.	Design and development of Multiplexer and De-multiplexer using multiplexer ICs	3	02
6.	Verification of the function of SR,D, JK and T Flip Flops	4	02
7.	Design controlled shift registers	4	02
8.	Construct a Single digit Decade Counter (0-9) with 7 segment display	4	03
9.	To design a programmable Up-Down Counter with a 7 segment display.	4	03
10.	Study of different memory ICs	5	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
11.	Study Digital- to – Analog and Analog to Digital Converters	5	02
12.	Simulate in Software (such as PSpice) an Analog to Digital Converter	5	03
13.	Simulate in Software (such as PSpice) an Analog to Digital Converter	5	03
	Total		**30**

Reference Books:

S.No.	Title of Book	Author	Publication
1.	Digital principles & Applications	Albert Paul Malvino & Donald P. Leach	McGraw Hill Education; Eighth edition ISBN: 978-9339203405
2.	Digital Electronics	Roger L. Tokheim Macmillian	McGraw-Hill Education (ISE Editions); International 2 Revised ed edition ISBN: 978-0071167963
3.	Digital Electronics – an introduction to theory and practice	William H. Gothmann	Prentice Hall India Learning Private Limited; 2 edition ISBN: 978-8120303485
4.	Fundamentals of Logic Design	Charles H. Roth Jr.	Jaico Publishing House; First edition ISBN: 978-8172247744
5.	Digital Electronics	R. Anand	Khanna Publications, New Delhi (Edition 2018) ISBN: 978-93-82609445

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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:

S. No.	Title of Book	Author	Publication
1.	Electrical & Electronic Measurement & Instruments	A.K. Sawhney	Dhanpat Rai & Sons, India
2.	Electronic Instrument and Measurement Technique	W.D. Cooper	Prentice Hall International, India.
3.	Electronic Measurement & Instrumentation	J.G. Joshi	Khanna Publishing House, Delhi
4.	Measurement systems application and design	E.O. Doebelin and D. N. Manik	The Mcgraw-Hill
5.	Electronic Measurements and Instrumentation	Oliver and Cage	The Mcgraw-Hill
6.	Basic Electrical Measurement	M.B. Stout	Prentice hall of India, India
7.	Electronic Instrumentation	H. S. Kalsi	The Mcgraw-Hill
8.	Electrical and Electronics Measurement and Instrumentation	Prithwiraj Pukrait, Budhaditya Biswas, Santanu Das, Chiranjib Koley	The Mcgraw-Hill

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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.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx Hrs. Required
1.	Measure unknown inductance using following bridges (a) Anderson Bridge (b) Maxwell Bridge	I	4
2.	Measure Low resistance by Kelvin's Double Bridge	I	2
3.	Calibrate an ammeter using DC slide wire potentiometer	II	2
4.	Calibrate a voltmeter using Crompton potentiometer	II	2
5.	Measure low resistance by Crompton potentiometer	II	2
6.	Calibrate a single-phase energy meter by phantom loading	III	2
7.	Study the working of Q-meter and measure Q of coils	IV	2

8.	Study working and applications of (i) C.R.O. (ii) Digital Storage C.R.O. & (ii) C.R.O. Probes	V	2
9.	Measurement of displacement with the help of LVDT	VI	2
10.	Draw the characteristics of the following temperature transducers (a) RTD (Pt-100) (b) Thermistor	VI	2
11.	Measurement of strain/force with the help of strain gauge load cell	VI	2

Reference Books:

S. No.	Title of Book	Author	Publication
1.	Electrical & Electronic Measurement & Instruments	A.K. Sawhney	Dhanpat Rai & Sons, India
2.	Electronic Instrument and Measurement Technique	W.D. Cooper	Prentice Hall International, India.
3.	Electronic Measurement & Instrumentation	J.G. Joshi	Khanna Publishing House, Delhi
4.	Measurement systems application and design	E.O. Doebelin and D. N. Manik	The Mcgraw-Hill
5.	Electronic Measurements and Instrumentation	Oliver and Cage	The Mcgraw-Hill
6.	Basic Electrical Measurement	M.B. Stout	Prentice hall of India, India
7.	Electronic Instrumentation	H. S. Kalsi	The Mcgraw-Hill
8.	Electrical and Electronics Measurement and Instrumentation	Prithwiraj Pukrait, Budhaditya Biswas, Santanu Das, Chiranjib Koley	The Mcgraw-Hill

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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

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

S. No.	Title of Book	Author	Publication
1	Networks and Systems	Ashfaq Husain	Khanna Publishing House
2	Network Analysis	M. E. Van Valkenburg	Prentice Hall of India
3	Engineering Circuit Analysis	W. H. Hayt, J. E. Kemmerly and S. M. Durbin	McGraw Hill
4	Electrical Circuits	Joseph Edminister	Schaum's Outline, Tata McGraw Hill
5	Basic Circuit Theory	Lawrence P. Huelsma	Prentice Hall of India
6	Network & Systems	D. Roy Choudhury	Wiley Eastern Ltd
7	Linear Circuit Analysis	De Carlo and Lin	Oxford Press

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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:

S. No.	Title of Book	Author	Publication
1.	The 8051 Micro Controller and Embedded Systems	Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely	PHI Pearson Education, 5th Indian reprint
2.	Microprocessor and Microcontrollers	Krishna Kant	Eastern Company Edition, Prentice Hall of India, New Delhi
3.	Microprocessor & Microcontroller Architecture: Programming & Interfacing using 8085,8086,8051	Soumitra Kumar Mandal	McGraw Hill Edu,
4.	Microcontrollers: Architecture implementation and Programming	Tabak Daniel, Hintz Kenneth j	Tata McGraw Hill, 2007
5.	ARM Developer's Guide.UM10139 LPC214X User manual – Rev.4	Andrew N.Sloss, Dominic Symes, Chris Wright	User manual – Rev.4
6.	Microprocessors and interfacing: programming and hardware	Douglas V. Hall	Tata McGraw Hill, 2editon, 2007
7.	"Microcontroller – Fundamentals and Applications with Pic	Valder – Perez	Yeesdee Publishers, Tayler & Francis

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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:

1. Programming 8051 Micro controller using ASM and C, and implementation in flash 8051 microcontroller.
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]
12. Pulse Width Modulation. [Assembly and C] Programming ARM Micro controller using ASM and C using simulator. 11.Programming with Arithmetic logic instructions[Assembly]
13. GPIO programming in ARM microcontroller. [C Programming].
14. Timers programing in ARM Microcontroller. [C Programming].

References:

S.No.	Title of Book	Author	Publication
1.	The 8051 Micro Controller and Embedded Systems	Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely	PHI Pearson Education, 5th Indian reprint
2.	Microprocessor and Microcontrollers	Krishna Kant	Eastern Company Edition, Prentice Hall of India, New Delhi
3.	Microprocessor & Microcontroller Architecture: Programming & Interfacing using 8085,8086,8051	Soumitra Kumar Mandal	McGraw Hill Edu,
4.	Microcontrollers: Architecture implementation and Programming	Tabak Daniel, Hintz Kenneth j	Tata McGraw Hill, 2007
5.	ARM Developer's Guide. UM10139 LPC214X User manual – Rev.4	Andrew N.Sloss, Dominic Symes, Chris Wright	User manual – Rev.4
6.	Microprocessors and interfacing: programming and hardware	Douglas V. Hall	Tata McGraw Hill, 2editon, 2007
7.	"Microcontroller – Fundamentals and Applications with Pic	Valder – Perez	Yeesdee Publishers, Tayler & Francis

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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:

S. No.	Title of Book	Author	Publication
1.	Consumer Electronics	Bali S.P.	Pearson Education India,2010 , latest edition
2.	Audio video systems : principle practices & troubleshooting	Bali R and Bali S.P	Khanna Book Publishing Co. (P) Ltd., 2010Delhi , India, latest edition
3.	Modern Television practices	Gulati R.R.	New Age International Publication (P) Ltd. New Delhi Year 2011, latest edition
4.	Audio video systems	Gupta R.G.	Tata Mc graw Hill, New Delhi, India 2010, latest edition
5.	Mastering Digital Television	Whitaker Jerry & Benson Blair	McGraw-Hill Professional, 2010, latest edition
6.	Standard handbook of Audio engineering	Whitaker Jerry & Benson Blair	McGraw-Hill Professional, 2010 , latest edition.

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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:

UNIT1

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:

S. No.	Title of Book	Author	Publication
1.	Communication Systems	Haykin, S	4th Ed., John Wiley & Sons
2.	Modern Digital and Analog Communication Systems	Lathi, B.P. and Ding, Z	Intl. 4th Ed., Oxford University Press.
3.	Digital Communications	Proakis, J.G. and Saheli, M	5th Ed., McGraw-Hill
4.	Digital Communication: Fundamentals and Applications	Sklar, B., and Ray, P.K	2nd Ed., Dorling Kindersley
5.	Elements of Information Theory	T. Cover and J. Thomas	2/e, Wiley.
6.	Principles of Digital Communication	R. G. Gallager	Cambridge Univ. Press
7.	A Foundation in Digital Communication	A. Lapidoth	Cambridge Univ. Press
8.	Error Control Coding	S. Lin and D. Costello	2/e, Prentice Hall.

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Course Code	:	ECPC210
Course Title	:	Digital Communication Systems Lab
Number of Credits	:	1 (L: 0, T:0, P: 2)
Prerequisites	:	NIL
Course Category	:	PC

Course Content:

1. Pulse Code Modulation and Differential Pulse Code Modulation.
2. Delta Modulation and Adaptive Delta modulation.
3. Simulation of Band Pass Signal Transmission and Reception • Amplitude Shift Keying • Frequency Shift Keying • Phase Shift Keying.
4. Performance Analysis of Band Pass Signal Transmission and Reception • Amplitude Shift Keying • Frequency Shift Keying • Phase Shift Keying.
5. Implementation of Amplitude Shift Keying
6. Implementation of Frequency Shift Keying
7. Implementation of Phase Shift Keying.
8. Time Division Multiplexing: PLL (CD 4046) based synch, clock and data extraction

References:

S. No.	Title of Book	Author	Publication
1.	Communication Systems	Haykin, S	4th Ed., John Wiley & Sons
2.	Modern Digital and Analog Communication Systems	Lathi, B.P. and Ding, Z	Intl. 4th Ed., Oxford University Press.
3.	Digital Communications	Proakis, J.G. and Saheli, M	5th Ed., McGraw-Hill
4.	Digital Communication: Fundamentals and Applications	Sklar, B., and Ray, P.K	2nd Ed., Dorling Kindersley
5.	Elements of Information Theory	T. Cover and J. Thomas	2/e, Wiley.
6.	Principles of Digital Communication	R. G. Gallager	Cambridge Univ. Press
7.	A Foundation in Digital Communication	A. Lapidoth	Cambridge Univ. Press
8.	Error Control Coding	S. Lin and D. Costello	2/e, Prentice Hall.

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Course Code	:	ECPE202
Course Title	:	Electronic Equipment Maintenance
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PE

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, Inductors Failures in fixed resistors, testing of resistors, variable resistors, variable resistors as potentiometers, 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, counters, 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:

S. No.	Title of Book	Author	Publication
1.	Modern Electronic Equipment: Troubleshooting, Repair and Maintenance	Khandpur	TMH 2006
2.	Electronic Instruments and Systems: Principles, Maintenance and Troubleshooting	R. G. Gupta	Tata McGraw Hill Edition 2001
3.	Student Reference Manual for Electronic Instrumentation Laboratories	David L Terrell	Butterworth-Heinemann
4.	Electronic Testing and Fault Diagnosis	G. C. Loveday, A. H	Wheeler Publishing

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Course Code	:	ECPE204
Course Title	:	Linear Integrated Circuits
Number of Credits	:	4 (L: 3, T: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	PE

Course Contents:

UNIT I - IC Fabrication and Circuit Configuration for Linear IC

Advantages of ICs over discrete components – Manufacturing process of monolithic Ics 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, Antilogarithmic 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

Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R2R Ladder types switches for D/A converters, high speed sample-and-hold circuits, A/D Converters specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D 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:

S. No.	Title of Book	Author	Publication
1.	Design with operational amplifiers and analog integrated circuits, 3rd Edition	Sergio Franco	Tata McGraw-Hill, 2007
2.	Linear Integrated Circuits,	. D.Roy Choudhry, Shail Jain	New Age International Pvt. Ltd
3.	System design using Integrated Circuits	. B.S.Sonde	New Age Pub, 2nd Edition, 2001
4.	Analysis and Design of Analog Integrated Circuits	Gray and Meyer	Wiley International, 2005.
5.	OP-AMP and Linear ICs	Ramakant A.Gayakwad	Prentice Hall / Pearson Education, 4th Edition, 2001
6.	Operational Amplifier and Linear Integrated Circuits	K Lal Kishore	, Pearson Education, 2006

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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.
2. Waveform Generation using Op-Amp (IC741).
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.
9. Implementation of combinational logic circuits.
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:

S. No.	Title of Book	Author	Publication
1.	Arduino Projects For Dummies (For Dummies Series)	Kennedy George; Davis Bernard; Prasanna SRM	Wiley (5 July 2013) ISBN : 978-1118551479
2.	Make: Getting Started With Arduino - The Open Source Electronics Prototyping Platform	Massimo Banzi and Michael Shiloh	Shroff/Maker Media; Third edition (27 December 2014) ISBN : 978-9351109075

SUGGESTED SOFTWARE/LEARNING WEBSITES:

d. https://www.arduino.cc/reference/en/

e. https://learn.adafruit.com/category/learn-arduino

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Course Code	:	ECPC303
Course Title	:	Embedded Systems 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.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Built-in LED state control by push button sketch implementation	I	02*
2.	Built-in LED blinking sketch implementation	I	02
3.	Built-in LED blinking by toggling states based on binary operation	I	02
4.	Built-in LED state control by user interface through serial port	I	02*
5.	User interface for boolean operation and bit wise operation through serial port	I	02
6.	User interface for compounded operation through serial port	I	02
7.	Looping mechanism to check the state of pin and if change print its status on serial port	II	02
8.	Controlling multiple LEDs with a loop and an array	II	02
9.	Use a potentiometer to control the blinking of an LED	III	02*
10.	Uses an analog output (PWM pin) to fade an LED.	III	02
11.	Servo Motor Control using PWM	III	02
12.	Temperature sensor interfacing and sending its reading over serial port	IV	04
13.	I2C light sensor interfacing and sending its reading over serial port	IV	04*
	Total		**30**

SUGGESTED LEARNING RESOURCES:

S. No.	Title of Book	Author	Publication
1.	Arduino Projects For Dummies (For Dummies Series)	Kennedy George; Davis Bernard; Prasanna SRM	Wiley (5 July 2013) ISBN : 978-1118551479
2.	Make: Getting Started With Arduino - The Open Source Electronics Prototyping Platform	Massimo Banzi and Michael Shiloh	Shroff/Maker Media; Third edition (27 December 2014) ISBN : 978-9351109075

SUGGESTED SOFTWARE/LEARNING WEBSITES:

f. https://www.arduino.cc/reference/en/

g. https://learn.adafruit.com/category/learn-arduino

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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:

S. No.	Title of Book	Author	Publication
1	Wireless Communications – Principles and Practice	T. S. Rappaport,	(2nd edition) Pearson ISBN 9788131731864
2	Modern Wireless Communications	Haykin & Moher	Pearson 2011 (Indian Edition) ISBN : 978-8131704431

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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.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	To understand the cellular frequency reuse concept to find the co-channel cells for a particular cell.	I	04
2.	To understand the path loss	II	04
3.	Understand the path loss with shadowing	II	04

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
4.	Understanding the Flat fading	II	04
5.	Understanding the Frequency selective fading	II	04
6.	Understanding the Multipath channel for the following objectives 1. No Fading 2. Flat Fading 3. Dispersive Fading	II	04
7.	To simulate a dipole antenna (λ, λ/4, λ/2, 3λ/2) for a particular frequency using 4NEC2	III	04
8.	Perform following experiments using CDMA trainer kit 1. PSK modulation and demodulation experiment 2. Bit synchronization extraction experiment 3. Error correction encoding experiment	IV	04
	Total		**32**

REFERENCES/SUGGESTED LEARNING RESOURCES:

S. No.	Title of Book	Author	Publication
1	Wireless Communications – Principles and Practice	T. S. Rappaport,	(2nd edition) Pearson ISBN 9788131731864
2	Modern Wireless Communications	Haykin & Moher	Pearson 2011 (Indian Edition) ISBN : 978-8131704431

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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

Architecture of Industrial Automation Systems.

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:

S. No.	Title of Book	Author	Publication
1.	Industrial Instrumentation, Control and Automation	S. Mukhopadhyay, S. Sen and A. K. Deb	Jaico Publishing House, 2013 ISBN : 978-8184954098
2.	Electric Motor Drives, Modelling, Analysis and Control	R. Krishnan	Prentice Hall India, 2002 ISBN : 978-0130910141

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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.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Develop a data acquisition system using arduino	I	04
2.	Temperature control system using PID	II	04
3.	Level control system based on error feedback	II	04
4.	PLC programming using Relay ladder Logic for AND , OR XOR and NOR gate	III	04
5.	PLC, RLL programming using CASCADE method	III	04
6.	PLC timer, counter, registers and analog input/output functions	III	04
7.	Variable Speed drive of an induction motor	IV	04
8.	PLC/ microcontroller based computer numerical control machine job completion	IV	04
	Total		**32**

SUGGESTED LEARNING RESOURCES:

S. No.	Title of Book	Author	Publication
1	Industrial Instrumentation, Control and Automation	S. Mukhopadhyay, S. Sen and A. K. Deb	Jaico Publishing House, 2013 ISBN : 978-8184954098
2	Electric Motor Drives, Modelling, Analysis and Control	R. Krishnan	Prentice Hall India, 2002 ISBN : 978-0130910141

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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, waveguides 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:

S. No.	Title of Book	Author	Publication
1	Microwave Engineering	D.M. Pozar	Wiley; Fourth edition (2013) ISBN 978-8126541904
2	Foundation for Microwave Engineering	R.E. Collins	Wiley; Second edition (2007) ISBN : 978-8126515288

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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.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	To study wave guide components.	I	04
2.	To study the characteristics of Gunn oscillator Gun diode as modulated source.	I	04
3.	Introduction to Smith chart and its application for the unknown impedance measurement.	I	04
4.	Study the behavior of impedance matching for passive networks using Smith chart.	II	04
5.	To study loss and attenuation measurement of attenuator	II	04
6.	Construct a cavity resonator in waveguide and study its characteristics using the network analyzer and a frequency counter.	III	04
7.	To determine the frequency and wavelength in a rectangular waveguide working in TE10 mode	IV	04
	Total		**28**

SUGGESTED LEARNING RESOURCES:

S. No.	Title of Book	Author	Publication
1	Microwave Engineering	D.M. Pozar	Wiley; Fourth edition (2013) ISBN 978-8126541904
2	Foundation for Microwave Engineering	R.E. Collins	Wiley; Second edition (2007) ISBN : 978-8126515288

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SEMESTER VI

Course Code	:	ECPC302
Course Title	:	Computer Networking and Data Communication
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

Course Content:

Unit 1 - Introduction to data communication.

Concept of analog and digital signals. Bandwidth. Network architecture.

Basics of OSI and TCP/IP reference models.

Types of Computer Networks – Personal Area Network, Local Area Netwrk, Metropolitan Area Network, Wide Area Network, Internetwork.

Computer Network Topologies – Point to Point, Bus topology, Star topology, ring topology, mesh topology, tree topology, Daisy Chain, Hybrid Topology,

Computer Network Model. Transmission media. Wired and wireless connectivity.

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, Micowave, 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.

Circuit and packet switching. Frame relay and ATM switching. ISDN. Local area network protocols. Fibre optic networks. Satellite networks.

Data link layer design issues: its functions and protocols. Internet protocol. Routing algorithms. Congestion control algorithms. IP addressing schemes. Internetworking and sub-netting.

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:

S. No.	Title of Book	Author	Publication
1.	Computer Networking A top down Approach:	J.F.Kurose	Pearson
2.	Computer Networks and Internet	D.E. Comer	Pearson
3.	Wireless Communications: Principles and Practice, 2nd edition	T. Rappaport	Prentice Hall, 2002
4.	Wireless Communication and Networking	John W. Mark, Weihua Zhuang	
5.	Modelling and Analysis of Computer Communication Networks	Jeremiah F. Hayes	
6.	Data communication & Networking	Stallings	

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

c) www.st-andrews.ac.uk/~www_pa/Scots_Guide/iandm/part3/page1.html

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

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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.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	To study the different physical equipment used for networking		02*
2.	Study the different internetworking devices in a computer network		02*
3.	Study the working of basic networking commands		02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
4.	To study PC to PC communication using parallel port		02
5.	Study of LAN in Star Topology		02
6.	Study of LAN in Bus Topology		02
7.	Study of LAN in Tree Topology		02
8.	Study and configuration of modem of computer		02
9.	Study of wireless communication		02*
10.	Studying PC Communication using LAN		02
	Total		**20**

Reference Books:

S. No.	Title of Book	Author	Publication
1.	Basic Electrical Engineering	Mittle and Mittal	McGraw Education, New Delhi, 2015, ISBN : 978-0-07-0088572-5
2.	Basic Electrical Engineering	Ritu Sahdev	Khanna Publishing House, Delhi 2018, ISBN: 978-93-86173-49-2
3.	Fundamentals of Electrical Engineering	Saxena, S. B. Lal	Cambridge University Press, latest edition ISBN : 9781107464353
4.	Electrical Technology Vol – I	Theraja, B. L.	S. Chand publications, New Delhi, 2015, ISBN: 9788121924405
5.	Basic Electronics	S. Biswas	Khanna Publishing House, Delhi ISBN: 978-81-87522-164
6.	Electrical Technology Vol – II	Theraja, B. L.	S. Chand publications, New Delhi, 2015, ISBN: 9788121924375
7.	Basic Electrical and Electronics Engineering	Jegathesan, V.	Wiley India, New Delhi, 2015 ISBN : 97881236529513
8.	A text book of Applied Electronics	Sedha, R.S.	S.Chand ,New Delhi, 2008 ISBN-13: 978-8121927833
9.	Electronics Principles	Malvino, Albert Paul, David	McGraw Hill Eduction, New Delhi,2015, ISBN-13: ٠٠٧٠٦٣٤٢٤٤-٩٧٨
10.	Principles of Electronics	Mehta, V.K. Mehta, Rohit	S. Chand and Company, New Delhi, 2014, ISBN-13-9788121924504
11.	Fundamental of Electronic Devices and Circuits	Bell Devid	Oxford University Press, New Delhi 2015 ISBN : 9780195425239

SUGGESTED SOFTWARE/LEARNING WEBSITES:

a. en.wikipedia.org/wiki/Transformer
b. www.animations.physics.unsw.edu.au//jw/AC.html
c. www.alpharubicon.com/altenergy/understandingAC.htm
d. www.electronics-tutorials
e. learn.sparkfun.com/tutorials/transistors
f. www.pitt.edu/~qiw4/Academic/ME2082/Transistor%20Basics.pdf
g. www.technologystudent.com/elec1/transis1.htm
h. www.learningaboutelectronics.com
i. www.electrical4u.com

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Appendix - I

Common Courses

(III to VI Semesters)

APPENDIX – I

COMMON COURSES TO ALL BRANCHES (From III to VI Semesters)

Course Code	:	HS 302
Course Title	:	Entrepreneurship and Start-ups
Number of Credits	:	4
Prerequisites (Course code)	:	None
Course Category	:	HS

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.
4. Acquiring entrepreneurial quality, competency, and motivation.
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:

S. No.	Title of Book	Author	Publication
1.	The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company	Steve Blank and Bob Dorf	K & S Ranch ISBN – 978-0984999392
2.	The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses	Eric Ries	Penguin UK ISBN – 978-0670921607
3.	Demand: Creating What People Love Before They Know They Want It	Adrian J. Slywotzky with Karl Weber	Headline Book Publishing ISBN – 978-0755388974
4.	The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business	Clayton M. Christensen	Harvard business ISBN: 978-142219602

SUGGESTED SOFTWARE/LEARNING WEBSITES:

a. https://www.fundable.com/learn/resources/guides/startup

b. https://corporatefinanceinstitute.com/resources/knowledge/finance/corporate-structure/

c. https://www.finder.com/small-business-finance-tips

d. https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your-business/

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Appendix - II
Open Elective Courses

APPENDIX – II

OPEN ELECTIVE COURSES (OE)

S. No.	Code No.	Course Title	Hours per week			Semes-ter	Cred-its
			L	T	P		
1	**OE###	Economic Policies in India	3	0	0	V / VI	3
2	**OE###	Artificial Intelligence & Machine Learning	3	0	0	V / VI	3
3	**OE###	Soft Computing Techniques	3	0	0	V / VI	3
4	**OE###	Project Management	3	0	0	V / VI	3
5	**OE###	Renewable Energy Technologies	3	0	0	V / VI	3
6	**OE###	Energy Conservation & Audit	3	0	0	V / VI	3
7	**OE###	Product Design	3	0	0	V / VI	3
8	**OE###	Engineering Economics & Accountancy	3	0	0	V / VI	3
9	**OE###	Operations Research	3	0	0	V / VI	3
10	**OE###	Renewable Energy Technologies	3	0	0	V / VI	3
11	**OE###	Energy Efficiency and Audit	3	0	0	V / VI	3
12	**OE###	Web Designing and Multimedia Technology (*)	3	0	0	V / VI	3
13	**OE###	History of Science and Engineering (*)	3	0	0	V / VI	3
14	**OE###	Internet of Things	3	0	0	V / VI	3
15	**OE###	Professional Orientation (*)	3	0	0	V / VI	3
16	**OE###	Disaster Management	3	0	0	V / VI	3
17	**OE###	Sustainable Development (*)	3	0	0	V / VI	3
18	**OE###	Smart Systems (*)	3	0	0	V / VI	3
19	**OE###	Robotics (*)	3	0	0	V / VI	3
20	**OE###	Introduction to E-Governance (*)	3	0	0	V / VI	3
21	**OE###	Cyber Security Laws, Standards and IPR (*)	3	0	0	V / VI	3
22	**OE###	Organic and Natural Farming Practices (*)	3	0	0	V / VI	3
23	**OE###	Classical Text Reading (*)	3	0	0	V / VI	3
24	**OE###	3-D Printing (*)	3	0	0	V / VI	3
25	**OE###	Virtual Reality (*)	3	0	0	V/ VI	3
26	**OE###	Mechatronics	3	0	0	V/VI	3
27	**OE###	Artificial Intelligence	3	0	0	V/VI	3

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:

1. Dutt Rudder and K.P.M Sunderam (2017). Indian Economy. S Chand & Co. Ltd. New Delhi.
2. Mishra S.K & V.K Puri (2017). Indian Economy and –Its Development Experience. Himalaya Publishing House.
3. Singh, Ramesh, (2016): Indian Economy, Tata-McGraw Hill Publications, New Delhi.
4. Dhingra, I.C., (2017): March of the Indian Economy, Heed Publications Pvt. Ltd.
5. Karam Singh Gill, (1978): Evolution of the Indian Economy, NCERT, New Delhi
6. Kaushik Basu (2007): The Oxford Companion to Economics of India, Oxford University Press.

Course outcomes:

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

CO1	Understand Indian economics policy, planning strategies
CO2	It will enable to students to comprehend theoretical and empirical development across countries and region for policy purposes

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

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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, Over fitting 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:

1. Russell, Norvig, Artificial intelligence: A modern approach, 2nd edition. Pearson/Prentice Hall.
2. M.C. Trivedi, A classical approach to Artificial Intelligence, Khanna Publishing House, New Delhi (2018)
3. V.K. Jain, Machine Learning, Khanna Publishing House, New Delhi (2018)
4. Ethem Alpaydin, Introduction to Machine Learning, Second Edition, http://mitpress.mit.edu/catalog/item/default.asp?ttype=2&tid=12012.

Course outcomes:

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

CO1	Identify problems that are amenable to solution by AI methods.
CO2	Design and carry out an empirical evaluation of different algorithms on a problem formalization, and state the conclusions that the evaluation supports.
CO3	Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
CO4	able to design and implement various machine learning algorithms in a range of real-world applications.
CO5	Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.

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Course Code	:	**OE###
Course Title	:	SOFT COMPUTING TECHNIQUES
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	OE

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-I: Problem Solving Methods and Tools: Problem Space, Problem solving, State space, Algorithm's performance and complexity, Search Algorithms, Depth first search method, Breadth first search methods their comparison, A*, AO*, Branch and Bound search techniques, p type, Np complete and Np Hard problems.

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.

UNIT-IV: Advances in Soft Computing Tools: Fuzzy Logic, Theory and applications, Fuzzy Neural networks, Pattern Recognition, Differential Evolution, Data Mining Concepts, Applications of above algorithms in manufacturing engineering problems.

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:

1. Tettamanzi Andrea, Tomassini and Marco, Soft Computing Integrating Evolutionary, Neural and Fuzzy Systems, Springer, 2001.
2. Elaine Rich, Artificial Intelligence, McGraw Hill, 2/e, 1990.
3. Kalyanmoy Deb, Multi-objective Optimization using Evolutionary Algorithms, John Wiley and Sons, 2001.

Course outcomes:

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

CO1	Classify and differentiate problem solving methods and tools.
CO2	Apply A*, AO*, Branch and Bound search techniques for problem solving.
CO3	Formulate an optimization problem to solve using evolutionary computing methods.
CO4	Design and implement GA, PSO and ACO algorithms for optimization problems in Mechanical Engineering.
CO5	Apply soft computing techniques for design, control and optimization of Manufacturing systems.

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Course Code	:	**OE###
Course Title	:	PROJECT MANAGEMENT
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	OE

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 break down 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-III: Financial estimates and projections: Cost of projects-means of financing-estimates of sales and production-cost of production-working capital requirement and its financing-profitability projected cash flow statement and balance sheet. Break even analysis.

UNIT-IV: Basic techniques in capital budgeting: Non discounting and discounting methods- pay-back period- Accounting rate of return-net present value-Benefit cost ratio-internal rate of return. Project risk. Social cost benefit analysis and economic rate of return. Non-financial justification of projects**.**

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:

1. Project planning, analysis, selection, implementation and review – Prasannachandra – Tata McGraw Hill
2. Project Management – the Managerial Process – Clifford F. Gray & Erik W. Larson - McGraw Hill
3. Project management - David I Cleland - Mcgraw Hill International Edition, 1999
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.

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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:

1. O.P. Gupta, Energy Technology, Khanna Publishing House, Delhi (ed. 2018)
2. Renewable Energy Sources, Twidell, J.W. & Weir, A., EFN Spon Ltd., UK, 2006.
3. Solar Energy, Sukhatme. S.P., Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
4. Renewable Energy, Power for a Sustainable Future, Godfrey Boyle, Oxford University Press, U.K., 1996.
5. Fundamental of Renewable Energy Sources, GN Tiwari and MK Ghoshal, Narosa, New Delhi, 2007.
6. Renewable Energy and Environment-A Policy Analysis for India, NH Ravindranath, UK Rao, B Natarajan, P Monga, Tata McGraw Hill.
7. Energy and The Environment, RA Ristinen and J J Kraushaar, Second Edition, John Willey & Sons, New York, 2006.
8. Renewable Energy Resources, JW Twidell and AD Weir, ELBS, 2006.

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.

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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 present scenario.
- To understand conservations 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 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 / Control; 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 pay back 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:

1. Electric Energy Generation, Utilisation and Conservation Sivaganaraju, S Pearson, New Delhi, 2012
2. Project Management, Prasanna Chandra, Tata Mcgraw Hill, New Delhi
3. O.P. Jakhar, Energy Conservations in Buildings, Khanna Publishing House, New Delhi
4. Financial Management, Prasanna Chandra Tata Mcgraw Hill, New Delhi.
5. Energy management Handbook, Prasanna Chandra, Tata Mcgraw Hill, New Delhi.
6. O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi (ed. 2018)

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 and industry and identify waste stream.
CO4	Identify energy wastage and suggest alternative methods.
CO5	Evaluate the concepts of energy audit.

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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:

1. Product Design and Development, Karl T. Ulrich and Steven D. Eppinger, Tata McGraw–Hill edition.
2. Engineering Design –George E. Dieter.
3. An Introduction to Engineering Design methods Vijay Gupta.
4. Merie Crawford : New Product management, McGraw-Hill Irwin.
5. Chitale A K and Gupta R C, "Product Design and Manufacturing", Prentice Hall of India, 2005.
6. Kevin Otto and Kristin Wood, Product Design, Techniques in Reverse Engineering and New Product Development, Pearson education.

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.

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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
2. McGuigan, Moyer and Harris, 'Managerial Economics; Applications, Strategy and Tactics', Thomson South Western, 10th Edition, 2005.
3. Prasanna Chandra. 'Fundamentals of Financial Management', Tata Mcgraw Hill Publishing Ltd., 4th edition, 2005.
4. Samuelson. Paul A and Nordhaus W.D., 'Economics', Tata Mcgraw Hill Publishing Company Limited, New Delhi, 2004.
5. Paresh Shah, 'Basic Financial Accounting for Management', Oxford University Press, New Delhi, 2007. 3. Salvatore Dominick, 'Managerial Economics in a global economy'. Thomson South Western, 4th Edition, 2001.

Course outcomes:

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

CO1	Understand the macro-economic environment of the business and its impact on enterprise
CO2	Understand cost elements of the product and its effect on decision making
CO3	Prepare accounting records and summarize and interpret the accounting data for managerial decisions
CO4	Understand accounting systems and analyze financial statements using ratio analysis
CO5	Understand the concepts of financial management and investment

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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:

1. Operations Research: Principles and Applications - G.Srinivasan, PHI Learning Private Limited.
2. Operations Research: An Introduction - Hamdy A. Taha, Pearson.
3. Operations Research: Principles and Practice - Ravindran, Phillips and Solberg, Wiley India
4. Operations Research: Concepts and Cases - Hillier and Liberman, McGraw-Hill

Course outcomes:

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

CO1	Recognize the importance and value of Operations Research and mathematical modeling in solving practical problems in industry.
CO2	Formulate a managerial decision problem into a mathematical model.
CO3	Understand Operations Research models and apply them to real-life problems.
CO4	Understand and implement the Transportation Models and Assignment Models at workplace.
CO5	Understand the characteristics of different types of decisions.

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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
2. Neill, Simon P.; Hashemi, M. Reza: Fundamentals of Ocean Renewable Energy: Generating Electricity from the Sea, Academic Press, ISBN:978-0-12-810448-4
3. David M. Buchla, Thomas E. Kissell, Thomas L. Floyd, Renewable Energy Systems, Pearson Education New Delhi , ISBN: 9789332586826,
4. Rachel, Sthuthi, Earnest, Joshua; -Wind Power Technologies, PHI Learning, New Delhi, ISBN: 978-93-88028-49- 3; E-book 978-93-88028-50-9
5. Deambi, Suneel: From Sunlight to Electricity: a practical handbook on solar photovoltaic application; TERI, New Delhi ISBN:9788179935736
6. Gipe, Paul: Wind Energy Basics, Chelsea Green Publishing Co; ISBN: 978-1603580304
7. Wizelius, Tore, Earnest, Joshua - Wind Power Plants and Project Development, PHI Learning, New Delhi, ISBN:978-8120351660
8. Kothari, D.P. et aL: Renewable Energy Sources and Emerging Technologies, PHI Learning, New Delhi, ISBN: -978-81-203-4470-9
9. Bhadra, S.N., Kastha, D., Banerjee, S, Wind Electrical Systems installation; Oxford University Press, New Delhi, ISBN: 9780195670936.

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.

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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 Conservation Equipment: Soft starters, Automatic star delta convertor, Variable Frequency Drives, Automatic p. f. controller (APFC)

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:

1. Guide Books No. 1 and 3 for National Certification Examination for Energy Managers and Energy Auditors, Bureau of Energy Efficiency (BEE), Bureau of Energy Efficiency (A Statutory body under Ministry of Power, Government of India) (Fourth Edition 2015).
2. O.P. Gupta, Energy Technology, Khanna Publishing House, Delhi, Edition 2018, (ISBN: 978-93-86173-683).
3. Henderson, P. D., India - The Energy Sector, University Press, Delhi, 2016. ISBN*: 978*-0195606539
4. Turner, W. C., Energy Management Handbook, Fairmount Press, 2012, ISBN 9781304520708
5. Sharma, K. V., Venkataseshaiah; P., Energy Management and Conservation, I K International Publishing House Pvt. Ltd; 2011 ISBN 9789381141298
6. Mehta,V.K.,PrinciplesofPowerSystem,S.ChandandCo.NewDelhi,2016,ISBN 9788121905947
7. Singh, Sanjeev; Rathore, Umesh, Energy Management, S K KatariaandSons,New Delhi ISBN-13: 9789350141014.
8. Desai, B. G.; Rana, J. S.; A. Dinesh, V.; Paraman, R., Efficient Use and Management of Electricity in Industry, Devki Energy Consultancy Pvt. Ltd.
9. Chakrabarti, Aman, Energy Engineering And Management, e-books Kindle Edition

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.

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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:

S. No.	Title of Book	Author	Publication
1	Internet of Things	Raj Kamal	McGraw Hill Education; First edition (10 March 2017) ISBN 978-9352605224
2	internet of Things: A Hands-On Approach	Arsheep Bahge and Vijay Madisetti	Orient Blackswan Private Limited - New Delhi; First edition (2015) ISBN : 978-8173719547

SUGGESTED SOFTWARE/LEARNING WEBSITES:

1. https://www.raspberrypi.org/blog/getting-started-with-iot/
2. https://www.arduino.cc/en/IoT/HomePage
3. https://www.microchip.com/design-centers/internet-of-things
4. https://learn.adafruit.com/category/internet-of-things-iot
5. http://esp32.net/

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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 –

Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment; IDNDR, Yokohama Stretegy, Hyogo Framework of Action.

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
2. Bhandani, R. K., An overview on natural & man-made disasters and their reduction, CSIR, New Delhi
3. Srivastava, H. N., and Gupta G. D., Management of Natural Disasters in developing countries, Daya Publishers, Delhi
4. Alexander, David, Natural Disasters, Kluwer Academic London
5. Ghosh, G. K., Disaster Management, A P H Publishing Corporation
6. Murthy, D. B. N., Disaster Management: Text & Case Studies, Deep & Deep Pvt. Ltd.

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

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Course Code	:	**OE###
Course Title	:	Mechatronics
Number of Credits	:	3
Prerequisites (Course code)	:	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:

S.No.	Title of Book	Author	Publication
1.	Analysis and design of Dynamic Systems	Cochin, Era and Cadwallender	AddisonWesley, 1997
2.	Mechatronics Engineering	Tomkinson, D. And Horne, J. Longman	McGraw Hill, 1996
3.	Mechatronics	Bolton, W	Pearson

S.No.	Title of Book	Author	Publication
4.	Fundamental of mechatronic	M. Jouaneh	Cengage Learning ISBN – 978-1111569020
5.	Mechatronics – An Integrated Approach	Clarence W. de Silva	CRC Press ISBN – 978-0849312748

SUGGESTED SOFTWARE/LEARNING WEBSITES:

6. https://youtu.be/Ro_tFv1iH6g
7. https://www.motioncontroltips.com/faq-what-are-stepper-drives-and-how-do-they-work/
8. https://science.howstuffworks.com/robot.htm
9. https://howtomechatronics.com/

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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.
- Heuristic Search Strategies, Local Search Algorithms.

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:

S. No.	Title of Book	Author	Publication
1	Artificial Intelligence By Example: Develop machine intelligence from scratch using real artificial intelligence use cases	Denis Rothman	Packt Publishing ISBN – 978-1788990547

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Appendix - III
Audit Courses

APPENDIX – III

AUDIT COURSES

Course Code	:	AU 102
Course Title	:	Environmental Science
Number of Credits	:	0 (L: 2, T:0; P:0)
Prerequisites (Course code)	:	High School Science
Course Category	:	AU

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

- Solar Energy: Basics of Solar energy. Flat plate collector (Liquid & Air). Theory of flat plate collector. Importance of coating. Advanced collector. Solar pond. Solar water heater, solar dryer. Solar stills.
- Biomass: Overview of biomass as energy source. Thermal characteristics of biomass as fuel. Anaerobic digestion. Biogas production mechanism. Utilization and storage of biogas.
- Wind energy: Current status and future prospects of wind energy. Wind energy in India. En-

vironmental 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, bio-medical waste.
- Metallic wastes and Non-Metallic wastes (lubricants, plastics, rubber) from industries.
- Collection and disposal: MSW (3R, principles, energy recovery, sanitary landfill), Hazardous waste
- Air quality act 2004, air pollution control act 1981 and water pollution and control act1996.
- 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:**

- C.N. R. Rao, Understanding Chemistry, Universities Press (India) Pvt. Ltd., 2011.
- Arceivala, Soli Asolekar, Shyam, Waste Water Treatment for Pollution Control and Reuse, Mc-Graw Hill Education India Pvt. Ltd., New York, 2007, ISBN:978-07-062099-5.
- Nazaroff, William, Cohen, Lisa, Environmental Engineering Science, Willy, New York, 2000, ISBN 10: 0471144940.
- Rao, C. S., Environmental Pollution Control and Engineering, New Age International Publication, 2007, ISBN: 81-224-1835-X.
- Rao, M. N.Rao, H.V.N, Air Pollution, Tata Mc-Graw Hill Publication, New delhi, 1988, ISBN: 0-07-451871-8.
- Frank Kreith, Jan F Kreider, Principles of Solar Engineering, McGraw-Hill, New York ; 1978, ISBN: 9780070354760.
- Aldo Vieira, Da Rosa, Fundamentals of renewable energy processes, Academic Press Oxford, UK; 2013. ISBN: 9780123978257.
- Patvardhan, A.D, Industrial Solid Waste, Teri Press, New Delhi, 2013, ISBN:978-81-7993-502-6
- Metcalf & Eddy, Waste Water Engineering, Mc-Graw Hill, New York, 2013, ISBN: 077441206.

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.whatis.techtarget.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.
5. Understand solid Waste Management, ISO 14000 & Environmental Management.

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Course Code	:	AU 202
Course Title	:	Essence of Indian Knowledge and Tradition
Number of Credits	:	0 (L: 2, T:0; P:0)
Prerequisites	:	NIL
Course Category	:	AU

Course Content:

Basic Structure of Indian Knowledge System:

(i) वेद, (ii) उन्नवेद (आयुवेद, धनुवेद, गन्धवेद, स्थानत्य आदद) (iii) वेदांग (शिक्षा, कल्न, ननरुत, व्याकरण, ज्योनतष छांद), (iv) उन्नाइग (धर्म शस्त्रि, ऱीऱांसा, नुराण, तकमिास्त्र)

- Modern Science and Indian Knowledge System
- Yoga and Holistic Health care
- Case Studies.

SUGGESTED TEXT/REFERENCE BOOKS:

S. No.	Title of Book	Author	Publication
1.	Cultural Heritage of India-Course Material	V. Sivaramakrishna	Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014
2.	Modern Physics and Vedant	Swami Jitatmanand	Bharatiya Vidya Bhavan
3.	The wave of Life	Fritzof Capra	
4.	Tao of Physics	Fritzof Capra	
5.	Tarkasangraha of Annam Bhatta, Inernational	V N Jha	Chinmay Foundation, Velliarnad, Amaku,am
6.	Science of Consciousness Psychotherapy and Yoga Practices	RN Jha	Vidyanidhi Prakasham, Delhi, 2016

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Course Code	:	AU302
Course Title	:	Indian Constitution
Number of Credits	:	0 (L: 2, T:0; P:0)
Prerequisites (Course code)	:	None
Course Category	:	AU

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:

S. No.	Title of Book	Author	Publication
1.	Ethics and Politics of the Indian Constitution	Rajeev Bhargava	Oxford University Press, New Delhi, 2008
2.	The Constitution of India	B.L. Fadia	Sahitya Bhawan; New edition (2017)
3.	Introduction to the Constitution of India	DD Basu	Lexis Nexis; Twenty-Third 2018 edition

Suggested Software/Learning Websites:

a. https://www.constitution.org/cons/india/const.html
b. http://www.legislative.gov.in/constitution-of-india
c. https://www.sci.gov.in/constitution
d. https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/

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Appendix - IV
Student Induction Program

APPENDIX – IV
STUDENT INDUCTION PROGRAM

The students will have to undergo a mandatory induction program as part of their Diploma Programme Curriculum 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.

Time	Activity	Students' Group	Venue
Whole day	Students arrive - Hostel allotment	I & II	
DAY 1			
9.30 am – 10.45 am	Mentor-mentee groups - Introduction within group.	I	Suitable Venue as per number of mentor-mentee groups
	Screening of Institute Documentary Movie; video clips of various functions and events	II	Conference/Seminar Hall
11.00 am – 12.15 pm	Mentor-mentee groups - Introduction within group.	II	Suitable Venue as per number of mentor-mentee groups
	Screening of Institute Documentary Movie; video clips of various functions and events	I	Conference/Seminar Hall
12.30 pm – 2.30 pm	Lunch	I & II	Respective Hostels
3.30 pm – 5.30 pm	Institute Excursion	I & II	Around the Campus
5.30 pm – 9.30 pm	Rest and Dinner	I & II	Respective Hostels
DAY 2			
6:00 am	Wake up call	I & II	Respective Hostels
6:30 am -7:20 am	Physical activity (mild exercise/yoga)	I & II	Sports Ground
7.30 am -9.20 am	Bath, Breakfast etc.	I & II	Respective Hostels
9.30 am – 12.30 pm	Presentation cum Interactive Session with: Important Institution Functionaries like Principal, HoDs etc.	I	Conference/Seminar Hall
	Visit to Respective Departments	II	Respective Departments
12.30 pm – 2.30 pm	Lunch	I & II	Respective Hostels
2.30 pm – 5.30 pm	Presentation cum Interactive Session with: Important Institution Functionaries like Principal, HoDs etc.	II	Conference/Seminar Hall
	Visit to Respective Departments	I	Respective Departments
DAY 3			
6:00 am	Wake up call	I & II	Respective Hostels
6:30 am -7:20 am	Physical activity (mild exercise/yoga)	I & II	Sports Ground
7.30 am -9.20 am	Bath, Breakfast etc.	I & II	Respective Hostels
9.30 am – 10.30 am	Diagnostic test (for English)	I & II	Suitable venue as per strength of students

10.30 am – 11.00 am	Break	I & II	
11.00 am – 12.30 pm	Universal Human Values	I (Section wise-)	Suitable venue as per number of sections
	Creative Arts / Technical Workshops / Proficiency Modules	II (Section wise)	Suitable venue as per number of sections
12.30 pm – 2.30 pm	Lunch	I & II	Respective Hostels
2.30 pm – 4.00 pm	Universal Human Values	II (Section wise-)	Suitable venue as per number of sections
	Creative Arts / Technical Workshops / Proficiency Modules	I (Section wise)	Suitable venue as per number of sections
4.00 pm – 4.30 pm	Break	I & II	
4.30 pm – 6.30 pm	Lecture Sessions or Films on Universal Human Values / Cultural / Talent hunt Activities / Performances by Classical or folk artists	II	Conference/Seminar Hall
	Sports & Games	I	Sports Ground
2.30 pm – 6.30 pm	Local visits	02/03 sections (by rotation)	Historical places in and around the area
6.30 pm – 9.30 pm	Rest and Dinner	I & II	Respective Hostels
DAY 4			
6:00 am	Wake up call	I & II	Respective Hostels
6:30 am - 7:20 am	Physical activity (mild exercise/yoga)	I & II	Sports Ground
7.30 am - 9.20 am	Bath, Breakfast etc.	I & II	Respective Hostels
9.30 am – 10.30 am	Universal Human Values	I (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	II	Conference/Seminar Hall
10.30 am – 11.00 am	Break	I & II	
11.00 am – 12.00 pm	Creative Arts / Technical Workshops / Proficiency Modules	I (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	II	Conference/Seminar Hall
12.30 pm – 2.30 pm	Lunch Break	I & II	Respective Hostels
2.30 pm – 3.30 pm	Universal Human Values	II (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	I	Conference/Seminar Hall

3.30 pm – 4.30 pm	Creative Arts / Technical Workshops / Proficiency Modules	II (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	I	Conference/Seminar Hall
4.30 pm – 5.00 pm	Break	I & II	
5.00 pm – 7.00 pm	Lecture Sessions or Films on Universal Human Values / Cultural / Talent hunt Activities / Performances by Classical or folk artists	II	Conference/Seminar Hall
	Sports & Games	I	Sports Ground
2.30 pm – 7.00 pm	Local visits	02/03 sections (by rotation)	Historical places in and around the area
7.00 pm – 9.30 pm	Rest and Dinner	I & II	Respective Hostels
DAY 5			
6:00 am	Wake up call	I & II	Respective Hostels
6:30 am -7:20 am	Physical activity (mild exercise/yoga)	I & II	Sports Ground
7.30 am -9.20 am	Bath, Breakfast etc.	I & II	Respective Hostels
9.30 am – 10.30 am	Universal Human Values	II (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	I	Conference/Seminar Hall
10.30 am – 11.00 am	Break	I & II	
11.00 am – 12.00 pm	Creative Arts / Technical Workshops / Proficiency Modules	II (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	I	Conference/Seminar Hall
12.30 pm – 2.30 pm	Lunch Break	I & II	Respective Hostels
2.30 pm – 3.30 pm	Universal Human Values	I (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	II	Conference/Seminar Hall
3.30 pm – 4.30 pm	Creative Arts / Technical Workshops / Proficiency Modules	I (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	II	Conference/Seminar Hall
4.30 pm – 5.00 pm	Break	I & II	

5.00 pm – 7.00 pm	Lecture Sessions or Films on Universal Human Values / Cultural / Talent hunt Activities / Performances by Classical or folk artists (coordinated by Students' Clubs and Technical Societies)	I	Conference/Seminar Hall
	Sports & Games	II	Sports Ground
2.30 pm – 7.00 pm	Local visits	02/03 sections (by rotation)	Historical places in and around the area
7.00 pm – 9.30 pm	Rest and Dinner	I & II	Respective Hostels
DAY 6			
6:00 am	Wake up call	I & II	Respective Hostels
6:30 am -7:20 am	Physical activity (mild exercise/yoga)	I & II	Sports Ground
7.30 am -9.20 am	Bath, Breakfast etc.	I & II	Respective Hostels
9.30 am – 10.30 am	Universal Human Values	I (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	II	Conference/Seminar Hall
10.30 am – 11.00 am	Break	I & II	
11.00 am – 12.00 pm	Creative Arts / Technical Workshops / Proficiency Modules	I (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	II	Conference/Seminar Hall
12.30 pm – 2.30 pm	Lunch Break	I & II	Respective Hostels
2.30 pm – 3.30 pm	Universal Human Values	II (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	I	Conference/Seminar Hall
3.30 pm – 4.30 pm	Creative Arts / Technical Workshops / Proficiency Modules	II (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	I	Conference/Seminar Hall
4.30 pm – 5.00 pm	Break	I & II	
5.00 pm – 7.00 pm	Lecture Sessions or Films on Universal Human Values / Cultural / Talent hunt Activities / Performances by Classical or folk artists (coordinated by Students' Clubs and Technical Societies)	II	Conference/Seminar Hall
	Sports & Games	I	Sports Ground

2.30 pm – 7.00 pm	Local visits	02/03 sections (by rotation)	Historical places in and around the area
7.00 pm – 9.30 pm	Rest and Dinner	I & II	Respective Hostels
DAY 7			
6:00 am	Wake up call	I & II	Respective Hostels
6:30 am -7:20 am	Physical activity (mild exercise/yoga)	I & II	Sports Ground
7.30 am -9.20 am	Bath, Breakfast etc.	I & II	Respective Hostels
9.30 am – 10.30 am	Universal Human Values	II (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	I	Conference/Seminar Hall
10.30 am – 11.00 am	Break	I & II	
11.00 am – 12.00 pm	Creative Arts / Technical Workshops / Proficiency Modules	II (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	I	Conference/Seminar Hall
12.30 pm – 2.30 pm	Lunch Break	I & II	Respective Hostels
2.30 pm – 3.30 pm	Universal Human Values	I (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	II	Conference/Seminar Hall
3.30 pm – 4.30 pm	Creative Arts / Technical Workshops / Proficiency Modules	I (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	II	Conference/Seminar Hall
4.30 pm – 5.00 pm	Break	I & II	
5.00 pm – 7.00 pm	Lecture Sessions or Films on Universal Human Values / Cultural / Talent hunt Activities / Performances by Classical or folk artists (coordinated by Students' Clubs and Technical Societies)	I	Conference/Seminar Hall
	Sports & Games	II	Sports Ground
2.30 pm – 7.00 pm	Local visits	02/03 sections (by rotation)	Historical places in and around the area
7.00 pm – 9.30 pm	Rest and Dinner	I & II	Respective Hostels
DAY 8			
6:00 am	Wake up call	I & II	Respective Hostels

6:30 am -7:20 am	Physical activity (mild exercise/yoga)	I & II	Sports Ground
7.30 am -9.20 am	Bath, Breakfast etc.	I & II	Respective Hostels
9.30 am – 10.30 am	Universal Human Values	I (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	II	Conference/Seminar Hall
10.30 am – 11.00 am	Break	I & II	
11.00 am – 12.00 pm	Creative Arts / Technical Workshops / Proficiency Modules	I (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	II	Conference/Seminar Hall
12.30 pm – 2.30 pm	Lunch Break	I & II	Respective Hostels
2.30 pm – 3.30 pm	Universal Human Values	II (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	I	Conference/Seminar Hall
3.30 pm – 4.30 pm	Creative Arts / Technical Workshops / Proficiency Modules	II (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	I	Conference/Seminar Hall
4.30 pm – 5.00 pm	Break	I & II	
5.00 pm – 7.00 pm	Lecture Sessions or Films on Universal Human Values / Cultural / Talent hunt Activities / Performances by Classical or folk artists (coordinated by Students' Clubs and Technical Societies)	II	Conference/Seminar Hall
	Sports & Games	I	Sports Ground
2.30 pm – 7.00 pm	Local visits	02/03 sections (by rotation)	Historical places in and around the area
7.00 pm – 9.30 pm	Rest and Dinner	I & II	Respective Hostels
DAY 9			
6:00 am	Wake up call	I & II	Respective Hostels
6:30 am -7:20 am	Physical activity (mild exercise/yoga)	I & II	Sports Ground
7.30 am -9.20 am	Bath, Breakfast etc.	I & II	Respective Hostels

9.30 am – 10.30 am	Universal Human Values	II (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	I	Conference/Seminar Hall
10.30 am – 11.00 am	Break	I & II	
11.00 am – 12.00 pm	Creative Arts / Technical Workshops / Proficiency Modules	II (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	I	Conference/Seminar Hall
12.30 pm – 2.30 pm	Lunch Break	I & II	Respective Hostels
2.30 pm – 3.30 pm	Universal Human Values	I (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	II	Conference/Seminar Hall
3.30 pm – 4.30 pm	Creative Arts / Technical Workshops / Proficiency Modules	I (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	II	Conference/Seminar Hall
4.30 pm – 5.00 pm	Break	I & II	
5.00 pm – 7.00 pm	Lecture Sessions or Films on Universal Human Values / Cultural / Talent hunt Activities / Performances by Classical or folk artists (coordinated by Students' Clubs and Technical Societies)	I	Conference/Seminar Hall
	Sports & Games	II	Sports Ground
2.30 pm – 7.00 pm	Local visits	02/03 sections (by rotation)	Historical places in and around the area
7.00 pm – 9.30 pm	Rest and Dinner	I & II	Respective Hostels
DAY 10			
6:00 am	Wake up call	I & II	Respective Hostels
6:30 am -7:20 am	Physical activity (mild exercise/yoga)	I & II	Sports Ground
7.30 am -9.20 am	Bath, Breakfast etc.	I & II	Respective Hostels
9.30 am – 10.30 am	Universal Human Values	I (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	II	Conference/Seminar Hall
10.30 am – 11.00 am	Break	I & II	

11.00 am – 12.00 pm	Creative Arts / Technical Workshops / Proficiency Modules	I (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	II	Conference/Seminar Hall
12.30 pm – 2.30 pm	Lunch Break	I & II	Respective Hostels
2.30 pm – 3.30 pm	Universal Human Values	II (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	I	Conference/Seminar Hall
3.30 pm – 4.30 pm	Creative Arts / Technical Workshops / Proficiency Modules	II (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	I	Conference/Seminar Hall
4.30 pm – 5.00 pm	Break	I & II	
5.00 pm – 7.00 pm	Lecture Sessions or Films on Universal Human Values / Cultural / Talent hunt Activities / Performances by Classical or folk artists (coordinated by Students' Clubs and Technical Societies)	II	Conference/Seminar Hall
	Sports & Games	I	Sports Ground
2.30 pm – 7.00 pm	Local visits	02/03 sections (by rotation)	Historical places in and around the area
7.00 pm – 9.30 pm	Rest and Dinner	I & II	Respective Hostels
DAY 11			
6:00 am	Wake up call	I & II	Respective Hostels
6:30 am -7:20 am	Physical activity (mild exercise/yoga)	I & II	Sports Ground
7.30 am -9.20 am	Bath, Breakfast etc.	I & II	Respective Hostels
9.30 am – 10.30 am	Universal Human Values	II (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	I	Conference/Seminar Hall
10.30 am – 11.00 am	Break	I & II	
11.00 am – 12.00 pm	Creative Arts / Technical Workshops / Proficiency Modules	II (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	I	Conference/Seminar Hall
12.30 pm – 2.30 pm	Lunch Break	I & II	Respective Hostels

2.30 pm – 3.30 pm	Universal Human Values	I (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	II	Conference/Seminar Hall
3.30 pm – 4.30 pm	Creative Arts / Technical Workshops / Proficiency Modules	I (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	II	Conference/Seminar Hall
4.30 pm – 5.00 pm	Break	I & II	
5.00 pm – 7.00 pm	Lecture Sessions or Films on Universal Human Values / Cultural / Talent hunt Activities / Performances by Classical or folk artists (coordinated by Students' Clubs and Technical Societies)	I	Conference/Seminar Hall
	Sports & Games	II	Sports Ground
2.30 pm – 7.00 pm	Local visits	02/03 sections (by rotation)	Historical places in and around the area
7.00 pm – 9.30 pm	Rest and Dinner	I & II	Respective Hostels
DAY 12			
6:00 am	Wake up call	I & II	Respective Hostels
6:30 am -7:20 am	Physical activity (mild exercise/yoga)	I & II	Sports Ground
7.30 am -9.20 am	Bath, Breakfast etc.	I & II	Respective Hostels
9.30 am – 10.30 am	Universal Human Values	I (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	II	Conference/Seminar Hall
10.30 am – 11.00 am	Break	I & II	
11.00 am – 12.00 pm	Creative Arts / Technical Workshops / Proficiency Modules	I (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	II	Conference/Seminar Hall
12.30 pm – 2.30 pm	Lunch Break	I & II	Respective Hostels
2.30 pm – 3.30 pm	Universal Human Values	II (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	I	Conference/Seminar Hall
3.30 pm – 4.30 pm	Creative Arts / Technical Workshops / Proficiency Modules	II (Section wise)	Suitable venue as per number of sections
	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	I	Conference/Seminar Hall

4.30 pm – 5.00 pm	Break	I & II	
6.00 pm – 8.00 pm	Talent Show and Valedictory Function Principal's Address	I & II	Suitable venue (indoor/ outdoor)
8.00 pm – 9.30 pm	Rest and Dinner	I & II	Respective Hostels

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
1.	Visits to different departments and around the campus	HoDs
2.	Physical/Sports activities in the Sports Ground (Morning as well as Evening)	In charge of Physical Education / Sports
3.	• Creative Arts / Technical Workshops. • Lecture Sessions or Films on Universal Human Values / Cultural / Talent hunt Activities / Performances by Classical or folk artists. • Talent Show and Valedictory Function.	In charge of Technical / Cultural activities
4.	Presentation cum Interactive Session with Eminent Alumni/Eminent Speaker	Training & Placement In charge
5.	Universal Human Values	Suitable Faculty members
6.	Proficiency Module (English)	Faculty of English language
7.	Local Visits	Hostel Wardens / Discipline in charge
8.	• Wake up call/Hostel related activities • Arrangements at Valedictory Function	Chief Wardens (Boys/Girls)

Schedule of local visits

Dates	Sections
...	...
...	...
...	...

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.

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Appendix - V
List of Books in Hindi

APPENDIX – V

LIST OF BOOKS IN HINDI

अभातशिप द्वारा 1998 से संचालित हिन्दी की तकनीकी पाठ्यपुस्तक पुरस्कार योजना के अंतर्गत अब तक की पुरस्कृत पुस्तको एवं लेखकों की सूचीः—

क्रम सं.	लेखक का नाम	पुस्तक का नाम	प्रकाशक एवं पता	संस्करण
1.	डॉ. आई. सी. भारती	कैड कैम	दीपक प्रकाशन डी. पी. हाउस 1, दुर्गा कॉलोनी, 6 नं. चौराहा कालपी रोड, मुरार ग्वालियर (म.प्र.)—474006	2015
2.	डॉ. पंकज जैन	विपणन प्रबन्ध	एस. के. जैन एण्ड सन्स 721, खजांची सदन, बोरडी का रास्ता, किशनपोल बाजार, जयपुर—302003	2013
3.	श्री शिवानंद कामड़े	द्रव अभियांत्रिकी एवं द्रवचालित मशीनें	मैसर्स यूनिवर्सिटी बुक हाऊस (प्रा.) लि. 79, चौड़ा रास्ता, जयपुर	2015
4.	डॉ. एम.एफ. कुरैशी	वैद्युत संस्थापन तथा अनुरक्षण	दीपक प्रकाशन डी. पी. हाउस 1, दुर्गा कॉलोनी, 6 नं. चौराहा कालपी रोड, मुरार ग्वालियर (म.प्र.)—474006	2014
5.	श्री योगेन्द्र वार्ष्णेय	अभियांत्रिकी मापन एवं अनुरक्षण अभ्यास	दीपक प्रकाशन डी. पी. हाउस 1, दुर्गा कॉलोनी, 6 नं. चौराहा कालपी रोड, मुरार ग्वालियर (म.प्र.)—474006	प्रथमः 2014
6.	डॉ. पंकज जैन	वित्तीय लेखांकन	संजय पब्लिकेशन्स 73, मायापुरी कॉलोनी, पालड़ी मीणा, जयपुर—32	2014
7.	श्री देवेन्द्र कुमार	तकनीकी आरेखन	अरिहन्त प्रकाशन कालिन्दि, टी.पी. नगर, मेरठ (यूपी)—250002 0121—2401479	
8.	डॉ. एम.एस. परमार	सिले सिलाये वस्त्रों पर रासायनिक अभिक्रियायें	नॉर्दर्न इंडिया टैक्सटाईल रिसर्च एसोसिएशन सेक्टर—23, राजनगर, गाजियाबाद (उ.प्र.)—201002	प्रथम : 2011

9.	श्री डी.वी. गुप्ता	भूकम्प इंजीनियरी तथा आपदा प्रबंधन	एशियन पब्लिशर्स, 46 / 20, कम्बल वाला बाग, नई मण्डी मुजफ्फरनगर–251001	प्रथम : 2008–2009
10.	स्व. श्री बी. एल. गुप्ता श्री अमित गुप्ता	उच्च सर्वेक्षण	स्टैण्डर्ड पब्लिशर्स डिस्ट्रीब्यूटर्स 1705–बी, नई सड़क, पोस्ट बॉक्स नं. 1066, दिल्ली–110006	प्रथम : 2011
11.	डॉ. आभा गर्ग	पर्यावरण अभियांत्रिकी तथा सुरक्षा	दीपक प्रकाशन डी.पी. हाउस 1, दुर्गा कॉलोनी, 6 न. चौराहा, कालपी रोड. मुरार, ग्वालियर (म. प्र.)–474006	
12.	प्रो. एच. के. सिंह डॉ. मीरा सिंह	व्यावसायिक अर्थशास्त्र–एक प्रबंधकीय उपागम	प्रयाग पुस्तक भवन 20–ए, यूनिवर्सिटी रोड इलाहाबाद–211002	प्रथम : 2011
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