Indira Gandhi University MeerpurRewari

(A State University established under Haryana Act No.29 of 2013)

Examination Scheme & Syllabus for B.Tech (Mechanical Engineering)
Semester- 3rd&4th

OUTCOME BASED EDUCATION SYSTEM / LEARNING OUTCOME CURRICULUM FRAMEWORK OBES / LOCF,

CBCS CURRICULUM (w.e.f. 2019-20)

VISION AND MISSION OF THE DEPARTMENT

VISION

To make contribution in the development of nation and evolution of technology by creating highly ethical professionals in Mechanical Engineering who are technically competent and are aware of their social responsibilities

MISSION

- To produce highly qualified, socially responsible, ethical and motivated students having sound theoretical and practical knowledge of Mechanical Engineering as well as communicative skills who can serve the nation as well as at global level.
- To inspire students to be a part of research and development activities.
- To encourage students to participate in conferences, workshops, seminars and research activities.

Programme Outcomes (PO), B.Tech, Mechanical Engineering, Indira Gandhi University, Meerpur, Rewari

PO1	Knowledge	Capable of demonstrating comprehensive disciplinary knowledge gained during course of study.
PO2	Research Aptitude	Capability to ask relevant/ appropriate questions for identifying, formulating and analyzing the research problems and to draw conclusion from the analysis.
PO3	Communication	Ability to communicate effectively on general and scientific topics with the scientific community and with society at large.
PO4	Problem Solving	Capability of applying knowledge to solve scientific and other problems.
PO5	Individual and Team Work	Capable to learn and work effectively as an individual, and as a member or leader in diverse teams, multidisciplinary settings.
PO6	Investigation of Problems	Ability of critical thinking, analytical reasoning and research based knowledge including design of experiments, analysis and interpretation of data to provide conclusions.
PO7	Modern Tool usage	Ability to use and learn techniques, skills and modern tools for scientific practices.
PO8	Science and Society	Ability to apply reasoning to assess the different issues related to society and the consequent responsibilities relevant to the professional scientific practices.
PO9	Life-Long Learning	Aptitude to apply knowledge and skills that are necessary for participating in learning activities throughout life.
PO10	Ethics	Capability to identify and apply ethical issues related to one’s work; avoid unethical behaviour such as fabrication of data, committing plagiarism and unbiased truthful actions in all aspects of work.
PO11	Project Management	Ability to demonstrate knowledge and understanding of the latest technologies and apply these to manage projects.

Programme Educational Objectives (PEOs):

The Indira Gandhi University, has formulated the Programme Educational Objectives (PEO's) with those in fields. The Programme educational objectives (PEO) are the statement that describes the career and professional achievement after receiving the degree. The PEO's of the Bachelor degree in Mechanical Engineering are as follows:

PEO1: To impart education in Production & Industrial Engineering to have all-round development of students in order to serve the global society.

PEO2: To develop independent research attitude through projects and its administrative & financial management as well as its dissemination to the UG students

PEO3: To encourage students to be ethically and socially responsible and articulate themselves to be a lifelong learner.

Programme Specific Outcomes (PSO's):

The Programme outcomes (PSO) are the statement of competencies/ abilities. PSOs are the statement that describes the knowledge and the abilities the Under-graduate will have by the end of Programme studies.

PSO1: The detailed functional knowledge of theoretical concepts and experimental aspects of mechanical engineering.

PSO2: To integrate the gained knowledge with various contemporary and evolving areas in mechanical engineering like fluid mechanics, Computer Aided Designetc.

PSO3: An ability to independently carry out research /investigation and development work to solve practical problems.

PSO4: An ability to write and present a substantial technical report/document.

Mapping of PEO's with PO's and PSO's

S. No.	*Programme Educational Objectives*	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
1	**PEO1**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
2	**PEO2**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
3	**PEO3**	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic ScienceCourses
ESC	EngineeringScienceCourses
HSMC	Humanities and Social Sciences includingManagementcourses
PCC	Professional Core Courses
LC	Laboratory Courses
MC	Mandatory Courses
PT	Practical Training
S	Seminar

Seminar

Max.Marks-25

Every candidate will have to deliver a seminar of 30 minutes duration on a topic (not from the syllabus) which will be chosen by him / her in consultation with the teacher of the department. The seminar will be delivered before the students and teachers of the department. A three member committee (one coordinator and two teachers of the department of different branches) duly approved by the departmental council will be constituted to evaluate the seminar. The following factors will be taken into consideration while evaluating the candidate.

Distribution of marks will be as follows:

1. Presentation 10 marks
2. Depth of the subject matter 10 marks
3. Answers to the questions 05 marks

Indira Gandhi University, Meerpur, Rewari Scheme of Examination for Semester III
(Second Year) B.Tech (MECHANICAL ENGINEERING)w.e.f. 2019-20

Sr. No.	Category Course Notation	Course Code	Course Title	Hours per week			Total Contact hrs/week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
				L	T	P			Mark of Classwork	Theory	Practical	Total	
1	Basic Science course	BSC-ME-201	Physics II(Optics& Waves)	3	0	0	3	3	25	75		100	3
2	Basic Science course	BSC-ME-203	Mathematics-III	3	1	0	4	4	25	75		100	3
3.	Basic Science course	BSC-BIO-205	Biology	2	1	0	3	3	25	75		100	3
4.	Engineering Science course	ESC-ECE-207	Basics of Electronics Engg.	2	0	0	2	2	25	75		100	3
5.	Engineering Science course	ESC-ME-209	Engineering Mechanics	3	0	0	3	3	25	75		100	3
6.	Engineering Science course	ESC-ME-211	Basics of Mechanical Engg.	2	0	0	2	2	25	75		100	3
7.	Professional Core courses	PCC-ME-213	Thermodynamics	3	1	0	4	4	25	75		100	3
8.	Engineering Science course	LC-ME-215	Basics of Mechanical Engg. lab	0	0	2	2	1	25		25	50	3
9			Seminar				-	1	-	-	-	25	-
TOTAL CREDIT								**23**				**775**	

Indira Gandhi University, Meerpur, Rewari Scheme of Examination for Semester IV
(Second Year) B.Tech.(MECHANICAL ENGINEERING)w.e.f. 2019-20

Sr. No.	Category Course Notation	Course Code	Course Title	Hours per week			Total Contact hrs/week	Credit	Examination Schedule(Marks)				Duration of Exam (Hours)
				L	T	P			Mark of Class work	Theory	Practical	Total	
1	Professional Core courses	PCC-ME-202	Applied Thermodynamics	3	1	0	4	4	25	75		100	3
2	Professional Core courses	PCC- ME-204	Fluid Mechanics	3	1	0	4	4	25	75		100	3
3	Professional Core courses	PCC- ME-206	Strength of materials	3	1	0	4	4	25	75		100	3
4	Professional Core courses	PCC- ME-208	Materials Engineering	3	0	0	3	3	25	75		100	3
5	Professional Core courses	PCC- ME-210	Instrumentation& Control	3	0	0	3	3	25	75		100	3
6	Professional Core courses	LC- ME-212	Applied ThermodynamicsLab	0	0	2	2	1	25		25	50	3
7	Professional Core courses	LC- ME-214	SOM Lab	0	0	2	2	1	25		25	50	3
8	Professional Core courses	LC- ME-216	Fluid MechanicsLab	0	0	2	2	1	25		25	50	3
9	Professional Core courses	LC- ME-218	Materials Lab	0	0	2	2	1	25		25	50	3
10	Professional Core courses	LC- ME-220	InstrumentationLab	0	0	2	2	1	25		25	50	3
11	Mandatory course	*MC-106	Environment Science	3	0	1	-		25	75		-	4
12			Seminar				-	1	-	-	-	25	-
							TOTAL CREDIT	**24**				**775**	

*__MC-106__ is a mandatory non –credit course in which the students will be requiredpassing marks in theory.

NOTE: At the end of 4th semester each student has to undergo Practical Training of 4/6 weeks in an Industry/ Institute/ Professional Organization/ Research Laboratory/ training centre etc. and submit typed report along with a certificate from the organization & its evaluation shall be carried out in the 5th Semester.

Course code	**BSC-ME- 201**				
Category	Basic Science course				
Course title	**Physics-II (Optics and Waves)**				
Scheme and Credits	L	T	P	**Credits**	Semester-III
	3	0	0	3	
Objectives:	➢ To acquire skills allowing the student to identify and apply formulas of optics and wave physics using course literature ➢ To be able to identify and illustrate physical concepts and terminology used in optics and to be able to explain them in appropriate detail. ➢ To be able to make approximate judgements about optical and other wave phenomena when necessary				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-1

Simple harmonic motion, damped and forced simple harmonic oscillator,Mechanical and electrical simple harmonic oscillators, differential equation of simple harmonic motion, damped harmonic oscillator , quality factor, forced mechanical andelectrical oscillators, steady state motion of forced damped harmonic oscillator.

UNIT-2

Sinusoidal waves (concept of frequency and wavelength), types of waves, the one dimensional wave, transverse vibrations of stretched strings. Longitudinal sound wave in solid, The matrix method in paraxial optics (unit plane and nodal plane) wave group and group velocity, Fermat's principle and its applications (mirage effect, laws of reflection and refraction), Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle and total internal reflection.

UNIT-3

Wave optics

Huygen's principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting, Young's double slit experiment, Newton's rings, Michelson interferometer, Fraunhofer's diffraction from a single slit, the Rayleigh criterion for limit of just resolution and its application to vision, Diffraction grating (Transmission), its dispersive and resolving power.

UNIT-4

Lasers

Stimulated and spontaneous emission, Einstein's theory of matter-radiation interaction, Einstein's coefficients, amplification of light by population inversion, Pumping in lasers, three and four level laser systems, different types of lasers: gas lasers (He-Ne, CO_2), solid-state lasers (Ruby, Neodymium), Properties of laser beams: mono-chromaticity, coherence, directionality and intensity, laser speckles, applications of lasers in science, engineering and medicine.

Course Outcomes:

CO1 To introduce the concept of Simple harmonic motion.
CO2 To describe the factors steady state motion of forced damped harmonic oscillator.
CO3 To apply the concept of matrix method in paraxial optics.
CO4 To impart knowledge of mono-chromaticity.
CO5 To know about the Michelson interferometer.
CO6 To instruct about the amplification of light by population inversion.
CO7 To explain the mechanism of Diffraction grating.
CO8 Gained knowledge about applications of lasers in science.

Mapping of Paper No. **BSC-ME- 201**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO3	M	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	M	S	S	M	S	S	S	S	S	S
CO6	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO7	S	S	S	M	S	S	M	S	S	S	S	S	S	S	S
CO8	S	S	S	M	S	S	M	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

References:

1. I. G. Main, “Vibrations and waves in physics”, Cambridge University Press, 1993.
2. Engineering Physics: Theory and Practical, 2ed by Katiyar, Wiley India Ltd
3. H. J. Pain, “The physics of vibrations and waves”, Wiley, 2006.
4. E. Hecht, “Optics”, Pearson Education, 2008.
5. A. Ghatak, “Optics”, McGraw Hill Education, 2012.
6. O. Svelto, “Principles of Lasers”, Springer Science & Business Media, 2010.

Course code	**BSC-ME- 203**				
Category	Basic Science course				
Course title	**Mathematics III** **(PDE, Probability & Statistics)**				
Scheme and Credits	L	T	P	**Credits**	Semester-III
	3	1	0	4	
Objectives:	(1) To introduce the solution methodologies for second order Partial Differential Equations with applications inengineering (2) To provide an overview of probability and statistics to engineers				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second- order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation;

UNIT-II

Duhamel's principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variables.

UNIT-III

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

Continuous random varibales and their properties, distribution functions and densities, normal, exponential and gamma densities.Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

UNIT-IV

Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and

Normal - evaluation of statistical parameters for thesethree distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio ofvariances – Chisquare test for goodness of fit and independence of attributes.

Course Outcomes:

CO1 To introduce the concept of Partial Differential Equations.
CO2 To describe the D'Alembert's solution of the wave equation.
CO3 To apply the concept of Duhamel's principle for one dimensional wave equation.
CO4 To impart knowledge of One dimensional diffusion equation and its solution by separation of variables.
CO5 To know about the Measures of Central tendency.
CO6 To instruct about the Probability distributions.
CO7 To explain the Probability spaces.
CO8 Gained knowledge about Probability & Statistics.

Mapping of Paper No. **BSC-ME- 203**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	M	S	S	S	S	M	S	S	S	S	M
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S
CO3	S	S	S	M	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	M	S	S	M	S	S	S	S	S	S
CO6	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO7	M	S	S	S	S	S	M	S	S	S	S	S	S	S	S
CO8	S	S	S	M	S	S	M	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Textbooks/References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications,Reprint, 2010.
3. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall,2003 (Reprint).
4. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
5. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
6. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications,Reprint, 2010.
7. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall,2003 (Reprint).
8. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

Course code	**BSC-BIO-205**				
Category	Basic Science Course				
Course title	**Biology**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-III/ V/ VII**
	2	**1**		**3**	
Branches (B. Tech.)	**All Branches**				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Objectives

1. To convey that Biology as an important scientific discipline.
2. To convey that "Genetics is to biology what Newton's laws are to Physical Sciences"
3. To convey that all forms of life has the same building blocks and yet the manifestationsare as diverse as one can imagine
4. The molecular basis of coding and decoding genetic information is universal.
5. How to analyse biological processes at the reductionist level

UNIT – I

Introduction to living world: Concept and definition of Biology; Aspect of biology. Need to study biology. Characteristic features of living organisms; Cell theory, Structure of Prokaryotic and Eukaryotic cell. Distinguish between animal and plant cell.Concept of single celled organisms,Ecological aspects of single celled organisms, Types of microbes and their important properties. Economic importance of microbes.

Genetics : Mendel's laws of inheritance, Concept of allele. Concepts of recessiveness anddominance . Gene interaction , Epistasis.

Cell division- Mitosis and Meiosis. Evidence of nucleic acid as a genetic material. Concept ofgenetic code, Central Dogma.

UNIT – II

Introduction to Biomolecules: Definition, structure and important functions of carbohydrates (glucose, fructose, disaccharides, starch and cellulose), lipids (phospholipid, cholesterol), Amino acids. Proteins- structure and function. Primary secondary, tertiary and quaternary structure.

Nucleic acid- Structure of DNA and RNA, types of RNA, Watson and Crick model of DNA

UNIT – III

Introduction to Genetic Engineering: Concept of genetic engineering. Tools used in recombinant DNA Technology. Restriction enzymes and DNA modifying enzymes, ligases. Gene cloning; plasmid vector. Transgenic plants and animals

UNIT – IV

Applications of Biotechnology: Applications of biotechnology in Agriculture, Medicine, Environment (sewage treatment), enzyme technology.

Course Outcomes:

CO1 To introduce the concept of Concept and definition of Biology.
CO2 To describe the Mendel's laws of inheritance.
CO3 To apply the concept of Watson and Crick model of DNA.
CO4 To impart knowledge of Amino acids. Proteins- structure and function.
CO5 To know about the Concept of genetic engineering.
CO6 To instruct about the Gene cloning.
CO7 To explain the Applications of biotechnology in Agriculture.
CO8 Gained knowledge about Medicine, Environment.

Mapping of Paper No. **BSC-BIO-205**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	M	S	S	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	S	M	S	S	S	S	S	S
CO6	S	S	S	S	S	S	S	S	S	S	M	S	S	S	S
CO7	S	S	S	M	S	S	M	S	S	S	S	S	S	S	S
CO8	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

References:

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M,
2. L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
3. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H. John Wileyand Sons
4. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freemanand Company
5. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R. W.H. Freeman andcompany, Distributed by Satish Kumar Jain for CBS Publisher
6. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C.Brown Publishers
7. Campbell, NA and Reece JB, Biology, International edition, 7th edition or later, BenjaminCummings, New York (2007 or later)
8. Karp, G, Cell and Molecular Biology: Concepts and Experiments, 7th edition, Wiley, NewYork (2013).
9. Biology for Engineers by Wiley Editorial team.

Course code	**ESC-ECE-207**				
Category	Engineering Science course				
Course title	**Basics of Electronic Engineering**				
Scheme and Credits	L	T	P	**Credits**	Semester-III
	2	0	0	2	
Objectives:	To provide an overview of electronic device components to Mechanical engineering students.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Semiconductor Devices and Applications: Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a singlestage CE amplifier, frequency response and bandwidth.

UNIT-II

Operational amplifier and its applications: Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical op-amp IC 741, inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator.

UNIT-III

Timing Circuits and Oscillators: RC-timing circuits, IC 555 and its applications as astable and mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phaseshift and Wein bridge oscillator.

UNIT-IV

Digital Electronics Fundamentals: Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K-map, Logic ICs, half and full adder/subtractor, multiplexers, de-multiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.

Electronic Communication Systems: The elements of communication system, IEEE frequencyspectrum, Transmission media: wired and wireless, need of modulation, AM and FM modulation
schemes, Mobile communication systems: cellular concept and block diagram of GSM system.

Course Outcomes:

CO1 To introduce the concept of Semiconductor Devices.
CO2 To describe the frequency response and bandwidth.
CO3 To apply the concept of operational amplifiers.
CO4 To impart knowledge of comparator, integrator and differentiator.
CO5 To know about the R -C phaseshift and Wein bridge oscillator.
CO6 To instruct about the Truth tables.
CO7 To explain the Block diagram of microprocessor/microcontroller.
CO8 Gained knowledge about block diagram of GSM system.

Mapping of Paper No. **ESC-ECE-207**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	M	S	S	S	S	M	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO3	M	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	M	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S	S	S	S	S	S
CO6	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO7	S	M	S	S	S	S	M	S	S	S	S	S	S	S	S
CO8	S	S	S	S	S	M	M	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Text /Reference Books:

1. Floyd ," Electronic Devices" Pearson Education 9th edition, 2012.
2. Basic Electrical and Electronics Engineering by Jagathesan, Wiley India Ltd.
3. R.P. Jain ,"Modern Digital Electronics", Tata Mc Graw Hill, 3rd Edition, 2007.
4. Frenzel, "Communication Electronics: Principles and Applications", Tata Mc Graw Hill,3rd Edition, 2001.
5. Basic Electronics engineering by Wiley Editorial team.

Course code	**ESC-ME- 209**				
Category	Basic Science course				
Course title	**Engineering Mechanics**				
Scheme and Credits	L	T	P	**Credits**	Semester-III
	3	0	0	3	
Objectives:	1. To understand the basic force system. 2. To learn about Applying principles of particle kinematics. 3. To understand the concepts of particle dynamics. 4. To Learn energy methods & momentum methods.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Introduction: Force system, dimensions and units in mechanics, laws of mechanics, vector algebra, addition and subtraction of forces, cross and dot products of vectors, momentof force about a point and axis, couple and couple moment, transfer of a force to a parallel position, resultant of a force system using vector method, Problems involving vector application

Equilibrium: Static and dynamic equilibrium, static in determinacy, general equations of equilibrium, Varingnon's theorem, Lami's theorem, equilibrium of bodies under a force system, Problems.

UNIT-II

Truss and Frames:Truss, classification of truss, assumptions in truss analysis, perfect truss,analysis of perfect plane truss using method of joints and method of sections, Problems. Centroid , Centre of mass and Centre of gravity, Determination of centroid, centre of massand centre of gravity by integration method of regular and composite figures and solid objects, Problems.

UNIT-III

Moment of Inertia: Area moment of inertia, mass moment of inertia, parallel axis and perpendicular axis theorems, radius of gyration, polar moment of inertia, product of inertia,principle axis, problem based on composite figures and solid objects.

Kinematics: Concept of rigid body, velocity and acceleration, relative velocity, translation and rotation of rigid bodies, equations of motion for translation and rotation, problems.

UNIT-IV

Particle Dynamics: Energy methods and momentum methods, Newton's laws, workenergy equation for a system of particles, linear and angular momentum equations, projectilemotion, problem.

Shear Force and Bending Moment Diagram for statically determinant beamsClassification of beams, types of loads, shear force and bending moment calculation and theirgraphical presentation, point of inflection, problem.

Course Outcomes:

CO1 To introduce the concept of laws of mechanics.
CO2 To describe Lami's theorem.
CO3 To apply the concept of centre of mass and centre of gravity
CO4 To impart knowledge of Centroid.
CO5 To know about the polar moment of inertia.
CO6 To instruct about the Concept of rigid body.
CO7 To explain the Particle Dynamics.
CO8 Gained knowledge about Shear Force and Bending Moment Diagram.

Mapping of Paper No. **ESC-ME- 209**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO2	S	S	M	S	S	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	M	S	S	M	S	S	S	S	S	S
CO6	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S
CO7	S	S	S	S	S	S	S	S	S	M	S	S	S	S	S
CO8	M	S	S	S	S	S	S	S	S	S	S	M	S	S	S

S=Strong M=Medium W=Weak

Recommended Books:-

1. Engineering Mechanics – Irving H. Shames, PHI Publication
2. Engineering Mechanics by Chandra, Wiley India Ltd.
3. Engineering Mechanics – U.C.Jindal, Galgotia Publication
4. Engineering Mechanics – A.K.Tayal, Umesh Publication.
5. Engineering Mechanics: Statics, by Meriam, Wiley India Ltd.

Course code	**ESC-ME-211**				
Category	Engineering Science courses				
Course title	**Basics of Mechanical Engineering**				
Scheme and Credits	L	T	P	**Credits**	Semester-III
	2	0	0	2	
Objectives:	1. To Learn Manufacturing Processes. 2. To Understand Basic Refrigeration & Air Conditioning Processes. 3. To Understand Hydraulic Turbines & Pumps. 4. To learn power transmission methods.				
Class work mark	25 Marks				
Practical mark	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Introduction to Commonly used Machine Tools in a Workshop: Lathe, Shaper, Planer, Milling, Drilling, Slotter, Introduction to MetalCutting. Basic concept of thermodynamicsIntroduction, States, Work, Heat, Temperature, Zeroth, 1st, 2nd and3rd law of thermodynamics,Concept of internal energy, enthalpy and entropy, Problems.

Properties of Steam & Steam Generator: Formation of steam under constant pressure, Thermodynamic properties of steam, use of steam tables, measurement of dryness fraction by throttlingcalorimeter.

UNIT-II

Refrigeration & Airconditioning: Introduction to refrigeration and air-conditioning, Rating of refrigeration machines, Coefficient of performance, simple refrigeration vapour compression cycle, Psychrometric charts and its use, Human comforts.

Hydraulic Turbines &Pumps : Introduction, Classification, Construction details and working of Pelton, Francis and Kaplan turbines, Specific speed and selection of turbines, Classification of water pumps and their working.

UNIT-III

Power Transmission Methods and Devices : Introduction to Power transmission, Belt, Rope, Chain and Gear drive, Types and functioning of clutches.

Stresses and Strains: Introduction, Concept & types of stresses and strains, Poison's ratio, stresses and strains in simple and compound bars under axial loading, flexure & torsional loading, Stress-strain diagrams. Hook's law, Elastic constants & their relationships.

UNIT-IV

Introduction to Manufacturing Systems, Fundamentals of Numerical Control (NC). Advantage of NCsystems, Classifications of NC, Comparison of NC and CNC.

Course Outcomes:

CO1 To introduce the Thermodynamic properties of steam.
CO2 To describe the Concept of internal energy, enthalpy and entropy.
CO3 To apply the concept of refrigeration.
CO4 To impart knowledge of Hydraulic Turbines &Pumps.
CO5 To know about the Stress-strain diagrams.
CO6 To instruct about the Power transmission.
CO7 To explain the Fundamentals of Numerical Control (NC.
CO8 Gained knowledge about NC and CNC.

Mapping of Paper No. **ESC-ME-211**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	S	S	M	S	S	M	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	M	S	M	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	M	S	S	M	S	S	S	S	S	S	S	S	S
CO6	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S
CO7	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S
CO8	M	S	S	M	S	S	M	S	S	S	S	S	S	S	M

S=Strong M=Medium W=Weak

Text Books :

1. Elements of Mechanical Engineering- R.K. Rajput Laxmi Pub.,Delhi.
2. Elements of Mechanical Engineering by Kittur, Wiley India Ltd.
3. Elements of Mechanical Engineering- D.S. Kumar, S.K. Katariaand Sons
4. Engineering Thermodynamics - P.K. Nag TMH, New Delhi.
5. Basic Mechanical Engineering by Agarwal, Wiley India Ltd.
6. Refrigeration & Airconditioning- Arora &Domkundwar, Dhanpat rai & Co. Pvt. Ltd.
7. Worshop Technology Volt. I & II - Hazra& Chaudhary, Asian Book Comp., New Delhi.
8. Process and Materials of Manufacture- Lindberg, R.A. Prentice Hall of India, New Delhi.
9. Principles of Manufacturing Materials and Processes- Compbell, J.S. - McGraw Hill.

Reference Books :

1. Strength of Materials- Popov, Pub. - PHI, New Delhi.
2. Hydraulic Machines- Jagdish Lal, Pub. Metropolitan, Allahabad.
3. Strength of Materials- G.H. Ryder, Pub. ELBS.
4. Hydraulic and Fluid Mechanics- Modi and Seth, Pub.- Standara Book House, New Delhi.
5. Engineering Thermodynamics- C.P. Arora, Pub. - TMH, New Delhi.
6. Refrigeration & Airconditioning- C.P. Arora, Pub. -TMH, New Delhi.
7. Manufacturing Science- Amitabha Ghosh & Ashok Kumar Malik, East-West Press.
8. Manufacturing Process and Systems- Ostwaid, Munoz, John Wiley.
9. Workshop Technology, Vol. 1, 2, & 3- Chapman, WAJ Edward Amold.
10. Mechanical Engineering Data Handbook by Pandey, Wiley India Ltd.

Course code	**PCC-ME 213**				
Category	Professional Core Courses				
Course title	**Thermodynamics**				
Scheme and Credits	L	T	P	**Credits**	
	3	1	0	4	
Objectives:	• To learn about work and heat interactions, and balance ofenergy between system and its surroundings • To learn about application of I law to various energyconversion devices • To evaluate the changes in properties of substances in variousprocesses • To understand the difference between high grade and lowgrade energies and II law limitations on energy conversion				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work-Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work.

Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law forCyclic & Non-cyclic processes; Concept of total energy E ; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy.

UNIT-II

Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gasmixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart.

UNIT-III

First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume.

Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius

statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale.

UNIT-IV

Clausius inequality; Definition of entropy S ; Demonstration that entropy S is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of s from steam tables- Principle of increase of entropy; Illustration ofprocesses in Ts coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles-Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Exergy balance equation and Exergy analysis.

Thermodynamic cycles - Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle.

Course Outcomes:

CO1 To introduce the concept of Exact & Inexact differentials.
CO2 To describe the Various Thermometers.
CO3 To apply the concept of Ideal Gases.
CO4 To impart knowledge of Mollier's chart.
CO5 To know about the Steady state steady flow processes.
CO6 To instruct about the Absolute temperature scale.
CO7 To explain the mechanism of Exergy balance equation and Exergy analysis.
CO8 Gained knowledge about Basic vapor compressioncycle

Mapping of Paper No. **PCC-ME 213**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	M	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO6	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO7	S	S	S	M	S	S	S	S	S	S	S	S	S	S	S
CO8	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Text Books:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals ofThermodynamics, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
3. Principles of Engineering Thermodynamics, SI Version, 8ed by Moran, Wiley India Ltd.
4. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics,John Wiley and Sons.
5. Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.
6. Fundamentals of Thermodynamics, 7ed, by Borgnakke, Wiley India Ltd.
7. Applications of Thermodynamics by Kadambi, Wiley India Ltd.

Course code	LC-ME-215				
Category	Engineering Science courses				
Course title	Basics of Mechanical Engg. Lab				
Scheme and Credits	L	T	P	**Credits**	
	0	0	2	1	
Objectives:	To understand various basic issues of Mechanical Engineering like IC engines, machines and mechanics of machines.				
Class work mark	25 Marks				
Practical mark	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiments

1. To study various types of boilers & also study mountings and accessories in boilers.
2. To study various types of internal Combustions Engines.
3. To calculate the Mechanical Advantage, Velocity Ratio and Efficiency of single start,Double start and Triple start worm & Worm Wheel.
4. To find the Mechanical Advantage, velocity Ratio and Efficiency of a Differential Wheeland Axle.
5. To find Moment of Inertia of a Fly Wheel.
6. Verification of reciprocal theorem of deflection using a simply supported beam.
7. Verification of moment area theorem for slopes and deflections of the beam.
8. Deflections of a truss-horizontal deflections & vertical deflections of variousjoints of a pin-jointed truss.
9. Elastic displacements (vertical & horizontal) of curved members.
10. Experimental and analytical study of 3 hinged arch and influence line forhorizontal thrust.
11. Experimental and analytical study of behavior of struts with various endconditions.
12. To determine elastic properties of a beam.
13. Experiment on a two-hinged arch for horizontal thrust & influence line forHorizontal thrust.
14. Experimental and analytical study of a 3 bar pin jointed Truss.
15. Experimental and analytical study of deflections for unsymmetrical bending of aCantilever beam.

Course Outcomes:

CO1 To introduce the concept of various types of boilers.
CO2 To describe various types of internal Combustions Engines.
CO3 To apply the concept of Moment of Inertia of a Fly Wheel.
CO4 To impart knowledge of moment area theorem for slopes and deflections of the beam.
CO5 To know about the elastic properties of a beam.
CO6 To instruct about the 3 bar pin jointed Truss.
CO7 To explain the behavior of struts with various endconditions.
CO8 Gained knowledge about Worm Wheel.

Mapping of Paper No. LC-ME-215

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	M	S	S	M	S	M	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	S	S	S	S	S	S	S
CO6	S	S	S	S	S	S	S	S	S	S	M	S	S	S	S
CO7	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S
CO8	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Course code	**PCC-ME 202**				
Category	Professional Core Courses				
Course title	**Applied Thermodynamics**				
Scheme and Credits	L	T	P	**Credits**	Semester-IV
	3	1	0	4	
Objectives:	(1) To learn about of I law for reacting systems and heating valueof fuels (2) To learn about gas and vapor cycles and their first law andsecond law efficiencies (3) To understand about the properties of dry and wet air and theprinciples of psychrometry (4) To learn about gas dynamics of air flow and steam throughnozzles (5) To learn the about reciprocating compressors with and withoutintercooling (6) To analyze the performance of steam turbines				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Introduction to solid, liquid and gaseous fuels–Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy.

UNIT-II

Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Supercritical and ultra super-critical Rankine cycle- Gas power cycles, Air standard Otto, Diesel and Dual cycles-Air standard Brayton cycle, effect of reheat, regeneration and intercooling- Combined gas and vapor power cycles- Vapor compression refrigeration cycles, refrigerants andtheir properties.

UNIT-III

Properties of dry and wet air, use of pschyrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point.

Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, super saturation compressible flow in diffusers, efficiency of nozzle and diffuser.

UNIT-IV

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.

Analysis of steam turbines, velocity and pressure compounding of steam turbines

Course Outcomes:

CO1 To introduce the concept of exhaust gas analysis.
CO2 To describe the Chemical equilibrium and equilibrium composition.
CO3 To apply the concept of Rankine cycle.
CO4 To impart knowledge of - Vapor compression refrigeration cycles.
CO5 To know about the use of ideal gas tables for isentropic flow.
CO6 To instruct about use of pschyrometric chart.
CO7 To explain the mechanism of Reciprocating compressors.
CO8 Gained knowledge about steam turbines.

Mapping of Paper No. **PCC-ME 202**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO3	M	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	M	S	M	S	S	S	S	S	M	S	S	S	S
CO5	S	S	S	M	S	M	S	S	M	S	S	S	S	S	S
CO6	M	M	S	S	S	M	S	S	S	S	S	S	S	S	M
CO7	S	S	S	M	S	S	M	S	S	S	S	S	M	S	S
CO8	S	S	S	M	S	S	M	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Text Books:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of
2. Thermodynamics, John Wiley and Sons. Jones, J. B. and Duggan, R. E., 1996, EngineeringThermodynamics, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics,John Wiley and Sons.
4. Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd

Course code	**PCC-ME-204**				
Category	Professional Core Courses				
Course title	**Fluid Mechanics**				
Scheme and Credits	L	T	P	**Credits**	Semester-IV
	3	1	0	4	
Objectives:	• To learn about the application of mass and momentum conservation laws for fluid flows • To understand the importance of dimensional analysis • To obtain the velocity and pressure variations in various typesof simple flows				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Fluid Properties and Fluid Statics: Concept of fluid and flow, ideal and real fluids, continuum concept, and properties of fluids, Newtonian and non-Newtonian fluids. Pascal's law, hydrostaticequation, hydrostatic forces on plane and curved surfaces, stability of floating and submerged bodies, relative equilibrium, Problems. Fluid Kinematics: Eulerian and Lagrangian description of fluid flow; stream, streak and path lines; types of flows, flow rate and continuity equation, differential equation of continuity in cylindrical and polar coordinates, rotation, vorticity and circulation, stream and potential functions, flow net, Problems.

UNIT-II

Fluid Dynamics: Concept of system and control volume, Euler's equation, Bernoulli's equation, venturimeter, orifices, orificemeter, mouthpieces, kinetic and momentum correction factors,Impulse momentum relationship and its applications, Problems. Compressible Fluid Flow: Introduction, continuity momentum and energy equation, sonic velocity, propagation of elastic waves due to compression of fluid, propagation of elastic waves due to disturbance in fluid, stagnation properties, isentropic flow, effect of area variation on flow properties, isentropic flow through nozzles,diffusers,injectors,Problems..

UNIT-III

Viscous Flow: Flow regimes and Reynolds's number, Relationship between shear stress and pressure gradient, uni-directional flow between stationary and moving parallel plates, movement of piston in a dashpot, power absorbed in bearings. Problems. Flow Through Pipes: Major and minor losses in pipes, Hagen-Poiseuilli law, hydraulic gradient and total energy lines, series and parallel connection of pipes, branched pipes; equivalent pipe, power transmission through pipes, Problems.

UNIT-IV

Boundary Layer Flow: Boundary layer concept, displacement, momentum and energy thickness, von-karman momentum integral equation, laminar and turbulent boundary layer flows, drag on a flat plate, boundary layer separation and control. Streamlined and bluff bodies lift and drag on a cylinder and an airfoil, Problems. Turbulent Flow: Shear stress in turbulent flow, Prandtl mixing length hypothesis, hydraulically smooth and rough pipes, velocity distribution in pipes, friction coefficients for smooth and rough pipes, Problems.

Course Outcomes:

CO1 To introduce the concept of Concept of fluid and flow.
CO2 To describe the factors of Fluid Kinematics.
CO3 To apply the concept of Bernoulli's equation.
CO4 To impart knowledge of propagation of elastic waves due to disturbance in fluid.
CO5 To know about the Reynolds's number.
CO6 To instruct about the power transmission through pipes.
CO7 To explain von-karman momentum integral equation.
CO8 Gained knowledge about friction coefficients for smooth and rough pipes.

Mapping of Paper No. **PCC-ME-204**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	S	S	S	M	S	M	S	S	S	S	S	S	M
CO3	M	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	M	S	M	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	M	S	S	M	S	S	S	S	S	S
CO6	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO7	S	S	S	M	S	S	M	S	S	S	S	S	S	S	S
CO8	S	S	S	M	S	S	M	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

TEXT BOOKS:

1. Fluid Mechanics – Streeter V L and Wylie E B, Mc Graw Hill
2. Fluid Meschanics by Munson, Wiley India Ltd
3. Mechanics of Fluids – I H Shames, Mc Graw Hill

REFERENCES BOOKS:

1. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som and G. Biswas, TMH
2. Engineering Fluid Mechanics, 10ed, bty Elger, Wiley India Ltd.
3. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar, S.K. Kataria and Sons
4. Fluid Mechanics and Machinery – S.K. Agarwal, TMH, New Delhi

Course code	**PCC-ME-206**				
Category	Professional Core Courses				
Course title	**Strength of Materials**				
Scheme and Credits	L	T	P	**Credits**	Semester-IV
	3	1	0	4	
Objectives:	• To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads • To calculate the elastic deformation occurring in various simple geometries for different types of loading				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr's circle.

UNIT-II

Beams and types transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.

UNIT-III

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems. Columns & Struts: Column under axial load, concept of instability and buckling, slenderness ratio, derivation of Euler's formulae for the elastic buckling load, Eulers,
Rankine, Gordom's formulae Johnson's empirical formula for axial loading columns and their applications, eccentric compression of a short strut of rectangular & circular sections, Numerical.

UNIT-IV

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs.
Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure.
Slope & Deflection: Relationship between bending moment, slope & deflection, Mohr's theorem, moment area method, method of integration, Macaulay's method, calculations for slope and deflection of (i) cantilevers and (ii) simply supported beams with or without overhang under concentrated load, Uniformly distributed loads or combination of concentrated and uniformly distributed loads, Numerical.

Course Outcomes:

CO1 To introduce the concept of Hooke's law.
CO2 To describe the Mohr's circle.
CO3 To apply the concept of shear force and bend moment diagrams.
CO4 To impart knowledge of Theory of bending of beams.
CO5 To know about the Moment of inertia.
CO6 To instruct about the Maxwell's reciprocal theorems.
CO7 To explain the mechanism of Torsion.
CO8 Gained knowledge about Macaulay's method.

Mapping of Paper No. **PCC-ME-206**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	S	S	S	M	M	S	S	S	S	S	S	S	S
CO3	M	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	M	S	S	M	S	S	M	S	S	S	S	S	S
CO6	S	S	S	S	S	M	S	S	S	S	M	S	S	S	M
CO7	S	S	S	M	S	S	S	S	S	S	S	S	S	S	S
CO8	S	S	S	M	S	S	M	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Text Books:

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.
2. Strength of Materials, 2ed, w/cd by Nag, Wiley India Ltd.
3. R. Subramanian, Strength of Materials, Oxford University Press, 2007.
4. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, TataMcGrawHill Publishing Co. Ltd., New Delhi 2005.

Course code	**PCC-ME-208**				
Category	Professional Core Courses				
Course title	**Materials Engineering**				
Scheme and Credits	L	T	P	**Credits**	Semester-IV
	3	0	0	3	
Objectives:	1. Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria. 2. To provide a detailed interpretation of equilibrium phase diagrams 3. Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

Mechanical Property measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yieldingand yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell,Brinell and Vickers and their relation to strength.

UNIT-II

Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracture mechanics: Introduction to Stressintensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to non-destructive testing(NDT)

UNIT-III

Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstrctural aspects of ledeburite,austenite, ferrite and cementite, cast iron.TTT-curve

UNIT-IV

Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous coolingcurves and interpretation of final microstructures and properties- austempering,martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame andinduction hardening, vacuum and plasma hardening

Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro- nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys

Course Outcomes:

CO1 To introduce the Metallic crystal structures.
CO2 To describe the generalized Hooke's law.
CO3 To apply the concept of Static failure theories.
CO4 To impart knowledge of SN curve.
CO5 To know about the Phase diagrams.
CO6 To instruct about the monotectic reactions.
CO7 To explain the Heat treatment of Steel.
CO8 Gained knowledge about Alloying of steel.

Mapping of Paper No. **PCC-ME-208**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO3	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	M	S	S	S	S	M	S	S	S	S	S	S	S
CO5	S	S	S	S	S	M	S	S	M	S	S	S	S	S	S
CO6	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO7	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S
CO8	S	S	S	M	S	S	M	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Text Books:

1. W. D. Callister, 2006, “Materials Science and Engineering-An Introduction”, 6th Edition,Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of IndiaPrivate Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, “Material Science and Engineering’, Prentice Hall of India Private Limited,1999.
4. U. C. Jindal, “Engineering Materials and Metallurgy”, Pearson, 2011.
5. DeGarmo's Materials and Processes in Manufacturing, by Black, Wiley India Ltd.

Course code	**PCC-ME-210**				
Category	Professional Core Courses				
Course title	**Instrumentation and Control**				
Scheme and Credits	L	T	P	**Credits**	Semester-IV
	3	0	0	3	
Objectives:	1. To provide a basic knowledge about measurement systems andtheir components 2. To learn about various sensors used for measurement ofmechanical quantities 3. To learn about system stability and control 4. To integrate the measurement systems with the process forprocess monitoring and control				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Measurement systems and performance – accuracy, range, resolution, error sources; Instrumentation system elements – sensors for common engineering measurements; Signal processing and conditioning;

Instruments and Their representation : Introduction, Typical Applications of Instrument Systems, Functional Elements of a Measurement System, Classification of Instruments, Standards and Calibration..

UNIT-II

Transducer Elements : Introduction, Analog and Digital Transducers, Electromechanical; Potentiometric,

Inductive Self Generating and Non-Self Generating Types, Electromagnetic, Electrodynamic, Eddy Current, Magnetostrictive, Variable Inductance, Linearly Variable Differential Transformer, Variable Capacitance, PiezoElectric Transducer and Associated Circuits, Unbonded and Bonded Resistance Strain Gages. Strain Gage Bridge circuits, Single Double and Four Active Arm Bridge Arrangements, Temperature Compensation, Balancing and Calibration, Ionisation Transducers, Mechano Electronic Transducers, Opto-Electrical Transducers, Photo Conductive Transducers, Photo Volatic Transducers, Digital Transducers, Frequency Domain Transducer, Vibrating String Transducer, Binary codes, Digital Encoders.

UNIT-III

Motion, Force and Torque Measurement : Introduction, Relative motion Measuring Devices, Electromechanical, Optical, Photo Electric, Moire-Fringe, Pneumatic, Absolute Motion Devices, Seismic Devices, Spring Mass & Force Balance Type, Calibration, Hydraulic Load Cell, Pneumatic Load Cell, Elastic Force Devices, Separation of Force Components, Electro Mechanical Methods, Strain Gage, Torque Transducer, Toque Meter. Intermediate, Indicating and Recording Elements : Introduction Amplifiers, Mechanical, Hydraulic, Pneumatic, Optical, Electrical Amplifying elements, Compensators, Differentiating and Integrating Elements.

Temperature Measurement : Introduction, Measurement of Temperature, Non Electrical Methods – Solid Rod Thermometer, Bimetallic Thermometer, Liquid-in-Glass thermometer, Pressure Thermometer, Electrical Methods – Electrical Resistance Thermometers, Semiconductor Resistance Sensors (Thermistors), Thermo–Electric Sensors, ThermocoupleMaterials, Radiation Methods (Pyrometry), Total Radiation Pyrometer, Selective Radiation Pyrometer.

UNIT-IV

Control systems – basic elements, open/closed loop, design of block diagram; control method –P, PI, PID, when to choose what, tuning of controllers; System models, transfer function and system response, frequency response; Nyquist diagrams and their use.
Practical group based project utilizing above concepts.
Pressure and Flow Measurement : Pressure & Flow Measurement, Introduction : Moderate Pressure
Measurement, Monometers, Elastic Transducer, Dynamic Effects of Connecting Tubing, High Pressure
Transducer, Low Pressure Measurement, Calibration and Testing, Quantity Meters, Positive Displacement Meters, Flow Rate Meters, Variable Head Meters, Variable Area Meters, Rotameters, Pitot-Static Tube Meter, Drag Force Flow Meter, Turbine Flow Meter, Electronic Flow Meter, Electro Magnetic Flow meter. Hot-Wire Anemometer.

Course Outcomes:

CO1 To introduce the Measurement systems and performance.
CO2 To describe the Instruments and their representation.
CO3 To apply the concept of Analog and Digital Transducers.
CO4 To impart knowledge of Binary codes.
CO5 To know about the Torque Measurement.
CO6 To instruct about the Temperature Measurement.
CO7 To explain the Control systems.
CO8 Gained knowledge about Pressure and Flow Measurement

Mapping of Paper No. **PCC-ME-210**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	S	S	S	M	S	M	S	S	S	S	S	S	M
CO3	M	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	M	S	S	M	S	S	S	S	S	S
CO6	S	S	S	S	S	M	S	S	S	S	S	S	M	S	M
CO7	S	S	S	M	S	S	M	S	S	S	S	S	S	S	S
CO8	S	S	S	M	S	S	M	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Text Books:

1. Instrumentation and control systems by W. Bolton, 2nd edition, Newnes, 200
2. Instrumentation and Process Control by Prasad, Wiley India Ltd.
3. Thomas G. Beckwith, Roy D. Marangoni, John H. Lienhard V , Mechanical Measurements(6^{th} Edition) 6th Edition, Pearson Education India, 2007
4. Gregory K. McMillan, Process/Industrial Instruments and Controls Handbook, Fifth Edition,McGraw-Hill: New York,1999.
5. Fundamentals of Industrial Instrumentation by Barua, Wiley India Ltd.

Course code	**LC-ME-212**				
Category	Professional Core Courses				
Course title	**Applied Thermodynamics Lab**				
Scheme and Credits	L	T	P	**Credits**	
	0	0	2	1	
Objectives:	1. To understand Vapour power cycles. 2. To understand steam boilers, their types and components. 3. To learn fundamentals of flow of steam through a nozzle. 4. To understand Steam turbines ,condensers and compressors.				
Class work mark	25 Marks				
Practical mark	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiments:

1. To study low pressure boilers and their accessories and mountings.
2. To study high pressure boilers and their accessories and mountings.
3. To prepare heat balance sheet for given boiler.
4. To study the working of impulse and reaction steam turbines.
5. To find dryness fraction of steam by separating and throttling calorimeter.
6. To find power output & efficiency of a steam turbine.
7. To find the condenser efficiencies.
8. To study and find volumetric efficiency of a reciprocating air compressor.
9. To study cooling tower and find its efficiency.
10. To find calorific value of a sample of fuel using Bomb calorimeter.
11. Calibration of Thermometers and pressure gauges.

Note:

1. At least eight experiments should be performed from the above list.

Course Outcomes:

CO1 To introduce the low pressure boilers.
CO2 To describe the high pressure boilers.
CO3 To apply the dryness fraction.
CO4 To impart knowledge about power output & efficiency of a steam turbine.
CO5 To know about the cooling tower.
CO6 To instruct about the Calibration of Thermometers and pressure gauges.
CO7 To explain the reciprocating air compressor.
CO8 Gained knowledge about condenser efficiencies

Mapping of Paper No. **LC-ME-212**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	M	S	S	M	S	S	S	S	S	S	S	S	S
CO3	M	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S	S	S	S	S	S
CO6	S	S	S	S	S	M	S	S	S	S	M	S	S	S	M
CO7	S	S	S	M	S	S	M	S	S	S	S	S	S	S	S
CO8	S	S	S	M	S	S	M	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Course code	**LC-ME-214**				
Category	Professional Core courses				
Course title	**Strength of MaterialsLab**				
Scheme and Credits	L	T	P	**Credits**	
	0	0	2	1	
Objectives:	1. To learn the principles of mechanics of solid and various properties of materials. 2. Able to understand the concepts of stress, strain of materials and ability to interpret the data from the experiments.				
Class work mark	25 Marks				
Practical mark	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiments:

1. To study the Brinell hardness testing machine & perform the Brinell hardnesstest.
2. To study the Rockwell hardness testing machine & perform theRockwellhardness test.
3. To study the Vickers hardness testing machine & perform the Vickershardnesstest.
4. To study the Erichsen sheet metal testing machine & perform the Erichsensheetmetal test.
5. To study the Impact testing machine and perform the Impact tests (Izod&Charpy).
6. To study the Universal testing machine and perform the tensile test.
7. To perform compression & bending tests on UTM.
8. To perform the sheer test on UTM.
9. To study the torsion testing machine and perform the torsion test.

Note:

1. At least Seven experiments are to be performed in the semester.

Course Outcomes:

CO1 To introduce the the Brinell hardness testing machine.
CO2 To describe the Rockwell hardness testing machine.
CO3 To apply the concept of Vickers hardness testing machine.
CO4 To impart knowledge of Erichsen sheet metal testing machine.
CO5 To know about the Impact testing machine.
CO6 To instruct about the Universal testing machine.
CO7 To explain the torsion testing machine.
CO8 Gained knowledge about sheer test on UTM.

Mapping of Paper No. **LC-ME-214**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	S	S	S	M	S	M	S	S	S	S	S	S	S
CO3	M	M	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	M	S	S	S	S	S	S	S	M	S
CO6	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO7	S	S	S	M	S	S	M	S	S	S	S	S	S	S	S
CO8	S	S	M	M	S	S	M	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Course code	**LC-ME-216**				
Category	Professional Core courses				
Course title	**Fluid Mechanics Lab**				
Scheme and Credits	L	T	P	**Credits**	
	0	0	2	1	
Objectives:	1. Understand the techniques and concept of stability. 2. Learning continuity and Bernoulli's equation. 3. Learn discharge measuring devices and hydraulic coefficients. 4. Knowledge of different types of pipe losses and determine the velocity profile in a pipe.				
Class work mark	25 Marks				
Practical mark	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiments:

1. To determine the coefficient of impact for vanes.
2. To determine coefficient of discharge of an orificemeter.
3. To determine the coefficient of discharge of Notch (V and Rectangular types).
4. To determine the friction factor for the pipes.
5. To determine the coefficient of discharge of venturimeter.
6. To determine the coefficient of discharge, contraction & velocity of an orifice.
7. To verify the Bernoullis Theorem.
8. To find critical Reynolds number for a pipe flow.
9. To determine the meta-centric height of a floating body.
10. To determine the minor losses due to sudden enlargement, sudden contraction and bends.
11. To show the velocity and pressure variation with radius in a forced vertex flow.
12. To verify the momentum equation.

Note:

1. **At least eight experiments are to be performed in the semester.**

Course Outcomes:

CO1 To introduce the concept of coefficient of impact for vanes.
CO2 To describe the coefficient of discharge of an orificemeter.
CO3 To apply the concept of the friction factor for the pipes.
CO4 To impart knowledge of coefficient of discharge of venturimeter.
CO5 To know about the momentum equation.
CO6 To instruct about the Bernoullis Theorem.
CO7 To explain the meta-centric height of a floating body.
CO8 Gained knowledge about coefficient of discharge, contraction & velocity of an orifice.

Mapping of Paper No. **LC-ME-216**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO3	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	M	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S
CO6	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S
CO7	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S
CO8	S	S	S	M	S	S	M	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Course code	**LC-ME-218**				
Category	Professional Core courses				
Course title	**Materials Lab**				
Scheme and Credits	L	T	P	**Credits**	
	0	0	2	1	
Objectives:	1. Learn the principles of materials science and engineering though lab investigation. 2. Understand the basics structure of materials and ability to interpret the data from the experiments.				
Class work mark	25 Marks				
Practical mark	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiments:

1. To study crystal structures of a given specimen.
2. To study crystal imperfections in a given specimen.
3. To study microstructures of metals/ alloys.
4. To prepare solidification curve for a given specimen.
5. To study heat treatment processes (hardening and tempering) of steel specimen.
6. To study microstructure of heat-treated steel.
7. To study thermo-setting of plastics.
8. To study the creep behavior of a given specimen.
9. To study the mechanism of chemical corrosion and its protection.
10. To study the properties of various types of plastics.
11. To study Bravais lattices with the help of models.
12. To study crystal structures and crystals imperfections using ball models.

Note:-

1. **At least eight experiments are to be performed in the semester.**

Course Outcomes:

CO1 To introduce the concept of crystal structures.
CO2 To describe the crystal imperfections.
CO3 To study the concept of microstructures of metals/ alloys.
CO4 To impart knowledge of solidification curve.
CO5 To know about the heat treatment processes.
CO6 To instruct about the thermo-setting of plastics.
CO7 To explain the mechanism of chemical corrosion and its protection.
CO8 Gained knowledge about creep behavior.

Mapping of Paper No. **LC-ME-218**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO3	M	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	M	S	S	M	S	S	S	S	S	S
CO6	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO7	S	S	S	M	S	S	M	S	S	S	S	S	S	S	S
CO8	S	S	S	M	S	S	M	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Course code	**LC-ME-220**				
Category	Professional Core courses				
Course title	**Instrumentation Lab**				
Scheme and Credits	L	T	P	**Credits**	
	0	0	2	1	
Objectives:	1 - To understand about the applications of measurement systems. 2 - To understand about the basics and working principle of pressure, temperature and flow measurement. 3 - Identify the different variation of measurement parameter with various input conditions. 4 - To analyze the primary, secondary and tertiary measurements. 5 - To learn about the various control devices and parts of measurement systems.				
Class work mark	25 Marks				
Practical mark	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiments :

1. To Study various Temperature Measuring Instruments
   (a) Mercury – in glass thermometer
   (b) Thermocouple
2. To study the working of Bourdon Pressure Gauge and to check the calibration of the gauge ina dead-weight pressure gauge calibration set up.
3. To study a Linear Variable Differential Transformer (LVDT) and use it in a simpleexperimental set up to measure a small displacement.
4. To measure load (tensile/compressive) using load cell on a tutor.
5. To measure torque of a rotating shaft using torsion meter/strain gauge torque transducer.
6. To measure the speed of a motor shaft with the help of non-contact type pick-ups (magneticor photoelectric).
7. To measure the stress & strain using strain gauges mounted on simply supportedbeam/cantilever beam.
8. To measure static/dynamic pressure of fluid in pipe/tube using pressure transducer/pressurecell.
9. To test experimental data for Normal Distribution using Chi Square test.
10. Vibration measurement.
11. To study various types of measurement Error.

Note:

1. **At least eight experiments are to be performed in the Semester.**

Course Outcomes:

CO1 To introduce the Temperature Measuring Instruments.
CO2 To describe the Bourdon Pressure Gauge.
CO3 To apply the concept of Linear Variable Differential Transformer (LVDT).
CO4 To impart knowledge of torque of a rotating shaft.
CO5 To know about the Vibration measurement.
CO6 To instruct about the various types of measurement Error.
CO7 To explain the Chi Square test.
CO8 Gained knowledge about Thermocouple

Mapping of Paper No. **LC-ME-220**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	M	S	S	M	S	S	S	S	S	S	S	S	M
CO3	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	M	S	S	M
CO5	S	S	S	S	S	M	S	S	M	S	S	S	S	S	S
CO6	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO7	M	S	S	S	S	S	M	S	S	S	S	S	S	S	S
CO8	S	S	S	M	S	S	M	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

ENVIRONMENTALSCIENCE

MC-106

L	T	P	Credits	Class Work : 25 Marks
3	0	1	-	Theory : 75 Marks
				Duration of Exam: 3 Hrs.
Theory 75 Marks				Field Work 25 Marks (Practical/Field visit)

Unit-1 The Multidisciplinary nature of environment studies. Definition, scope and importance.

Unit-2 Natural Resources :

Renewable and non-renewable resources : Natural resources and associated problems.

a) Forest resources : Use and over-exploitation : deforestation, case studies. Timberextraction, mining dams and their effects on forests and tribal people.
b) Water resources : Use and over-utilization of surface and ground water, floods,drought, conflicts over water, dams-benefits and problems.
c) Mineral resources : Use and exploitation, environmental effects of extracting and usingmineral resources, case studies.
d) Food resources : World food problems, changes, caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, Water logging, salinity, case studies.
e) Energy resources : Growing energy needs; renewable and non-renewable energy sources, use of alternate energy sources, case studies.
f) Land resources : Land as a resource, land degradation, man induced landslides,soil erosion and desertification.

* Role of an individual in conservation of natural resources.
* Equitable use of resources for sustainable lifestyles.

Unit-3 Ecosystems :

* Producers, consumers and decomposers.
* Energy flow in the ecosystem.
* Ecological succession.
* Food chains, food webs and ecological pyramids.
* Introduction, types, characteristic features, structure and function of the followingeco-system :

a. Forest ecosystem.
b. Grassland ecosystem.
c. Desert ecosystem.
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) (6 lectures)

Unit-4 Biodiversity and its conservation

* Introduction - Definition : Genetic, Species and ecosystem diversity.
* Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic andoption values.

* Biodiversity at global, National and local levels.
* India as a mega-diversity nation.
* Hot-spots of biodiversity.
* Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.
* Endangered and endemic species of India.
* Conservation of biodiversity : In-situ and ex-situ conservation of biodiversity.

Unit-5 Environmental pollution :

Definition, causes, effects and control measures of :

a) Air pollution.
b) Water pollution
c) Soil pollution
d) Marine pollution
e) Noise pollution
f) Thermal pollution
g) Nuclear hazards

* Solids waste management: causes, effects and control measures of urbanand industrial wastes.
* Role of an individual in prevention of pollution.
* Pollution case studies.
* Disaster management : floods, earthquake, cyclone and landslides.

(8 lectures)

Unit-6 Social issues and the Environment:

* From unsustainable to sustainable development.
* Urban problems related to energy.
* Water conservation, rain water harvesting, watershed management.
* Resettlement and rehabilitation of people : its problems and concerns casestudies.
* Environmental ethics : Issues and possible solutions.
* Climate change, global warming, acid rain, ozone layer depletion, nuclear accidentsand holocaust. Case studies.
* Wasteland reclamation.
* Consumerism and waste products.
* Environment Protection Act.
* Air (Prevention and Control of pollution) Act.
* Water (Prevention and Control of pollution) Act.
* Wildlife Protection Act.
* Forest Conservation Act.
* Issues involved in enforcement of environmental legislation.
* Public awareness. (7 lectures)

Unit-7 Human population and the Environment.

Population growth, variation among nations. Population explosion- Family Welfare Programme.Environment and human health.
Human Rights. Value Education.

HIV/AIDS.
Woman and Child Welfare
Role of Information Technology in Environment and human health.
Case Studies. (6 lectures)

Unit-8 Field Work :

* Visit to a local area to document environmental assets - river/forest/grassland/hill/mountain.
* Visit to a local polluted site-urban/Rural/ Industrial/ Agricultural.
* Study of common plants, insects, birds.

Study of simple ecosystems- pond, river, hill slopes, etc. (Field work equal to 10 lecture hours)

Course Outcomes:

CO1 To introduce the Multidisciplinary nature of environment studies.
CO2 To describe the Natural Resources.
CO3 To know about the Ecosystems.
CO4 To impart knowledge of Environmental pollution.
CO5 To know about the Biodiversity.
CO6 To instruct about the Social issues.
CO7 To explain the Human Rights.
CO8 Gained knowledge about Role of Information Technology in Environment and human health.

Mapping of Paper No. MC-106

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S
CO3	M	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	M	M	S	S	S	S	S	S
CO6	S	S	S	S	S	S	S	S	S	S	S	S	S	S	M
CO7	S	M	S	M	S	S	M	S	S	S	S	S	S	S	S
CO8	S	S	S	M	S	S	M	S	S	S	M	S	S	S	S

S=Strong M=Medium W=Weak

References

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3. Brunner R.C. 1989, Hazardous Waste Incineration, Mc. Graw Hill Inc. 480p.
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5. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, EnvironmentalEncyclopedia, Jaico Pub. House, Mumbai 1196 p.
6. De A.K., Environmental Chemistry, WileyEastern Ltd.
7. Down to Earth, Centre for Science and Environment (R).
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9. Hawkins R.E. Encyclopedia of Indian Natural History, Bombay NaturalHistorySociety, Bombay(R).
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12. Mackinney, M.L. & Schoch, RM 1996, Environmental Science systems & solutions, Webenhanced edition. 639p.
13. Mhaskar A.K., Mayyer Hazardous, Tekchno-Science Publications (TB).
14. Miller T.G. Jr. Environmental Science, Wadsworth Publishing
15. Odum, E.P. 1971, Fundamentals of Ecology. W.B. Saunders Co. USA, 574p.
16. Rao M.N. & Datta, A.K. 1987 Waste Water Treatment. Oxford & TBH Publ. Co. Pvt. Ltd.345p.

17. Sharma, B.K. 2001, Environmental Chemistry, Goal Publ. House, Meerut.
18. Survey of the Environment, The Hindu (M).
19. Townsend C., Harper J. and Michael Begon. Essentials of Ecology, Blackwell Science (TB).
20. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Comliances andStandards, Vol. I and II Enviro Media (R).
21. Tridevi R.K. and P.K. Goal, Introduction to air pollution, Techno Science Publications (TR).
22. Wagner K.D., 1998, Environmental Management, W.B. Saunders co. Philadelphia, USA499p.
23. Atext book environmental education G.V.S. Publishers byDr. J.P. Yadav.

The scheme of the paper will be under :

The subject of Environmental Studies will be included as a qualifying paper in all UG Courses and the students will be required to qualify the same otherwise the final result will not be declared and degree will not be awarded.

The duration of the course will be 40 lectures. The examination will be conducted along with thesemester examinations.

Exam. Pattern : In case of awarding the marks, the paper will carry 100 marks. Theory: 75 marks,Practical/ Field visit : 25 marks.

The structure of the question paper will be :

Part- A: Short Answer Pattern : 15marks Part- B :EssayType with inbuilt choice :

60marks Part-C : Field Work (Practical) : 25marksInstructions for Examiners :

Part- A : Question No. 1 is compulsory and will contain five short- answer type question of 3 marks each covering the entire syllabus.

Part-B : Eight essay type questions (with inbuilt choice) will be set from the entire syllabus and thecandidate will be required to answer any four of them. Each essay type question will be of 15marks.

The examination of the regular students will be conducted by the concerned college/Institute. Eachstudent will be required to score minimum 40% marks separately in theory and practical/Field visit. The marks in this qualifying paper will not be included in determining the percentage of marks obtained for the award of degree.

However, these marks will be shown in the detailed marks certificate of the students.

Indira Gandhi University MeerpurRewari

(A State University established under Haryana Act No.29 of 2013)

Examination Scheme & Syllabus for B.Tech (Mechanical Engineering)
Semester- 5th & 6th

OUTCOME BASED EDUCATION SYSTEM / LEARNING OUTCOME CURRICULUM FRAMEWORK

OBES / LOCF, CBCS CURRICULUM (w.e.f. 2020-21)

VISION AND MISSION OF THE DEPARTMENT

VISION

To make contribution in the development of nation and evolution of technology by creating highly ethical professionals in Mechanical Engineering who are technically competent and are aware of their social responsibilities

MISSION

- To produce highly qualified, socially responsible, ethical and motivated students having sound theoretical and practical knowledge of Mechanical Engineering as well as communicative skills who can serve the nation as well as at global level.
- To inspire students to be a part of research and development activities.
- To encourage students to participate in conferences, workshops, seminars and research activities.

COURSE CODE AND DEFINITIONS:

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional Core Courses
LC	Laboratory Courses
MC	Mandatory Courses
PT	Practical Training
S	Seminar
TH	Theory
Pr	Practical

General Notes:

1. Mandatory courses are non credit courses in which students will be required passingmarks in internal assessments.
2. Students will be allowed to use non programmable scientific calculator. However,sharing of calculator will not be permitted in the examination.
3. Students will be permitted to opt for any elective course run by the department. However, the department shall offer those electives for which they have expertise.

The choice of the students for any elective shall not be binding for the department tooffer, if the department does not have expertise. To run the elective course a minimum of 1/3rd students of the class should opt for it.

Scheme of Studies and Examination B.TECH (Mechanical Engineering) – 5th Semester
w.e.f. 2020-21

S. N.	Course Code	Course Title	Hours per week			Total Contact hrs/week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
			L	T	P			Internal Assessment	External Examination	Practical	Total	
1	PCC-ME-301	Computer AidedDesign & Manufacturing	3	0	0	0	3	25	75		100	3
2	PCC- ME-303	Solid Mechanics	3	1	0	4	4	25	75		100	3
3	PCC- ME-305	Manufacturing Technology-I	3	0	0	3	3	25	75		100	3
4	PCC- ME-307	Kinematics of Machine	3	0	0	3	3	25	75		100	3
5	PCC- ME-309	Fluid Machines	3	0	0	3	3	25	75		100	3
6	**OEC/HSMC-I**	Refer List -I	2	0	0	2	2	25	75		100	3
7	LC-ME-311	Computer AidedDesign & Manufacturing Lab	0	0	2	2	1	25		25	50	3
8	LC-ME-313	Fluid Machines Lab	0	0	2	2	1	25		25	50	3
9	LC-ME-315	Kinematics of Machine Lab	0	0	2	2	1	25		25	50	3
10	PT-ME-317G	Practical Training-I	0	0	2	2	0					3
11	MC-315	Essence of Indian Traditional knowledge										
	TOTAL						**21**				**750**	

Note:

1. The evaluation of Practical Training-I will be based on seminar, viva-voce, report submitted by the students. According to performance, the students are awarded grades A, B, C, F. A student who is awarded 'F' grade is required to repeat Practical Training.

   Excellent: A; Good : B; Satisfactory: C; Not Satisfactory: F.

OPEN ELECTIVE COURSES(OEC)/ HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES (HSMC)-LIST-I

LIST-I (Semester -V)

S.No.	Code	Name of Course	No. of Contact Hours	Credits
1.	HSMC-01	Economics For Engineers	2	2
2.	HSMC-03	Finance and Accounting	2	2
3.	OEC –ME-301	Air and Noise Pollution and Control	2	2
4.	OEC –ME-303	Installation Testing & Maintenance of Electrical Equipments	2	2
5.	OEC –ME-305	Microprocessor and Interfacing	2	2

Note: Students have to select any one subject from the above list of courses.

Scheme of Studies and Examination B.TECH (Mechanical Engineering) – 6th Semester
w.e.f. 2020-21

S. N.	Course Code	Course Title	Hours per week			Total Cont act hrs/w eek	Credit	Examination Schedule(Marks)				Du ration of Ex am (Ho urs)
			L	T	P			Internal Asses sment	Exte rnal Exa min atio n	Pract ical	Total	
1	PCC-ME-302	Manufacturing Technology-II	3	0	0	3	3	25	75		100	
2	PCC- ME-304	Design of machine element-I	3	0	0	3	3	25	75		100	
3	PCC- ME-306	Heat Transfer	3	1	0	4	4	25	75		100	
4	PCC- ME-308	Dynamics ofMachines	3	0	0	3	3	25	75		100	
5	LC-ME-310	Workshop Lab-I	0	0	3	3	1.5	25		25	50	
6	LC-ME-312	Workshop Lab-II	0	0	2	2	1	25		25	50	
7	LC-ME-314	Heat Transfer Lab	0	0	2	2	1	25		25	50	
8	LC-ME-316	Dynamics of Machines Lab	0	0	2	2	1	25		25	50	
9	PCC-ME-318	Seminar	0	0	2	2	1	50			50	
10	PEC	Professional Elective Courses(PEC): Refer List -I	3	0	0	3	3	25	75		100	
11	**HSMC-II**	Refer List -II	2	0	0	2	2	25	75		100	
	TOTAL						**23.5**				**850**	

NOTE:

1. Each student has to undergo practical training of 4/6 weeks during summer vacationand its evaluation shall be carried out in the VII semester.
2. Assessment of Practical Training-II, undergone at the end of VI semester, will be based on seminar, viva-voce, report and certificate of practical training obtained bythe student from the industry/ Professional organization/ Research Laboratory etc. According to performance letter grades A, B, C, F are to be awarded:

Excellent: A; Good : B; Satisfactory:C; notsatisfactory: F.

A student who has been awarded 'F' grade will be required to repeat the practical training.

PROFESSIONAL ELECTIVE COURSES(PEC) (Semester-VI) LIST-I

S.No.	Code	Name of Course	No. of ContactHours	Credits
1.	PEC-ME-320	Internal Combustion Engines & Gas Turbines	3	3
2.	PEC-ME-322	Welding Technology	3	3
3.	PEC-ME-324	Air Craft Technology	3	3
4.	PEC-ME-326	Reliability, Availability & Maintainability	3	3

Note: Students will have to select any one out of the list.

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENTCOURSES (HSMC)-LIST-II.

List-II (Semester-VI)

S.No.	Code	Name of Course	No. of Contact Hours	Credits
1.	HSMC -02	Organizational Behaviour	2	2
2.	HSMC -04	Human Resource Management	2	2
3.	HSMC -06	Industrial Psychology	2	2
4.	HSMC -08	Fundamentals of Management	2	2

Note: Students have to select any one subject from the above list of courses.

<table>
<tr><td>Course code</td><td colspan="5">PCC-ME -301</td></tr>
<tr><td>Category</td><td colspan="5">Professional Core Courses</td></tr>
<tr><td>Course title</td><td colspan="5">COMPUTER AIDED DESIGN & MANUFACTURING</td></tr>
<tr><td rowspan="2">Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td rowspan="2">Semester-V</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Objectives:</td><td colspan="5">• Understand the fundamentals of various Computer Aided Design, basics of geometric modeling, curves surfaces, solids and Additive Manufacturing Technologies for application to various industrial needs.
• Learn what Advanced/Additive manufacturing (AM) is and understand why it has become one of the most important technology trends in decades for product development and innovation.
• Differentiate between subtractive and Additivemanufacturing.</td></tr>
<tr><td>Class work</td><td colspan="5">25 Marks</td></tr>
<tr><td>Exam</td><td colspan="5">75 Marks</td></tr>
<tr><td>Total</td><td colspan="5">100 Marks</td></tr>
<tr><td>Duration of Exam</td><td colspan="5">03 Hours</td></tr>
</table>

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Introduction: Introduction to CAD/CAM/CAE, Design Process, Importance and Necessity of CAD, Applications of CAD, Hardware and Software requirement of CAD.

Fundamentals of Additive Manufacturing (AM), Basic steps to perform AM, Classification of AM, Applications of AM: Aerospace, Biomedical, Automotive, Bio-printing, Tissue & Organ Engineering, Architectural Engineering, Surgical simulation, Art, Health care.

UNIT-II

Basics of geometric and solid modeling, coordinate systems. Transformations: Introduction, transformation of points and line, 2-D rotation, reflection, scaling and combined transformation, homogeneous coordinates, 3-D scaling, shearing, rotation, reflection and translation, combined transformations. Curves: Algebraic and geometric forms, reparametrization, Analytical and Synthetic curves, cubic splines, Bezier curves and B-spline curves.

Surfaces and Solids: Plane surface, ruled surface, surface of revolution, tabulated cylinder, bi- cubic surface, Bezier surface, B-spline surface, Solid models and representation scheme, boundary representation, constructive solid geometry, sweep representation, cell decomposition.

UNIT-III

Finite Element Method: Introduction, Procedure, Finite Element Analysis, Finite Element Modeling, Analysis of 1D, 2D structural problems.

Design for Additive Manufacturing, Software issues for AM, Direct Digital Manufacturing.

Difference between machining and additive manufacturing. Photo polymerization Processes, Powder bed fusion processes, Extrusion Based systems, Printing Processes, Effects of significant parameters.

UNIT-IV

Flexible Manufacturing Systems & Computer aided process planning: Introduction, FMS components, types of FMS, FMS layouts, planning for FMS, advantages and applications Conventional process planning, types of CAPP, Steps in variant process planning, planningfor CAPP.

Course Outcomes:

CO1 To introduce the concept of Computer Aided design.
CO2 To describe the Additive Manufacturing.
CO3 To apply the concept of wireframe modeling.
CO4 To impart knowledge surface modeling.
CO5 To know about the solidmodeling.
CO6 To instruct about the method of manufacturing of liquid based techniques.
CO7 To explain the method of manufacturing of powder based techniques.
CO8 Gained knowledge about method of manufacturing of solidbased techniques.

Mapping of Paper No. **PCC-ME -301**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO3	M	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	M	S	S	M	S	S	S	S	S	S
CO6	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO7	S	S	S	M	S	S	M	S	S	S	S	S	S	S	S
CO8	S	S	S	M	S	S	M	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

References:

1. CAD/ CAM by Groover and Zimmer, Prantice Hall.
2. CAD/ CAM Theory and Practice by Zeid, McGraw Hill
3. Numerical Control and Computer Aided Manufacturing by Kundra, Rao & Tiwari, TMH.
4. Ian Gibson, Davin Rosen, Brent Stucker “Additive Manufacturing Technologies, Springer,2nd Ed, 2014.

Course code	**PCC-ME -303**				
Category	Professional Core Courses				
Course title	**SOLID MECHANICS**				
Scheme and Credits	L	T	P	**Credits**	Semester-V
	3	1	0	4	
Objectives:	The objective is to present the mathematical and physical principles in understanding the linear continuum behavior of solids.Apply and use energy methods to find force, stress and displacement in simple structures and springs.Understand and determine the stressesand strains in pressure vessels. Knowledge of stress functions, and calculate stresses in rotating rings, discs, andcurved beams.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be setby taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Strain Energy & Impact Loading: Definitions, expressions for strain energy stored in a body when load is applied (i) gradually, (ii) suddenly and (iii) with impact, strain energy of beams in bending, beam deflections, strain energy of shafts in twisting, energy methods in determining spring deflection,Castigliano's & Maxwell's theorems, Numericals.

Theories of Elastic Failure: Various theories of elastic failures with derivations and graphical representations, applications to problems of 2- dimensional stress system with (i) Combined direct loading and bending, and (ii) combined torsional and direct loading, Numericals.

UNIT-II

Unsymmetrical Bending: Properties of beam cross section, product of inertia, ellipse of inertia, slope of the neutral axis, stresses & deflections, shear center and the flexural axis Numericals.

Springs: Stresses in open coiled helical spring subjected to axial loads and twisting couples, leaf springs, flat spiral springs, concentric springs, Numericals.

UNIT-III

Derivation of Lame's equations, Radial & Hoop Stresses in compound spherical shells subjected to internal fluid pressure only, wire wound cylinders, hub shrunk on solid shaft, Numericals.

Rotating Rims & Discs: Stresses in uniform rotating rings & discs, rotating discs of uniform strength, stresses in (I) rotating rims, neglecting the effect of spokes, (ii) rotating cylinders, hollow cylinders & solids cylinders. Numericals.

UNIT-IV

Bending of Curved Bars : Stresses in bars of initial large radius of curvature, bars of initial small radius of curvature, stresses in crane hooks, rings of circular & trapezoidal sections, deflection of curved bars & rings, deflection of rings by Castigliano's theorem stresses in simple chain link, deflection of simple chain links, Problems.

Course Outcomes:

CO1	To introduce the concept of Strain Energy.
CO2	To describe the Theories of Elastic Failure.
CO3	To apply the concept of Unsymmetrical Bending.
CO4	To impart knowledge Springs.
CO5	To know about the Lame's equations.
CO6	To instruct about the Rotating Rims & Discs.
CO7	To explain the Bending of Curved Bars.
CO8	Gained knowledge about Castigliano's theorem.

Mapping of Paper No. **PCC-ME -303**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	M	S	M	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	M	S	S	S	S	S	M	S	S	S	S	S	S
CO6	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO7	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S
CO8	S	S	S	M	S	S	M	S	S	S	S	S	M	S	S

S=Strong M=Medium W=Weak

Text Books:

1. Strength of Materials – G.H.Ryder, Third Edition in SI Units 1969 Macmillan, India.
2. Strength of Materials – Sadhu Singh, Khanna Publishers

ReferenceS:

1. Book of Solid Mechanics – Kazmi, Tata Mc Graw Hill
2. Strength of Materials – D.S. Bedi - S. Chand & Co. Ltd.
3. Strength of Materials – U.C Jindal - Pearson India Ltd.

Course code	**PCC-ME -305**				
Category	Professional Core Courses				
Course title	**MANUFACTURING TECHNOLOGY-I**				
Scheme and Credits	L	T	P	**Credits**	Semester-V
	3	0	0	3	
Objectives:	To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size andform of the raw materials into the desirable product by conventional or unconventional manufacturing methods.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Metal Cutting & Tool Life: Introduction, basic tool geometry, single point tool nomenclature, chips types and their characters tics, mechanics of chips formation, theoretical and experimental determination of shear angle, orthogonal and oblique metal cutting, metal cutting theories, relationship of velocity, forces, and power consumption, cutting speed, feed and depth of cut, coolant, temperature profile in cutting, tool life relationship, tailor equation of tool life, tool material and mechanism

Economics of Metal Machining: Introduction, elements of machining cost, tooling economics, machining, economics and optimization, geometry of twist, drills and power calculation in drills.

UNIT-II

Metal forming Jigs and Fixtures: Introduction, Metal blow condition, theories of plasticity, conditions of plane strains, friction, conditions in metal working, wire drawing, theory of forging, rolling theory, no slip angle, and foreword slip, types of tools, principles of locations, locating and clamping devices, jigs bushes, drilling jigs, milling fixtures, turning fixtures, boring and broaching fixtures, welding fixtures, different materials, for jigs and fixtures, economics of jigs and fixtures.

Metrology: Measurement, linear and angular simple measuring instruments, various clampers, screw gauge, sine bar, auto-collimator, comparator- mechanical, electrical, optical, surface finish and its measurements, micro and macro deviation, factors influencing surface finish and evaluation of surfacefinish.

UNIT-III

Machine tools: Introduction, constructional features, specialization, operations and devices of basic machine tools such as lathe, shaper, planner, drilling machining, and milling machine, indexing in milling operation, working principles of capstan and turret lathes.

Metal Casting Process: Introduction, Foundry: Introduction to Casting Processes, Basic Steps in Casting Processes. Pattern: Types of Pattern and Allowances. Sand Casting: Sand Properties,

Constituents and Preparation. Mould & Core making with assembly and its Types. Gating System. Melting of Metal, Furnaces and Cupola, Metal Pouring, Fettling. Casting Treatment, Inspection and Quality Control, Sand Casting Defects & Remedies.

UNIT-IV

Welding: Introduction to Welding, Classification of Welding Processes, Gas Welding: Oxy-Acetylene Welding, Resistance Welding; Spot and Seam Welding, Arc Welding: Metal Arc, TIG & MIG Welding, Submerged arc welding (SAW), resistance welding principles, electrode types and selection, thermit welding, electro slag welding, electron beam welding, laser beam welding, forge welding, friction welding, Welding Defects and remedies, brazing & soldering.

Forming Processes: Basic Principle of Hot & Cold Working, Hot & Cold Working Processes, Rolling, Extrusion, Forging, Drawing, Wire Drawing and Spinning. Sheet Metal Operations: Measuring, Layout marking, Shearing, Punching, Blanking, Piercing, Forming, Bending and Joining.

Course Outcomes:

CO1	To introduce the concept of sand moulding.
CO2	To describe the metal casting processes.
CO3	To apply the concept of basics of powder metallurgy.
CO4	To impart knowledge plastic deformation of metals.
CO5	To know about the gear manufacturing.
CO6	To instruct about the gear finishing operations.
CO7	To explain the Welding.
CO8	Gained knowledge about Furnaces.

Mapping of Paper No. **PCC-ME -305**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	M	S	S	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	M	S	S	M
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S	S	S	S	S	S
CO6	M	S	S	S	S	M	S	S	S	S	S	S	S	S	S
CO7	S	M	S	S	S	S	S	S	S	S	S	S	S	S	S
CO8	S	S	S	M	S	S	M	S	S	M	S	S	M	S	S

S=Strong M=Medium W=Weak

References:

1. Manufacturing Engineering Technology, K. Jain, Pearson Education
2. Manufacturing Technology: Foundry, Forming and Welding by P.N.Rao, TMH.
3. Principles of Manufacturing Materials and Processes, James S.Campbell, TMH.
4. Welding Metallurgy by G.E.Linnert, AWS.
5. Production Engineering Sciences by P.C.Pandey and C.K.Singh, Standard Publishers Ltd.
6. Manufacturing Science by A.Ghosh and A.K.Mallick, Wiley Eastern

Course code	**PCC-ME -307**				
Category	Professional Core Courses				
Course title	**KINEMATICS OF MACHINE**				
Scheme and Credits	L	T	P	**Credits**	Semester-V
	3	0	0	3	
Objectives:	• To understand the kinematics and rigid- body dynamics of kinematically driven machine components. • To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link. • To be able to design some linkage mechanisms and cam systems to generate specified output motion. • To understand the kinematics of gear trains.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Introduction: mechanism and machines, kinematics links, kinematics pairs, kinematics chains, degree of freedom, Grubler's rule, kinematics inversion, equivalent linkages, four link planar mechanisms, straight line mechanisms, steering mechanisms, pantograph, problems.

Kinematics Analysis of Plane Mechanisms: displacement analysis, velocity diagram, velocity determination, relative velocity method, instantaneous center of velocity, Kennedy's theorem, graphical and analytical methods of velocity and acceleration analysis, problems.

UNIT-II

Cams: Classification of cams and followers, disc cam nomenclature, construction of displacement, velocity and acceleration diagrams for different types of follower motions, analysis of follower motions, determination of basic dimension, synthesis of cam profile by graphical methods, cams withspecified contours, problems.

Gears: fundamental law of gearing, involute spur gears, characteristics of involute and cycloidal action, Interference and undercutting, center distance variation, path of contact, arc of contact, non standard gear teeth, helical, spiral bevel and worm gears, problems.

UNIT-III

Gear Trains: synthesis of simple, compound and reverted gear trains, analysis of epicylic gear trains, problems.

Kinematics synthesis of Mechanisms: function generation, path generation, Freudenstein's equation, two and three position synthesis of four bar and slider crank mechanisms by graphical and analytical methods, precision positions, structural error; Chebychev spacing, transmission angle, problems.

UNIT-IV

Friction : Types of friction, laws of friction, motion along inclined plane, screw threads, efficiency oninclined plane, friction in journal bearing, friction circle and friction axis, pivots and collar friction, uniform pressure and uniform wear.

Belts and pulleys: Open and cross belt drive, velocity ratio, slip, material for belts, crowning of pulleys, law of belting, types of pulleys, length of belts, ratio of tension, centrifugal tension, power transmitted by belts and ropes, initial tension, creep, chain drives, chain length, classification of chains.

Course Outcomes :

CO1 - To understand about the applications of mechanism and machines.

CO2 - To understand about the basics Cams and Friction

CO3 - Students get familiarity about power transmitted with Belts and pulleys and also Gears andGear Trains.

CO4 - Students having familiarization with calculate Kinematics Analysis of Plane Mechanisms

CO5 - Students would be able to know the Kinematics synthesis of Mechanisms.

CO6 - To understand about the centrifugal tension.

CO7- To understand about the Chebychev spacing.

CO8- To understand about the Kennedy's theorem.

Mapping of Paper No. **PCC-ME -307**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	M	S	M	S	S	S	S	S
CO2	S	S	S	M	S	M	S	S	S	S	S	S	S	S	M
CO3	S	S	S	S	S	S	S	M	M	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	M	S	S	S	S	S	S	S	S	S	S	M	S
CO6	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO7	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S
CO8	S	S	S	M	S	S	M	S	S	S	S	S	M	S	S

S=Strong M=Medium W=Weak

TEXT BOOKS:

1. Theory of Mechanisms and Machines: Amitabha Ghosh and Ashok kumar Malik, ThirdEdition Affiliated East-West Press.
2. Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. SecondEdition, MGH, New York.

References:

1. Mechanism and Machine Theory : J.S. Rao and R.V. Dukkipati Second Edition New ageInternational.
2. Theory and Machines: S.S. Rattan, Tata McGraw Hill.
3. Theory of Machines, Beven, Pearson Indian Education Service Pvt. Ltd. India.

Course code	**PCC-ME -309**				
Category	Professional Core Courses				
Course title	**FLUID MACHINES**				
Scheme and Credits	L	T	P	**Credits**	Semester-V
	3	0	0	3	
Objectives:	The students completing this course are expected to understand the theory of boundary layer, working and performance characteristics of various hydraulic machines like pumps and turbines.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be setby taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Impact of free jets: Impulse – momentum principle, jet impingement - on a stationary flat plate, inclined plate and a hinged plate, at the center of a stationary vane, on a moving flat plate, inclined plate, a moving vane and a series of vanes, Jet striking tangentially at the tip of a stationary vane andmoving vane(s), jet propulsion of ships, Problems.

Impulse Turbines: Classification – impulse and reaction turbines, water wheels, component parts, construction, operation and governing mechanism of a Pelton wheel, work done, effective head, available head and efficiency of a Pelton wheel, design aspects, speed ratio, flow ratio, jet ratio, number of jets, number of buckets and working proportions, Performance Characteristics, governing of impulse turbines, Problems.

UNIT-II

Francis Turbines: Component parts, construction and operation of a Francis turbine, governing mechanism, work done by the turbine runner, working proportions and design parameters, slow, medium and fast runners, degree of reaction, inward/outward flow reaction turbines, Performance Characteristics, Problems.

Propeller and Kaplan turbines: Component parts, construction and operation of a Propeller, Kaplan turbine, differences between the Francis and Kaplan turbines, draft tube - its function and different forms, Performance Characteristics, Governing of reaction turbine, Introduction to new types of turbine, Deriaz (Diagonal), Bulb, Tubular turbines, Problems.

UNIT-III

Dimensional Analysis and Model Similitude: Dimensional homogeneity, Rayleigh's method and Buckingham's πtheorem, model studies and

similitude, dimensionless numbers and their significance. Unit quantities, specific speed and model relationships for turbines, scale effect, cavitations – its causes, harmful effects and prevention, Thomas cavitation factor, permissible installation height, Problems.

Centrifugal Pumps: Classification, velocity vector diagrams and work done, manometric efficiency, vane shape, head capacity relationship and pump losses, pressure rise in impeller, minimum starting speed, design considerations, multi-stage pumps. Similarity relations and specific speed, net positive suction head, cavitation and maximum suction lift, performance characteristics. Brief introduction to axial flow, mixed flow and submersible pumps, Problems.

UNIT-IV

Reciprocating Pumps: Construction and operational details, discharge coefficient, volumetric efficiency and slip, work and power input, effect of acceleration and friction on indicator diagram (pressure – stroke length plot), separation, air vessels and their utility, rate of flow into or from the air vessel, maximum speed of the rotating crank, characteristic curves, centrifugal vs reciprocating pumps, brief introduction to screw, gear, vane and radial piston pumps, Problems.

Hydraulic systems: Function, construction and operation of Hydraulic accumulator, hydraulic intensifier, hydraulic crane, hydraulic lift and hydraulic press, Fluid coupling and torque converter, Hydraulic ram, Problems.

Course Outcomes:

CO1 To introduce the concept of momentum equation
CO2 To describe the design analysis of hydraulic turbines.
CO3 To understand construction, working principle and design analysis of pumps.
CO4 To impart knowledge Reciprocating Pumps.
CO5 To know about the Hydraulic systems.
CO6 To instruct about the Centrifugal Pumps.
CO7 To explain the Rayleigh's method and Buckingham's π theorem
CO8 Gained knowledge about hydraulic crane.

Mapping of Paper No. **PCC-ME -309**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	M	S	M	S	M	S	S	S
CO2	S	S	S	M	S	M	S	S	S	S	S	S	S	S	M
CO3	S	S	M	S	S	S	S	M	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	M	S	S	S	S	S
CO6	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO7	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S
CO8	S	S	S	S	S	S	M	S	S	S	S	S	M	S	S

S=Strong M=Medium W=Weak

Text Books:

1. Fluid Mechanics and Hydraulic Machines – Mahesh Kumar, Pearson Indian EducationService Pvt. Ltd. India.
2. Hydraulics & Fluid Mechanics – Modi & Seth, Pub. - Standard Book House, N.Delhi
3. Hydraulic Machines – Jagdish Lal, Metropolitan

References:

1. Fluid Mechanics and Hydraulic Machines – S S Rattan, Khanna Publishers
2. Introduction to Fluid Mechanics and Fluid Machines – S K Som and G Biswas, Tata McGrawHill
3. Fluid Mechanics and Fluid Power Engineering – D S Kumar, S K Kataria and Sons.

Course code	**LC-ME -311**				
Category	Engineering Science courses				
Course title	**COMPUTER AIDED DESIGN & MANUFACTURING LAB**				
Scheme and Credits	L	T	P	**Credits**	Semester-VI
	0	0	2	1	
Objectives:	At the end of the course, the student shall be able to: Display of the basic fundamentals of modeling package. Explore the surface and solid modeling features. Learning the techniques of 3D modeling of various mechanical parts.				
Class work mark	25 Marks				
Practical mark	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiments:

The students will be required to carry out the following exercises using software packages(e.g. Solid works / Pro Engineer/AutoCAD/ I-Deas/ Solid Edge/CURA etc.)

1. CAD Modeling Assignments
   (i) Use and learn import/export techniques and customization of software.
   (ii) Construction of simple machine parts and components like Coupling, Crankshaft, Pulley, Piston , Connecting rod, nuts, bolts, gears and helical springs
   (iii) Assembly drawing with sectioning and bill of materials from given detailed drawings of assemblies: Lathe Tail stock, Machine vice, Pedestal bearing, Drill jigsand Milling fixture.
   (iv) Make the part family/family table of a bolt.

2. CAM Assignments Tool path generation, Part programming, G & M codes development for machining operations, Physical interpretation of machining features and tool geometries.

3. To perform reverse engineering of a product using 3D scanner.

4. To print coupling, crankshaft, pulley, piston, connecting rod, nuts, bolts with FDM 3D printer with suitable filament like Nylon, ABS etc.

5. To print a product with FDM 3D printer which is developed with reverse engineering.

6. To Draw Orthographic projection Drawings (Front, Top and side) of boiler safety valve giving name the various components of the valve.

7. Make an Isometric dimensioned drawing of a connecting Rod using isometric grid and snap.

8. Draw 3D models by extruding simple 2D objects, dimension and name the objects.

Course Outcomes (COs):

CO 1- Display of the basic fundamentals of modeling package.
CO 2- Explore the surface and solid modeling features.
CO 3- Learning the techniques of 3D modeling of various mechanical parts.
CO 4- To expedite the procedure and benefits of FEA and CAE.
CO 5-. To know about Orthographic projection
CO 6- To instruct about the 3D models.
CO 7- To explain the 3D scanner.
CO 8- Gained knowledge about CAM.

Mapping of Paper No. **LC-ME -311**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S		S	S	S	S	S	M	M	M	S	M	S	S	S
CO2	S	S	S	M	S	M	S	S	S	S	S	S	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	M	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	M	S	S	S	S	S
CO6	M	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO7	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO8	S	S	S	M	S	S	M	S	S	S	S	S	M	S	S

S=Strong M=Medium W=Weak

Note:-

1. At least Five experiments are to be performed in the semester.
2. At least five experiments should be performed from the above list. Remaining three experiments may either be performed from the above list or designed & set by the concernedinstitute as per the scope of the syllabus.
3. The students will be required to carry out the following exercises using educational software(AutoCAD, I-DEAS, Pro-Engineer etc).

Course code	**LC-ME -313**				
Category	Engineering Science courses				
Course title	**FLUID MACHINES LAB**				
Scheme and Credits	L	T	P	**Credits**	Semester-V
	0	0	2	1	
Objectives:	(i) To understand the principles and performance characteristics of flow andthermal devices. (ii) To know about the measurement of thefluid properties. (iii) To understand the theory, working and performance characteristics of various hydraulic machines like pumps and turbines.				
Class work mark	25 Marks				
Practical mark	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiments:

1. To study the constructional details of a Pelton turbine and draw its fluid flow circuit.
2. To draw the following performance characteristics of Pelton turbine-constant head, constant-speed and constant efficiency curves.
3. To study the constructional details of a Francis turbine and draw its fluid flow circuit.
4. To draw the constant head, constant speed and constant efficiency performance characteristicsof Francis turbine.
5. To study the construction details of a Kaplan turbine and drawits fluid flow circuit.
6. To drawthe constant head, speed and efficiency curves for a Kaplan turbine.
7. To study the constructional details of a Centrifugal Pump and draw its characteristic curves.
8. To study the constructional details of a Reciprocating Pump and draw its characteristicscurves.
9. To study the construction details of a Gear oil pump and its performance curves.
10. To study the constructional details of a Hydraulic Ram and determine its various efficiencies..
11. To study the constructional details of a Centrifugal compressor.
12. To study the model of Hydro power plant and draw its layout.

Course Outcomes:

CO1 To introduce the concept of Pelton turbine
CO2 To describe the Francis turbine.
CO3 To understand Kaplan turbine.
CO4 To impart knowledge Reciprocating Pumps.
CO5 To know about the Centrifugal Pump.
CO6 To instruct about the details of a Hydraulic Ram.
CO7 To explain the Centrifugal compressor
CO8 Gained knowledge about Hydro power plant

Mapping of Paper No. **LC-ME -313**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	M	M	S	S	S	S	S	S
CO2	M	S	S	M	S	M	S	S	S	S	S	S	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	M	S	S	S	S	S
CO6	S	M	S	S	S	M	S	S	S	S	S	S	S	M	M
CO7	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO8	S	S	S	M	S	S	S	S	S	S	S	S	M	S	S

S=Strong M=Medium W=Weak

NOTE:

1. At least ten experiments are to be performed in the Semester.
2. At least seven experiments should be performed from the above list. Remaining three experiments may either be performed from the above list or designed & set by the concernedinstitution as per the scope of the syllabus.

Course code	**LC-ME -315**				
Category	Engineering Science courses				
Course title	**KINEMATICS OF MACHINES LAB**				
Scheme and Credits	L	T	P	**Credits**	Semester-V
	0	0	2	1	
Objectives:	• To understand the kinematics and rigid- body dynamics of kinematically driven machine components. • To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link. • To be able to design some linkage mechanisms and cam systems to generate specified output motion. • To understand the kinematics of gear trains.				
Class work mark	25 Marks				
Practical mark	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiments:

1. To study various types of Kinematic links, pairs, chains and Mechanisms.
2. To study inversions of 4 Bar Mechanisms, Single and double slider crank mechanisms.
3. To plot slider displacement, velocity and acceleration against crank rotation for single slidercrank mechanism.
4. To find coefficient of friction between belt and pulley.
5. To study various type of cam and follower arrangements.
6. To plot follower displacement vs cam rotation for various Cam Follower systems.
7. To generate spur gear involute tooth profile using simulated gear shaping process.
8. To study various types of gears – Helical, cross helical worm, bevel gear.
9. To study various types of gear trains – simple, compound, reverted, epicyclic and differential.
10. To find co-efficient of friction between belt and pulley.
11. To study the working of Screw Jack and determine its efficiency.
12. Create various types of linkage mechanism in CAD and simulate for motion outputs andstudy the relevant effects.
13. Creation of various joints like revolute, planes, spherical, cam follower and study the degreeof freedom and motion patterns available.
14. To design a cam profile by using the requirement graph using on-line engineering handbookand verify the same using a 3D mechanism on CAD.

Course Outcomes:

CO1 To introduce the concept of Kinematic links
CO2 To describe the 4 Bar Mechanisms.
CO3 To understand coefficient of friction between belt and pulley.
CO4 To impart knowledge various type of cam.
CO5 To know about the working of Screw Jack.
CO6 To instruct about the types of gear trains.
CO7 To design a cam profile
CO8 Gained knowledge about types of linkage mechanism in CAD

Mapping of Paper No. **LC-ME -315**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	M	S	S	S	S	S	S	S
CO2	S	S	S	M	S	M	S	S	S	S	S	S	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	M	S	S	S	S	S	S	S	S	M	S	S	S	S	S
CO6	S	M	S	S	S	S	S	S	S	S	S	S	S	M	M
CO7	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO8	S	S	S	M	S	S	S	S	S	S	S	S	M	S	S

S=Strong M=Medium W=Weak

Note:

1. At least ten experiments are to be performed in the Semester.
2. At least eight experiments should be performed from the above list. However these experiments should include experiments at Sr. No. 12, 13 and 14. Remaining two experiments may either be performed from the above list or as designed & set by the concerned institution as per the scope of thesyllabus.

<table>
<tr><td>Course code</td><td colspan="5">PT-ME -317</td></tr>
<tr><td>Category</td><td colspan="5">Engineering Science courses</td></tr>
<tr><td>Course title</td><td colspan="5">PRACTICAL TRAINING -I</td></tr>
<tr><td rowspan="2">Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td rowspan="2">Semester-V</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td>Objectives:</td><td colspan="5">• Achieving the objectives of the University and its colleges and departments in practical training.
• Providing students with practical skills, which match the requirements of the job market and allow them to directly enter the work community in a serious and constructive manner.
• Providing students with experience to help them take decisions pertaining to their future career objectives.
• Providing college students the full opportunity to apply theoretical knowledge (gained during their studies) in a real work environment at a later stage of their studies.
• Developing the student's understanding of the needs of the job market and reaching this understanding successfully.
.</td></tr>
<tr><td>Class work mark</td><td colspan="5">25 Marks</td></tr>
<tr><td>Practical mark</td><td colspan="5">25 Marks</td></tr>
<tr><td>Total</td><td colspan="5">50 Marks</td></tr>
<tr><td>Duration of Exam</td><td colspan="5">03 Hours</td></tr>
</table>

PRACTICAL TRAINING VIVA-VOCE:

1) Assessment of Practical Training-I, undergone at the end of IV semester, will bebased on seminar, viva-voce, report and certificate of practical training obtained by the student from the industry/ Professional organization/ Research Laboratory with the prior approval of the Director-Principal/ **Mechanical Software /Automobile Workshop. According to performance letter grades A, B, C, F are to be awarded:**

Excellent : A ; Good : B ; Satisfactory : C ; Not satisfactory : F.

A student who has been awarded 'F' grade will be required to repeat the practical training.

2) Each student has to undergo practical training of 4/6 weeks during summer vacation and its evaluation shall be carried out in the V semester.

Course code	MC-315			
Category	Mandatory Course			
Course title	**Essence of Indian Traditional Knowledge**			
Scheme and credits	L	T	P	Credits
	2	0	0	0

Course Contents

- Basic structure of Indian knowledge System
- Modern Science and Indian KnowledgeSystem
- Yoga and Holistic Health care
- Case studies

References

1. V. Sivaramakrishnan (Ed.), *Cultural Heritage of India-course material*,Bharatiya Vidya Bhavan, Mumbai. 5th Edition,2014
2. Swami Jitatmanand, *Modern Physics and Vedant*, Bharatiya VidyaBhavan
3. Swami Jitatmanand, *Holistic Science and Vedant*, Bharatiya VidyaBhavan
4. Fritzof Capra, *Tao ofPhysics*
5. Fritzof Capra, *The Wave oflife*
6. VN Jha (Eng. Trans.), *Tarkasangraha of Annam Bhatta*, InternationalChinmay Foundation, Velliarnad,Arnakulam
7. *Yoga Sutra of Patanjali*, Ramakrishna Mission,Kolkata
8. GN Jha (Eng. Trans.), Ed. RN Jha, *Yoga-darshanamwith Vyasa Bhashya*,Vidyanidhi Prakashan, Delhi2016
9. RN Jha, *Science of Consciousness Psychotherapyand Yoga Practices*,Vidyanidhi Prakashan, Delhi2016
10. P B Sharma (English translation), *ShodashangHridayan*

Course code	**HSMC -01**				
Category	**HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES (HSMC)**				
Course title	**ECONOMICS FOR ENGINEERS**				
Scheme and Credits	L	T	P	**Credits**	Semester-V
	2	0	0	2	
Objectives:	• Acquaint the students to basic concepts of economics and their operational significance. • To stimulate the students to think systematically and objectively about contemporary economic problems.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Definition of Economics- Various definitions, types of economics- Micro and Macro Economics, nature of economic problem, Production Possibility Curve, Economic laws and their nature, Relationship between Science, Engineering, Technology and Economic Development.

Demand- Meaning of Demand, Law of Demand, Elasticity of Demand- meaning, factors affecting it,its practical application and importance.

UNIT-II

Production- Meaning of Production and factors of production, Law of variable proportions, Returns toscale, Internal and external economies and diseconomies of scale.

Various concepts of cost of production- Fixed cost, Variable cost, Money cost, Real cost, Accounting cost, Marginal cost, Opportunity cost. Shape of Average cost, Marginal cost, Total cost etc. in short run and long run.

UNIT-III

Market- Meaning of Market, Types of Market- Perfect Competition, Monopoly, MonopolisticCompetition and Oligopoly (main features).

Supply- Supply and law of supply, Role of demand & supply in price determination and effect ofchanges in demand and supply on prices.

UNIT-IV

Indian Economy- Nature and characteristics of Indian economy as under developed, developing andmixed economy (brief and elementary introduction), Privatization - meaning, merits and demerits.
Globalization of Indian economy - merits and demerits.

Banking- Concept of a Bank, Commercial Bank- functions, Central Bank- functions, Differencebetween Commercial & Central Bank.

Course Outcomes:

CO1 To introduce the concept of Micro and Macro Economics
CO2 To describe the Demand.
CO3 To understand Production.
CO4 To impart knowledge Supply and law of supply.
CO5 To know about Market.
CO6 To instruct about the Banking.
CO7 To Understand Globalization
CO8 Gained knowledge about Indian Economy

Mapping of Paper No. **HSMC -01**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	M	S	S	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO6	S	S	S	S	S	S	M	S	S	S	S	S	S	S	M
CO7	M	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO8	S	S	S	S	S	S	S	S	S	S	S	S	M	S	S

S=Strong M=Medium W=Weak

REFERENCES:

1. Jain T.R., Economics for Engineers, VK Publication.
2. Chopra P. N., Principle of Economics, Kalyani Publishers.
3. Dewett K. K., Modern economic theory, S. Chand.
4. H. L. Ahuja., Modern economic theory, S. Chand.
5. Dutt Rudar & Sundhram K. P. M., Indian Economy.
6. Mishra S. K., Modern Micro Economics, Pragati Publications.
7. Singh Jaswinder, Managerial Economics, dreamtech press.
8. A Text Book of Economic Theory Stonier and Hague (Longman's Landon).
9. Micro Economic Theory – M.L. Jhingan (S.Chand).
10. Micro Economic Theory - H.L. Ahuja (S.Chand).
11. Modern Micro Economics : S.K. Mishra (Pragati Publications).
12. Economic Theory - A.B.N.Kulkarni & A.B. Kalkundrikar (R.Chand & Co).

Course code	**HSMC -03**				
Category	**HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES (HSMC)**				
Course title	**FINANCIAL ACCOUNTING**				
Scheme and Credits	L	T	P	**Credits**	Semester-V
	2	0	0	2	
Objectives:	The role of accounting is to provide information to investors, policy-makers, regulators, and other decision-makers to facilitate the allocation of resources in society. The purpose of this course is to understand the accounting process and to develop skills necessary to evaluate an enterprise's financial position and its operating, investing and financing activities				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Theoretical Framework:Accounting as an information system, the users of financial accounting information and their needs. Qualitative characteristics of accounting, information. Functions, advantages and limitations of accounting. Branches of accounting. Bases of accounting; cash basis and accrual basis.

The nature of financial accounting principles – Basic concepts and conventions: entity, money measurement, going concern, cost, realization, accruals, periodicity, consistency, prudence(conservatism), materiality and full disclosures.

Financial accounting standards: Concept, benefits, procedure for issuing accounting standards in India. International Financial Reporting Standards (IFRS): - Need and procedures, Convergence to IFRS, Distinction between Indian Accounting Standards (Ind ASs) and Accounting Standards (ASs).

Accounting Process From recording of a business transaction to preparation of trial balance including adjustments: Capital and Revenue expenditure & receipts, Preparation trial balance, Profit and Loss Account and Balance Sheet(Sole Proprietorship only).

UNIT-II

Business Income: Measurement of business income-Net income: the accounting period, the continuitydoctrine and matching concept. Objectives of measurement. Revenue: concept, revenue recognition principles, recognition of expenses.

The nature of depreciation. The accounting concept of depreciation. Factors in the measurement ofdepreciation. Methods of computing depreciation: straight line method and diminishing balance method; Disposal of depreciable assets-change of method

Inventories: Meaning. Significance of inventory valuation. Inventory Record Systems: periodic andperpetual. Methods: FIFO, LIFO and Weighted Average. Preparation of financial statements of not for profit organizations.

UNIT-III

Accounting for Hire Purchase and Installment System, Consignment, and Joint Venture:Accountingfor Hire Purchase Transactions, Journal entries and ledger accounts in the books of Hire Vendors andHire purchaser for large value items including default and repossession, stock and debtors system.
Consignment: Features, Accounting treatment in the books of the consignor and consignee.

Joint Venture: Accounting procedures: Joint Bank Account, Records Maintained by Coventurer of alltransactions and only his own transactions. (Memorandum joint venture account).

UNIT-IV

Accounting for Inland Branches Inland Branches; Dependent branches only and Ascertainment ofProfit by Debtors Method & Stock and Debtors Method.

Accounting for Dissolution of Partnership Firm Dissolution of the Partnership Firm IncludingInsolvency of partners, sale to a limited company and piecemeal distribution.

Computerized Accounting System (using any popular accounting software); Creation of Vouchers; recording transactions; preparing reports, cash book, bank book, ledger accounts, trial balance, Profitand loss account, Balance Sheet.

Course Outcomes:

CO1	To introduce the concept of functions of accounting
CO2	To describe the financial accounting.
CO3	To understand the nature of depreciation.
CO4	To impart knowledge Business Income.
CO5	To know about Computerized Accounting System.
CO6	To instruct about Accounting for Dissolution.
CO7	To Understand Joint Venture
CO8	Gained knowledge about Accounting for Hire Purchase

Mapping of Paper No. **HSMC -03**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	M	S	S	S	M	S	S	S	S	S	S
CO6	S	S	S	S	S	S	M	S	S	S	S	S	S	S	M
CO7	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO8	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

References:

1. Lal, Jawahar and Seema Srivastava, Financial Accounting, Himalaya Publishing House.

2. Monga, J.R., Financial Accounting: Concepts and Applications, Mayoor Paper Backs, New Delhi.

3. Shukla, M.C., T.S. Grewal and S.C.Gupta. Advanced Accounts. Vol.-I. S. Chand & Co., NewDelhi.

4. S. N. Maheshwari, Financial Accounting, Vikas Publication, New Delhi. T.S, Grewal, Introductionto Accounting, S. Chand and Co., New Delhi

5. P.C. Tulsian, Financial Accounting, Tata McGraw Hill, New Delhi.

6. Bhushan Kumar Goyal and HN Tiwari,Financial Accounting,Vikas publishing House, New Delhi.

7. Jain, S.P. and K.L. Narang. Financial Accounting. Kalyani Publishers, New Delhi.

Course code	**OEC –ME-301**				
Category	**OPEN ELECTIVE COURSES(OEC)**				
Course title	**AIR AND NOISE POLLUTION AND CONTROL**				
Scheme and Credits	L	T	P	**Credits**	Semester-VI
	2	0	0	2	
Objectives:	To impart knowledge on the sources, effects and control techniques of air pollutants and noise pollution.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Atmosphere as a place of disposal of pollutants – Air Pollution – Definition – Air Pollution and Global Climate – Units of measurements of pollutants – Air quality criteria – emission standards – National ambient air quality standards – Air pollution indices – Airquality management in India.

UNIT-II

Sources and classification of air pollutants – Man made – Natural sources – Type of air pollutants – Pollution due to automobiles – Analysis of air pollutants – Chemical,
Instrumental and biological methods. Air pollution and its effects on human beings, plants and animals – Economic effects of air pollution – Effect of air pollution on meteorological conditions – Changes on the Meso scale, Micro scale and Macro scale.

UNIT-III

Sampling and measurement of particulate and gaseous pollutants – Ambient air sampling – Stack sampling. Environmental factors – Meteorology – temperature lapse rate and stability
– Adiabatic lapse rate – Wind Rose – Inversion – Wind velocity and turbulence –Plumebehaviour – Dispersion of air pollutants- Air Quality Modeling.

Control of gaseous contaminants: Absorption, Adsorption, Condensation and Combustion, Control of sulphur oxides, nitrogen oxides,

carbon monoxide, and hydro carbons.Automotiveemission control, catalytic convertor, Euro-I, Euro-II and Euro-III specifications, Indian specifications.

UNIT-IV

Noise Pollution: Basics of acoustics and specification of sound; sound power, sound intensityand sound pressure levels; plane, point and line sources, multiple sources; outdoor and indoor

noise propagation; psycho-acoustics and noise criteria, effects of noise on health, annoyance rating schemes; special noise environments: Infra-sound, ultrasound, impulsive sound and sonic boom; noise standards and limit values; noise instrumentation and monitoring procedure, Noise indices.

Course Outcomes:

CO1 To introduce the concept of Air Pollution.
CO2 To describe Airquality management in India.
CO3 To understand the Sources and classification of air pollutants.
CO4 To impart knowledge Effect of air pollution on meteorological conditions.
CO5 To know about Ambient air sampling.
CO6 To instruct about Control of gaseous contaminants.
CO7 To Understand Noise Pollution.
CO8 Gained knowledge about noise instrumentation and monitoring procedure.

Mapping of Paper No. **OEC –ME-301**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	S	S	S	S	M	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S
CO3	S	S	S	M	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO6	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S
CO7	S	S	S	S	S	S	S	S	S	S	S	M	S	S	S
CO8	M	S	S	S	S	S	S	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

TEXTBOOKS:

- C. S. Rao, "Environmental Pollution Control Engineering", Wiley Eastern Limited,2000.
- M. N. Rao, H. V. N. Rao, Air pollution, Tata McGraw Hill Pvt Ltd, New Delhi, 1993
- Dr. Y. Anjaneyulu, "Air Pollution and Control Technologies", Allied publishers Pvt.Ltd., 2002.

REFERENCES:

- Noel De Nevers, "Air pollution control Engineering", McGraw Hill InternationalEdition, McGraw Hill Inc, New Delhi, latest edition
- Air Pollution act, India, latest edition
- Peterson and E.Gross Jr., "Hand Book of Noise Measurement", latest edition
- Mukherjee, "Environmental Pollution and Health Hazards", causes and effects, latestedition
- Antony Milne, "Noise Pollution: Impact and Counter Measures", David & CharlesPLC, latest edition
- Kenneth wark, Cecil F.Warner, "Air Pollution its Origin and Control", Harper andRow Publishers, New York, latest edition
- Peavy, Rowe and Tchobanoglous: Environmental Engineering.
- Martin Crawford: Air Pollution Control Theory.
- Warkand Warner: Air Pollution: Its Origin and Control.
- Keshav Kant and Rajni Kant, "Air Pollution and Control Engineering", Khanna PublishingHouse.
- Environmental Noise Pollution – PE Cunniff, McGraw Hill, New York, latest edition
- Nevers: Air Pollution Control Engineering.
- M. P. Poonia and S C Sharma," Environmental Engineering, Khanna Publishing House.
- My cock, Mc Kenna and Theodore: Handbook of Air Pollution Control Engineering and
- Technology. Suess and Crax ford: W.H.O. Manualon Urban Air Quality Management
- OP Gupta,Elements of Environmental Polluton Control, Khanna Publishing House.

Course code	**OEC –ME-303**				
Category	**OPEN ELECTIVE COURSES(OEC)**				
Course title	**INSTALLATION TESTING & MAINTENANCE OF ELECTRICAL EQUIPMENTS**				
Scheme and Credits	L	T	P	**Credits**	Semester-VI
	2	0	0	2	
Objectives:	The course content should be taught and implemented with the aim to develop required skills in the students so that they are able to acquire following competency: Undertake installation, commissioning and maintenance of various power system• components and equipment.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Installation of Electrical Equipements: Introduction Unloading of electrical equipment at site Inspection Storage Foundation Alignment of electrical machines Tools/Instruments necessary for installation Inspection, storage and handling of transformer, switchgear and induction motor Preparation of technical report

Commissioning And Testing:Tests before commissioning of electrical equipment :Electrical and Mechanical test Specific tests on - transformer, induction motor, alternator, synchronous power and electrical power installation Need of gradually loading of Various Tests to be performed after commissioning and before starting the machine Various instruments required for testing Commissioning of switchgear Test report on commissioning and test certificate electrical equipment Preparations before commissioning of power transformer Commissioning - power transformer, three phase induction motor Transformer insulation oil: Properties as per IS, sampling, testing and filtering/purifying, standard tests as per IS Measurement of insulation resistance of different equipments/machines Methods of Drying the winding of electrical equipments and its record Classification and measurement of insulation resistance, Polarization Index Appropriate insulation test for specific purpose Factor affecting

UNIT-II

Maintenance Of Electrical Equipments: General aspect of maintenance, Classification Preventive maintenance-concept, classification, advantages, activities, functions of the Maintenance Department Breakdown maintenance-concept, advantages, activities Reasons of failure of electrical equipment due to poor maintenance Factors for preparing maintenance schedule Frequency of maintenance Maintenance schedule of transformer below and above 1000kVA Maintenance schedule - induction motor, circuit Breaker, overhead line, storage Battery Probable faults

due to poor maintenance in transformer, induction motor, circuit breaker, overhead lines and battery

UNIT-III

Trouble Shooting:Causes of fault in electrical equipments- Internal and external Instruments and toolsfor trouble shooting Common troubles in electrical equipment – DC Machines, AC Machines, Transformers, Circuit- breaker, under-ground cable, electrical Installation Need of trouble shooting chart, advantages Trouble shooting chart – DC Motor, DC Generator, Transformer, Synchronous Motor, Induction Motor, Circuit-breaker Trouble shooting chart for Domestic appliances- electrical iron, ceiling fan, Washing machine, Air cooler, Vacuum cleaner Fluorescent tube light: Construction,working and troubleshooting chart

UNIT-IV

Earthing:Necessity of earthing System earthing : advantage of neutral earthing of generator in power station Equipment earthing: Objective Types of earth electrodesMethods of earthing : plate earthing,pipe earthing and coil earthing Earthing in extra high voltage and underground cable Earthing resistance- factor affecting Determination of maximum permissible resistance of the earthing system Measurement of earth resistance: voltmeterammeter method, earth tester method, ohm meter method and earth loop tester method Define: earthing , grounding and bonding Comparison between equipment earthing and system grounding Earthing procedure - Building installation, Domestic appliances, Industrial premises Earthing in substation, generating station and overhead line

Electrical Accidents And Safety: Causes of electrical accidents Factors affecting the severity of electrical shock Actions to be taken when a person gets attached to live part Safety regulations and safety measures Indian electricity supply act 1948- 1956 Factory act 1948 Procedure of shut down for sub- station and power lines Permit to work : certificate of (i)requisition for shut down(ii) Permit to work and (iii)Line clear certificate Instruction for the safety of persons working on a job with a permit to work Fire extinguishers- For fixed installation and portable devices

Course Outcomes:

CO1 To introduce the Installation of Electrical Equipements.
CO2 To describe Commissioning And Testing.
CO3 To understand the Maintenance Of Electrical Equipments.
CO4 To impart knowledge DC Machines, AC Machines.
CO5 To know about Transformers.
CO6 To instruct about Earthing.
CO7 To Understand Safety regulations.
CO8 Gained knowledge about Electrical Accidents And Safety.

Mapping of Paper No. **OEC –ME-303**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	M	S	S	S	S	S	S	S
CO2	S	M	S	S	S	M	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO6	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S
CO7	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO8	S	S	S	S	S	S	S	S	S	S	S	S	S	S	M

S=Strong M=Medium W=Weak

REFERENCES:

1. Testing Commissioning operation and maintenance of Electrical Equipments by Rao S, KhannaPublication (Latest edition)

2. Installation, commissioning & maintenance of Electrical equipments by Singh TARLOK,S.K.Kataria & Sons, New Delhi, latest edition

3. Electrical power system by Wadhwa C.L., New Age international Publications.

Course code	**OEC –ME-305**				
Category	**OPEN ELECTIVE COURSES(OEC)**				
Course title	**MICROPROCESSOR AND INTERFACING**				
Scheme and Credits	L	T	P	**Credits**	Semester-VI
	2	0	0	2	
Objectives:	This course deals with the systematic study of the Architecture and programming issues of 8086-microprocessor family and interfacing with other peripheral ICs and co-processor. In addition, various 32-bit and 64 bit microprocessors are introduced. The aim of this course is to give the students basic knowledge of the microprocessors needed to develop the systems using it.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Architecture of 8085: Functional block diagram—Registers, ALU, Bus systems. Pin configuration,Timing and control signals, Machine cycle and timing diagrams. Interrupts—Types of interrupt, interrupt structure.

Programming of 8085: Instruction format, Addressing modes, Instruction set. Development ofassembly language programs.

UNIT-II

Interfacing Devices:(a).The 8255 PPI chip: Architecture, pin configuration, control words, modes andInterfacing with 8085. (b). The 8254 PIC chip: Architecture, pin configuration, control words, modes and Interfacing with 8085.

UNIT-III

Interrupt and DMA controller: The 8259 Interrupt controller chip: Architecture, pin configuration,control words, modes.

Introduction to Microcontrollers, comparison with Microprocessor, Architecture and programming of8051 microcontroller & brief introduction to PIC Microcontroller.

UNIT-IV

Architecture of 8086: Functional block diagram of 8086, details of sub-blocks such as EU, BIU,memory segmentation, physical address computations, pin configuration, program relocation,Minimum and Maximum modes of 8086— Block diagrams and machine cycles. UNIT6. Programming of 8086: Instruction format, Addressing modes, Instruction set and programs.

Course Outcomes:

CO1 To introduce the Architecture of 8085.
CO2 To describe Programming of 8085.
CO3 To understand the 8255 PPI chip.
CO4 To impart knowledge 8254PPI chip.
CO5 To know about Interrupt and DMA controller.
CO6 To instruct about Microcontrollers.
CO7 To Understand Architecture of 8086.
CO8 Gained knowledge about Programming of 8086.

Mapping of Paper No. **OEC –ME-305**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	M	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	M	S	S	S	S	M	S	S	S	S	S
CO6	S	S	S	S	S	S	S	S	S	S	S	S	S	M	S
CO7	M	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO8	S	M	S	S	S	S	M	S	S	S	S	S	S	S	M

S=Strong M=Medium W=Weak

TEXT BOOKS:

1. Microprocessor Architecture, Programming & Applications with 8085: Ramesh S Gaonkar; WileyEastern Ltd.

2. Microprocessor and applications – A.K.Ray. , TMH

REFERENCES:

1. Microprocessors and interfacing : Hall; TMH

2. The 8088 & 8086 Microprocessors-Programming, interfacing,Hardware& Applications :Triebel& Singh; PHI

3. Microcomputer systems: the 8086/8088 Family: architecture, Programming &Design : Yu-ChangLiu & Glenn A Gibson; PHI.

4. Advanced Microprocessors and Interfacing :Badri Ram; TMH.

Course code	**PCC-ME -302**				
Category	Professional Core Courses				
Course title	**Manufacturing Technology-II**				
Scheme and Credits	L	T	P	**Credits**	Semester-VI
	3	0	0	3	
Objectives:	(i) To provide knowledge onmachines and related tools for manufacturing various components. (ii) To understand the relationship between process and system in manufacturing domain. (iii) To identify the techniques for the quality assurance of the products and the optimality of the process in terms of resources and time management.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Mechanism of Metal Cutting: Deformation of metal during machining, nomenclature of lathe, millingtools, mechanics of chip formation, built-up edges, mechanics of orthogonal and oblique cutting, Merchant cutting force circle and shear angle relationship in orthogonal cutting, factors affecting toolforces. Cutting speed, feed and depth of cut, surface finish. Temperature distribution at tool chip interface. Numerical on cutting forces and Merchant circle.

Cutting Tool Materials & Cutting Fluids: Characteristics of tool materials, various types of cutting tool materials, coated tools, cutting tool selection, Types of tool wear, tool life, factors governing toollife, Purpose and types of cutting fluids, basic actions of cutting fluids, effect of cutting fluid on tool life, selections of cutting fluid.

UNIT-II

Unconventional Machining Processes: Abrasive jet machining: Principles, applications, process parameters. Ultrasonic machining: Principles, applications, analysis of process parameters. Electro- chemical machining and grinding: Principles, classifications, choice of electrolytes, applications. Electric discharge machining: Principles, selection of tools materials and dielectric fluid. Electron beam machining: Generation of electron beam, relative merits and demerits. Laser beam machining: Principles and applications.

Jigs & Fixtures: Introduction, location and location devices, clamping and clamping devises, Drill Jigs, Milling Fixtures.

UNIT-III

Numerical Control of Machine Tools; Introduction, Numerical Control & its growth, NC Machines tools, Axes of NC Machines, Classification of NC System, CNC, DNC and Machining Centre. Machine Control unit, NC tools & Tool changer.

Manual Part Programming; coordinate, Feed, Speed & Tool, Preparation & Miscellaneous functions,Examples of two axes part programming for Turning and Milling Operations, G & M Codes.

UNIT-IV

Group Technology; Definition and concept, Group and Family, working of group technology, Stagesfor Adopting Group Technology, Advantages of Group Technology.

Component Classification and Coding, Personnel and Group Technology, Planning the introductionof Group Technology, Group Technology layout.

Course Objectives (COs):

CO 1- Acquire knowledge about mechanics of chip formation and to identify the factors related totool wear and machinability.
CO 2- Learn about different gear manufacturing and gear finishing operations.
CO 3- Select the proper cutting tool material and components of jigs and fixtures.
CO 4- Understand the basics principles of non-conventional machining processes and theirapplications.
CO 5- Identify and select different measuring instruments for the inspection of different components.
CO6 To instruct Group Technology.
CO7 To Understand Component Classification and Coding.
CO8 Gained knowledge about G & M Codes

Mapping of Paper No. **PCC-ME -302**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	S	S	S	S	M	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S
CO3	S	S	S	M	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO6	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S
CO7	S	S	S	S	S	S	S	S	S	S	S	M	S	S	S
CO8	M	S	S	S	S	S	S	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Text Books

1. Manufacturing Technology – Vol. - 2, P.N. Rao, T.M.H, New Delhi
2. Computer Aided Manufacturing: S Kumar & B Kant Khan, Satya Prakashan, New Delhi .

References:

1. Principles of Machine Tools – G.C. Sen & A. Bhattacharya, Tata McGraw Hill, New Delhi
2. Manufacturing Engg.& Tech, Kalpakian, Serope Addison -Wisly Publishing Co. New York.
3. Modern Machining Processes: P.C. Pandey & H.S. Shan, T.M.H. Company, New Delhi
4. Text Book of Production Engineering: P.C. Sharma, S.Chand & Sons.
5. Production Engineering by KC Jain & AK Chilate, PHI, New Delhi

Course code	**PCC-ME -304**				
Category	Professional Core Courses				
Course title	**DESIGN OF MACHINE ELEMENT-I**				
Scheme and Credits	L	T	P	**Credits**	Semester-VI
	3	0	0	3	
Objectives:	This course seeks to provide an introduction to the design of machine elements commonly encountered in mechanical engineering practice, through 1. A strong background in mechanics of materials based failure criteria underpinning the safety-critical design of machine components. 2. An understanding of the origins, nature and applicability of empirical design principles, based on safety considerations. 3. An overview of codes, standards and design guidelines for different elements. 4. An appreciation of parameter optimization and design iteration. 5. An appreciation of the relationships between component level design and overall machine system design and performance.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Design Philosophy: Problem identification- problem statement, specifications, constraints, Feasibility studytechnical feasibility, economic & financial feasibility, societal & environmental feasibility, Generation of solution field (solution variants), Brain storming, Preliminary design, Selection of bestpossible solution, Detailed design, Selection of Fits and tolerances and analysis of dimensional chains.Selection of Materials: Classification of Engg. Materials, Mechanical properties of the commonly used engg. Materials, hardness, strength parameters with reference to stress-strain diagram, Factor ofsafety.

UNIT-II

Mechanical Joints: ISO Metric Screw Threads, Bolted joints in tension, Eccentrically loaded bolted joints in shear and under combined stresses, Design of power screws, Design of various types of welding joints under different static load conditions.Riveted Joints, Cotter & Knuckle Joints: Design of various types of riveted joints under different static loading conditions, eccentrically loaded riveted joints, design of cotter and knuckle joints.

UNIT-III

Belt rope and chain drives: Design of belt drives, Flat & V-belt drives, Condition for Transmission ofmax. Power, Selection of belt, design of rope drives, design of chain drives with sprockets. Keys, Couplings & Flywheel: Design of Keys – Flat, Kennedy Keys, Splines, Couplings design – Rigid & Flexible coupling, turning Moment diagram, coefficient of fluctuation of energy and speed, design of flywheel – solid disk & rimmed flywheels.

UNIT-IV

Clutches: Various types of clutches in use, Design of friction clutches – Disc. Multidisc, Cone & Centrifugal, Torque transmitting capacity.

Brakes: Various types of Brakes, Self energizing condition of brakes, Design of shoe brakes – Internal & external expanding, band brakes, Thermal Considerations in brake designing.

Course Outcomes:

CO 1- Exploration of different concepts & considerations of machine design.

CO 2- Understanding design of different types of mechanical joints.

CO 3- Learning of design of different types of keys & couplings.

CO 4- Design procedure of transmission of shafts.

CO 5- Design of different types springs.

CO6 To instruct about Brakes.

CO7 To Understand Clutches.

CO8 Gained knowledge about Belt rope and chain drives.

Mapping of Paper No. **PCC-ME -304**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	M	S	S	S	M	S	S	S	M	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO6	S	S	S	S	S	S	S	S	S	S	S	S	M	S	S
CO7	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO8	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Note:

1. The paper setter will be required to mention in the note of the question paper that the use offollowing Design Data book is permitted:
2. Design Data Handbook (In SI and Metric Units) for Mechanical Engineers by Mahadevan
3. Design Data Book PSG College of Technology Coimbatore

Text Books:

1. Mechanical Engg. Design - First Metric Editions: Joseph Edward Shigley-MGH, New York.
2. Design of Machine Elements – V.B. Bhandari – Tata McGraw Hill, New Delhi. 5. PSGDesign Data Book

References:

1. Engineering design – George Dieter, MGH, New York.
2. Product Design and Manufacturing, A.K.Chitale and R.C.Gupta, PHI.
3. Machine Design An Integrated Approach: Robert L.Norton, Addison Wesley.
4. Machine Design : S.G. Kulkarini - Tata MacGraw Hill.
5. Design of machine elements-C S Sharma, Kamlesh Purohit, PHI.

Course code	**PCC-ME -306**				
Category	Professional Core Courses				
Course title	**HEAT TRANSFER**				
Scheme and Credits	L	T	P	**Credits**	Semester-V
	3	1	0	4	
Objectives:	(1) The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation. (2) Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations. (3) The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Basics and Laws: Definition of Heat Transfer, Reversible and irreversible processes, Modes of heat flow, Combined heat transfer system and law of energy conservation.

Steady State Heat Conduction: Introduction, I-D heat conduction through a plane wall, long hollow cylinder, hollow sphere, Conduction equation in Cartesian, polar and spherical co-ordinate systems, Numericals.

UNIT-II

Steady State Conduction with Heat Generation: Introduction, 1 – D heat conduction with heat sources,Extended surfaces (fins), Fin effectiveness 2-D heat conduction , Numericals.

Transient Heat Conduction: Systems with negligible internal resistance, Transient heat conduction in plane walls, cylinders, spheres with convective boundary conditions, Chart solution, Relaxation Method, Numericals.

UNIT-III

Convection: Forced convection-Thermal and hydro-dynamic boundary layers, Equation of continuity, Momentum and energy equations, Some results for flow over a flat plate and flow through tube, Fluidfriction and heat transfer (Colburn analogy), Free convection from a vertical flat plate, Empirical relations for free convection from vertical and horizontal o\planes & cylinders, Numericals.

Thermal Radiation: The Stephen-Boltzmann law, The black body radiation, Shape factors and their relationships, Heat exchange between non black bodies, Electrical network for radiative exchange inan enclosure of two or three gray bodies, Radiation shields, Numericals.

UNIT-IV

Heat Exchangers: Classification, Performance variables, Analysis of a parallel/counter flow heat exchanger, Heat exchanger effectiveness, Numericals.

Winglets, Types of Winglets, Heat Transfer Augmentation Process, effect of heat treatment augmentation, Application of heat treatment augmentation process, Heat transfer augmentation in a channel flow.

Heat Transfer with Change of Phase: Laminar film condensation on a vertical plate, Drop-wise condensation, Boiling regimes, Free convective, Nucleate and film boiling, Numericals.

Course Outcome

CO 1- Understand the basic concept of conduction, convection and radiation heat transfer.
CO 2- Formulation of one dimension conduction problems.
CO 3- Application of empirical correlations for both forced and free convection for determines thevalue of convection heat transfer coefficient.
CO 4- Expedite basic concept of the radiation heat transfer for black and grey body.
CO 5- Learning of thermal analysis and sizing of Heat exchangers.
CO6- To know about Heat Exchangers
CO7- To understand about Laminar film condensation
CO8- Gained knowledge about Thermal Radiation.

Mapping of Paper No. **PCC-ME -306**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	M	S	M	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	M	S	S	S	S	S	M	S	S	S	S	S	S
CO6	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO7	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S
CO8	S	S	S	M	S	S	M	S	S	S	S	S	M	S	S

S=Strong M=Medium W=Weak

Text Books:

1. Heat Transfer – J.P. Holman, John Wiley & Sons, New York.
2. Fundamentals of Heat & Mass Transfer–Incropera, F.P. & Dewill, D.P –John Willey New York.
3. Heat Transfer-Principles & Applications-Binay K. Dutta, PHI, New Delhi

References:

1. Conduction of Heat in Solids – Carslow, H.S. and J.C. Jaeger – Oxford Univ. Press.
2. Conduction Heat Transfer – Arpasi, V.S. – Addison – Wesley. 3. Compact Heat Exchangers – W.M. Keys & A.L. Landon, Mc. Graw Hill.
4. Thermal Radiation Heat Transfer – Siegel, R. and J.R. Howell, Mc. Graw Hill.
5. Heat Transmission – W.M., Mc.Adams, Mc Graw Hill.
6. Heat and Mass Transfer, Mohan, Pearson Indian Education Services, Pvt. Ltd. India

Course code	**PCC-ME -308**				
Category	Professional Core Courses				
Course title	**DYNAMICS OF MACHINES**				
Scheme and Credits	L	T	P	**Credits**	Semester-VI
	3	0	0	3	
Objectives:	1) To understand the student with fundamental knowledge of dynamics of machines so that student can appreciate problems of dynamic force balance, transmissibility of forces, isolation of systems, vibrations. 2) Develop knowledge of analytical and graphical methods for calculating balancing of rotary and reciprocating masses. 3) To understand the Special purpose mechanism (governor, Gyroscope Cam and followers etc) used in designing of a machine.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Static and Dynamic Force Analysis: Static force analysis of planer mechanisms, dynamic force analysis including inertia and frictional forces of planer mechanisms.

Dynamics of Reciprocating Engines: engine types, indicator diagrams, gas forces, equivalent masses, inertia forces, bearing loads in a single cylinder engine, crankshaft torque, engine shaking forces.

UNIT-II

Balancing of Rotating Components: static balance, dynamic balance, balancing of rotating masses, two plane balancing, graphical and analytical methods, balancing of rotors, balancing machines, fieldbalancing.

Balancing of Reciprocating Parts: Balancing of single cylinder engine, balancing of multi cylinder; inline, radial and V type engines, firing order.

UNIT-III

Governors: introduction, types of governors, characteristics of centrifugal governors, gravity controlled and spring controlled centrifugal governors, hunting of centrifugal governors, inertia governors.

Dynamometers: types of dynamometers, Prony brake, rope brake and band brake dynamometers, belt transmission dynamometer, torsion dynamometer, hydraulic dynamometer.

UNIT-IV

Gyroscope: gyroscopes, gyroscopic forces and couples, gyroscopic stabilization, ship stabilization,stability of four wheel and two wheel vehicles moving on curved paths.

Course Outcomes

CO 1- Understand the Static and Inertia Force Analysis.
CO 2- Explore the concept of Balancing of rotating and reciprocating masses.
CO 3- Knowledge of concept of Mechanical Governor.
CO 4- Develop the concept of Gyroscope and its application.
CO 5- explore the concept of Mechanical Vibration.
CO6- To know about Dynamometers.
CO7- To understand about ship stabilization.
CO8- Gained knowledge about engine shaking forces.

Mapping of Paper No – **PCC-ME -308**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	M	S	S	M
CO3	S	M	S	S	S	S	S	M	S	S	S	S	S	M	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S	S	S	S	S	S
CO6	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S
CO7	S	S	S	M	S	S	M	S	S	S	S	S	S	S	S
CO8	S	S	S	S	S	S	S	S	S	S	M	S	S	S	S

S=Strong M=Medium W=Weak

Text Books:

1. Theory of Mechanisms and Machines: Amitabha Ghosh and Ashok kumar Mallik, ThirdEdition Affiliated East-West Press.
2. Theory of Machine: S.S. Rattan, McGraw Hill Higher Education.

References:

1. Mechanism and Machine Theory: J.S. Rao and R.V. Dukkipati, New age International.
2. Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr.Second Edition Mc Graw Hill, Inc .
3. Theory of Machines, Beven, Pearson Indian Education Services, Pvt. Ltd.

Course code	**LC-ME -310**				
Category	Engineering Science courses				
Course title	**WORKSHOP LAB -I**				
Scheme and Credits	L	T	P	**Credits**	Semester-VI
	0	0	3	1.5	
Objectives:	To study and practice the various operations that can be performed in lathe, shaper, drilling, milling machines,NC,CNC machine etc. To understanding with the practical knowledge required in the core industries and different types of components using the machine tools.				
Class work mark	25 Marks				
Practical mark	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiments: (MANUFACTURING TECHNOLOGY –II LAB)

1. Study and Practice of Orthogonal & Oblique Cutting on a Lathe.
2. Machining time calculation and comparison with actual machining time while cylindricalturning on a Lathe and finding out cutting efficiency.
3. Study of Tool Life while Milling a component on the Milling Machine.
4. Study of Tool Wear of a cutting tool while Drilling on a Drilling Machine.
5. Study of Speed, Feed, Tool, Preparatory (Geometric) and miscellaneous functions for N. Cpart programming.
6. Part Programming and proving on a NC lathe for:- a. Outside Turning b. Facing and StepTurning c. Taper Turning d. Drilling e. Outside Threading
7. Part Programming and Proving on a NC Milling Machine:-
    a. Point to Point Programming
    b. Absolute Programming
    c. Incremental Programming
8. Part Programming and Proving for Milling a Rectangular Slot.

Course Outcomes:

CO1 To introduce the concept of Orthogonal & Oblique Cutting on a Lathe
CO2 To describe the Milling Machine..
CO3 To understand the Drilling Machine.
CO4 To impart knowledge NC Milling Machine.
CO5 To know about Tool Wear.
CO6 To instruct about Part Programming and Proving for Milling a Rectangular Slot.
CO7 To Understand Part Programming and proving on a NC lathe.
CO8 Gained knowledge about Tool Life.

Mapping of Paper No. **LC-ME -310**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	M	S	S	S	M	S	S	S	S	S	S
CO6	S	S	S	S	S	S	M	S	S	S	S	S	S	S	M
CO7	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO8	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

NOTE:

1. At least Six experiments are to be performed in the Semester.

Course code	**LC-ME -312**				
Category	Engineering Science courses				
Course title	**WORKSHOP LAB -II**				
Scheme and Credits	L	T	P	**Credits**	Semester-VI
	0	0	2	1	
Objectives:	After studying this course, students will be able: Understand the how to prepare the graph between bhp, ihp, fhp vs speed by using variable compression test rig. Knowledge of functions of 4 stroke and two stroke engines and Combustion System of IC Engines with Lubrication and Cooling system.				
Class work mark	25 Marks				
Practical mark	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiments: (I.C. ENGINES & GAS TURBINES LAB)

1. To study the constructional details & working principles of two-stroke/ four stroke petrolengine.
2. To study the constructional detail & working of two-stroke/ four stroke diesel engine.
3. Analysis of exhaust gases from single cylinder/multi cylinder diesel/petrol engine by OrsatApparatus.
4. To prepare heat balance sheet on multi-cylinder diesel engine/petrol engine.
5. To find the indicated horse power (IHP) on multi-cylinder petrol engine/diesel engine byMorse Test.
6. To prepare variable speed performance test of a multi-cylinder/single cylinder petrol engine/diesel engine and prepare the curves (i) bhp, ihp,fhp, vs speed (ii) volumetricefficiency & indicated specific specific fuel consumption vs speed.
7. To find fhp of a multi-cylinder diesel engine/petrol engine by Willian's line method & bymotoring method.
8. To perform constant speed performance test on a single cylinder/multi-cylinder diesel engine & draw curves of (i) bhp vs fuel rate, air rate and A/F and (ii) bhp vs mep, mech efficiency &sfc.
9. To measure CO & Hydrocarbons in the exhaust of 2- stroke / 4-stroke petrol engine.
10. To find intensity of smoke from a single cylinder / multi-cylinder diesel engine.
11. To draw the scavenging characteristic curves of single cylinder petrol engine.
12. To study the effects of secondary air flow on bhp, sfc, Mech. Efficiency & emission of a two-stroke petrol engine.

Course Outcomes:

CO1 To introduce the constructional details & working principles of two-stroke/ four stroke petrolengine
CO2 To describe the constructional detail & working of two-stroke/ four stroke diesel engine.
CO3 To understand heat balance sheet on multi-cylinder diesel engine/petrol engine
CO4 To impart knowledge of horse power (IHP) on multi-cylinder petrol engine/diesel engine by Morse Test.
CO5 To know about the CO & Hydrocarbons in the exhaust of 2- stroke / 4-stroke petrol engine.
CO6 To instruct about the Willian's line method.
CO7 To explain the Efficiency & emission of a two-stroke petrol engine
CO8 Gained knowledge about I.C. Engines & Gas turbines.

Mapping of Paper No. **LC-ME -312**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	M	M	S	S	S	S	S	S
CO2	M	S	S	M	S	M	S	S	S	S	S	S	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	M	S	S	S	S	S
CO6	S	M	S	S	S	M	S	S	S	S	S	S	S	M	M
CO7	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO8	S	S	S	M	S	S	S	S	S	S	S	S	M	S	S

S=Strong M=Medium W=Weak

NOTE:

2. At least ten experimentsare tobe performed in the Semester.
3. At least seven experiments should be performed from the above list. Remaining three experiments may either be performed from the above list or designed & set by the concernedinstitution as perthe scope of the syllabus.

Course code	**LC-ME-314**				
Category	Engineering Science courses				
Course title	**HEAT TRANSFER LAB**				
Scheme and Credits	L	T	P	**Credits**	Semester-V
	0	0	2	1	
Objectives:	(1) The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation. (2) The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.				
Class work mark	25 Marks				
Practical mark	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiments:

1. To determine the thermal conductivity of a metallic rod.
2. To determine the thermal conductivity of an insulating power.
3. Measurement of heat transfer rate in a channel flow using winglets.
4. To determine the thermal conductivity of a solid by the guarded hot plate method.
5. To find the effectiveness of a pin fin in a rectangular duct natural convective condition andplot temperature distribution along its length.
6. To find the effectiveness of a pin fin in a rectangular duct under forced convective and plottemperature distribution along its length.
7. To determine the surface heat transfer coefficient for a heated vertical tube under natural convection and plot the variation of local heat transfer coefficient along the length of the tube.Also compare the results with those of the correlation.
8. To determine average heat transfer coefficient for a externally heated horizontal pipe underforced convection & plot Reynolds and Nusselt numbers along the length of pipe. Also compare the results with those of the correlations.
9. To measure the emmisivity of the gray body (plate) at different temperature and plot thevariation of emmisivity with surface temperature.
10. To find overall heat transfer coefficient and effectiveness of a heat exchange under parallel and counter flow conditions. Also plot the temperature distribution in both the cases along thelength of heat of heat exchanger.
11. To verify the Stefen-Boltzmann constant for thermal radiation.
12. To demonstrate the super thermal conducting heat pipe and compare its working with that of the best conductor i.e. copper pipe. Also plot temperature variation along the length with timeor three pipes.
13. To study the two phases heat transfer unit.
14. To determine the water side overall heat transfer coefficient on a cross-flow heat exchanger.
15. Design of Heat exchanger using CAD and verification using thermal analysis package eg. I-Deas etc.

Course Outcomes:

CO1 To introduce the thermal conductivity.
CO2 To describe heat transfer rate.
CO3 To understand the Stefen-Boltzmann constant for thermal radiation.
CO4 To impart knowledge of Design of Heat exchanger using CAD.
CO5 To know about heat transfer coefficient.
CO6 To instruct about guarded hot plate method.
CO7 To Understand two phases heat transfer unit..
CO8 Gained knowledge about heat transfer.

Mapping of Paper No. **LC-ME-314**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	M	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	M	S	S	S	S	M	S	S	S	S	S
CO6	S	S	S	S	S	S	S	S	S	S	S	S	S	M	S
CO7	M	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO8	S	M	S	S	S	S	M	S	S	S	S	S	S	S	M

S=Strong M=Medium W=Weak

Note:

1. At least ten experiments are to be performed in the semester.
2. At least seven experiments should be performed from the above list. Remaining three experimentsmay either be performed from the above list or designed & set by the concerned institute as per the scope of the syllabus.

Course code	**LC-ME-316**				
Category	Engineering Science courses				
Course title	**DYNAMICS OF MACHINE LAB**				
Scheme and Credits	L	T	P	**Credits**	Semester-VI
	0	0	2	1	
Objectives:	1. Tounderstand the student with fundamental knowledge of dynamics of machines so that student can appreciate problems of dynamic force balance, transmissibility of forces, isolation of systems, vibrations. 2. Develop knowledge of analytical and graphical methods for calculating balancing of rotary and reciprocating masses.				
Class work mark	25 Marks				
Practical mark	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiments:

1. To perform experiment on Watt and Porter Governors to prepare performance characteristicCurves, and to find stability & sensitivity.
2. To perform experiment on Proell Governor to prepare performance characteristic curves, andto find stability & sensitivity.
3. To perform experiment on Hartnell Governor to prepare performance characteristic Curves,and to find stability & sensitivity.
4. To study gyroscopic effects through models.
5. To determine gyroscopic couple on Motorized Gyroscope.
6. To perform the experiment for static balancing on static balancing machine.
7. To perform the experiment for dynamic balancing on dynamic balancing machine.
8. Determine the moment of inertial of connecting rod by compound pendulum method and tri-flair suspension pendulum.

Course Outcomes:

CO 1- Understand the various practical demonstrations of forces in mechanism.

CO 2- Knowledge of various Design features of mechanism with practical demonstration.

CO 3- Learning the Special purpose mechanism (governor, Gyroscope Cam and followers etc) used indesigning of a machine

CO 4- Prepare practical model using the various linkages.

CO5- To know about Watt and Porter Governors.

CO6- To understand Proell Governor

CO7- To instruct about Motorized Gyroscope

CO8- Gained knowledge about dynamic balancing

Mapping of Paper No – **LC-ME-316**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO3	S	S	S	M	S	S	S	S	S	M	S	S	S	M	S
CO4	M	S	S	S	M	S	S	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	M	S	S	M	S	S	S	S	S	S
CO7	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO8	S	S	S	S	S	S	S	S	S	S	M	S	S	S	S
		M	S	S	S	S	M	S	S	S	M	S	S	S	S

S=Strong M=Medium W=Weak

Note :

1. Ten experiments are to be performed in the Semester.
2. At least seven experiments should be performed from the above list. Remaining three experiments should be performed as designed & set by the concerned Institution as per thescope of the syllabus.

<table>
<tr><td>Course code</td><td colspan="5">PCC-ME -318</td></tr>
<tr><td>Category</td><td colspan="5">Professional Core Courses</td></tr>
<tr><td>Course title</td><td colspan="5">SEMINAR</td></tr>
<tr><td rowspan="2">Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td rowspan="2">Semester-VI</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td>Objectives:</td><td colspan="5">1. To teach the student how to face interview and presentation given and remove their hesitation and improve their communications skills and overall personal developments.</td></tr>
<tr><td>Practical Class mark</td><td colspan="5">25 Marks</td></tr>
<tr><td>Total</td><td colspan="5">25Marks</td></tr>
<tr><td>Duration of Exam</td><td colspan="5">03 Hours</td></tr>
</table>

Selecting of Seminar Topics by Teacher or concerned to teacher by students. A seminar topic givenby students in semester.

Course code	**PEC-ME -320**				
Category	Professional Elective Courses				
Course title	**INTERNAL COMBUSTION ENGINES & GAS TURBINES**				
Scheme and Credits	L	T	P	**Credits**	Semester-VI
	3	0	0	3	
Objectives:	1. To familiarize with the terminology associated with IC engines. 2. To understand the basics of IC engines. 3. To understand combustion, and various parameters and variables affecting it in various types of IC engines. 4. To learn about various systems used in IC engines and the type of IC engine required for various applications				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Air Standard Cycles: Internal and external combustion engines; classification of I.C. Engines, Cyclesof operation in four stroke and two stroke I.C. Engines, Wankel Engines, Assumptions made in air standard cycle; Otto cycle; diesel cycle, dual combustion cycle, comparison of Otto, diesel and dual combustion cycles; sterling and Ericsson cycles; air standard efficiency, specific work output, specificweight; work ratio; mean effective pressure; deviation of actual engine cycle from ideal cycle. Problems.

Carburetion, fuel Injection and Ignition systems: Mixture requirements for various operating conditions in S.I. Engines; elementary carburetor, Requirements of a diesel injection system; types ofinject systems; petrol injection, Requirements of ignition system; types of ignition systems ignition timing; spark plugs. Problems.

UNIT-II

Combustion in I.C. Engines: S.I. engines; Ignition limits; stages of combustion in S.I. Engines; Ignition lag; velocity of flame propagation; detonation; effects of engine variables on detonation; theories of detonation; octane rating of fuels; pre-ignition; S.I. engine combustion chambers, Stages ofcombustion in C.I. Engines; delay period; variables affecting delay period; knock in C.I. engines, Cetane rating; C.I. engine combustion chambers.

Lubrication and Cooling Systems: Functions of a lubricating system, Types of lubrication system; mist, wet sump and dry sump systems; properties of lubricating oil; SAE rating of lubricants, engine performance and lubrication, Necessity of engine cooling; disadvantages of overcooling; cooling systems; air-cooling, water cooling; radiators.

UNIT-III

Engine Testing and Performance: Performance parameters: BHP, IHP, mechanical efficiency, brake mean effective pressure and indicative mean effective pressure, torque, volumetric efficiency; specific fuel consumption (BSFC, ISFC), thermal efficiency; heat balance; Basic engine measurements; fuel and air consumption, brake power, indicated power and friction power, heat lost to coolant and exhaust gases; performance curves. Problems.

Air pollution from I.C. Engine and Its remedies: Pollutants from S.I. and C.I. Engines, Methods of emission control; alternative fuels for I.C. Engines; the current scenario on the pollution front.

UNIT-IV

Rotary Compressors: Root and vane blowers; Static and total head values; Centrifugal compressors- Velocity diagrams, slip factor, ratio of compression, pressure coefficient, pre-whirl; Axial flow compressor- Degree of reaction, polytropic efficincy, surging, choking and stalling, performance characteristics, Problems.

Gas Turbines: Brayton cycle; Components of a gas turbine plant; open and closed types of gas turbine plants; Optimum pressure ratio; Improvements of the basic gas turbine cycle; multi stage compression with intercooling; multi stage expansion with reheating between stages; exhaust gas heatexchanger, Applications of gas turbines. Problems.

Course Outcomes

CO 1- Understand the Air Standard Cycles with their applications.
CO 2- Analyze carburetion, injection and ignition systems with new technologies.
CO 3- Conceptualize Combustion System of IC Engines.
CO 4- Knowledge of Lubrication and Cooling systems and fuel cells.
CO 5- Analyses the gas turbines.
CO6- To instruct about Brayton cycle
CO7- To Understand Air pollution from I.C. Engine and Its remedies
CO8- Gained knowledge about Engine Testing.

Mapping of Paper No – **PEC-ME -320**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO2	S	M	S	S	S	S	S	S	S	S	M	S	S	S	M
CO3	S	S	S	M	S	S	S	M	S	S	S	S	S	S	S
CO4	M	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	M	S	S	S	S	S	S
CO6	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO7	S	S	S	S	S	S	M	S	S	S	M	S	S	S	S
CO8	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Text Books:

1. Internal Combustion Engines –V. Ganesan, Pub.-Tata McGraw-Hill.
2. Gas Turbines - V. Ganesan, Pub.- Tata McGraw Hill.
3. Engineering fundamental of the I.C.Engine – Willard W. Pulkrabek Pub.-PHI,India

References:

1. Internal Combustion Engines & Air pollution- Obert E.F, Pub.-Hopper & Row Pub., NewYork
2. Internal Combustion Engines Fundamentals- John B. Heywood, Pub.-McGraw Hill, NewYork
3. Fundamentals of Internal Combustion Engines-H.N. Gupta, PHI, New Delhi

Course code	**PEC-ME -322**				
Category	Professional Elective Courses				
Course title	**WELDING TECHNOLOGY**				
Scheme and Credits	L	T	P	**Credits**	Semester-VI
	3	0	0	3	
Objectives:	1.To study essential concepts for welding processes. 2.To study various techniques for weld testing. 3. To study the concept special welding processes and welding automation.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Oxy-Acetylene Welding: Introduction: Welding processes and their principles, Industrial Applications, Principles of Oxy- Acetylene Welding, Procedure, Types of flames, Poping, Flash Backand Fire. Equipment and Accessories: Torches, Regulators, Pressure Gauges, Gas Cylinders, Filler Rods and Welding Fluxes. Welded Joints and their Defects: Types of Joints and Welding Positions, Common Welding Defects and their control.

Automation in Welding: Introduction, Manual Welding, Semi-Automatic Welding, Automatic Welding, Welding Mechanization, Flexible Automated Welding, Robotic Welding, Types of WeldingRobots, Robot Selection Mechanics, Joint tracking system.

UNIT-II

Electric Arc Welding: Principle of Electric Arc Welding: Principle, Welding Procedure, Arc Length,Arc Force and Arc Blow. Equipment and Accessories: Welding Machines, A.C. and D.C. Transformers, Motor Generators, Rectifiers, Use of Tong Tester for measuring welding currents, Types of Electrodes and Indian system of classification and coding of covered Electrodes for Mild Steels.

UNIT-III

Special and Allied Welding Processes: Resistance Welding: Principle, Types and Applications, Equipment and Machinery required. Metal Inert Gas Arc Welding (MIG): Principle, Advantage of Gas Shielded Arc Welding, Types of Metal Transfer, Welding Equipment and Shielding Gases, MIGWelding and its components.CO_2 Welding: Difference from MIG Welding, Principle of operation, Welding Equipments, Welding Parameters, Joint Design, Welding Procedure, Advantages, Disadvantages and Applications. Tungsten Inert Gas Arc Welding: Welding Equipment-Electrodes,Inert gases and Torches, Inert gas shielded, Spot welding Processes. Submerged Arc Welding:

Principle of the Process and its Applications, Fluxes and Welding Rods. Soldering and Brazing: Soft and Hard Solders, Fluxes, Soldering Iron, Soldering procedure, principle of Brazing and different methods of Brazing, Comparison between Brazing and Soldering.

UNIT-IV

Destructive Testing of Welds: Destructive tests: their advantage and Types such as Tensile Test, BendTest, Impact Test, Hardness Test, Fatigue Tests, Equipment required and the test piece Geometry.
Computer systems for Welding Engineering: Introduction, computer systems, software for weldingengineers, magdata, weld cost, weld vol, distortcalc, cut best, weld best, ferrite predictor and weld selector.

Non Destructive Testing of Welds: Non Destructive Tests: their Advantages and Limitations, Comparison with Destructive Tests, Visual Examination, Dye Penetrant Inspection, Magnetic ParticleInspection, X-Rays and Gamma Rays Inspection and Ultrasonic Inspection of Welds. Standards/ codes for welding.

Course Outcomes:

CO1 To introduce the concept Oxy-Acetylene Welding.
CO2 To describe the Automation in Welding.
CO3 To apply the concept of Electric Arc Welding.
CO4 To impart knowledge of Metal Inert Gas Arc Welding (MIG).
CO5 To know about the Tungsten Inert Gas Arc Welding.
CO6 To instruct about the BendTest.
CO7 To explain the Magnetic ParticleInspection.
CO8 Gained knowledge about X-Rays and Gamma Rays Inspection.

Mapping of Paper No. **PEC-ME -322**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	M	S	S	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	M	S	S	M
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	M	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S	S	S	S	S	S
CO6	M	S	S	S	S	M	S	S	S	S	S	S	S	S	S
CO7	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO8	S	S	S	M	S	S	M	S	S	M	S	S	M	S	S

S=Strong M=Medium W=Weak

Text Books: 1. Welding and Welding Technology by R. Little- Tata McGraw Hill Publication.

2. Welding Processes and Technology by R. S. Parmar- Khanna Publication.

References:

1. Welding Technology by Koeingsberger, J. R. Adair- Macmillan.

2. Welding Technology by Rossi- Mc Graw Hill Publications.

3. Welding Handbook, Eighth Edition, Vol. 1 & 2- American Welding Society.

4. Welding, Hoffman, Pearson Indian Education Services, Pvt. Ltd. India

Course code	**PEC-ME -324**				
Category	Professional Elective Courses				
Course title	**AIRCRAFT TECHNOLOGY**				
Scheme and Credits	L	T	P	**Credits**	Semester-VI
	3	0	0	3	
Objectives:	To understand the principles of operation of aircrafts, aerodynamics, general familiarization of aircraft engine systems, maintenance procedures and standard practices.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Principles of Flight: History of flights, Aircraft configurations, Flight control systems; Mechanicalcontrol, Powered control, Fly-By-Wire and digital Fly-By-Wire control systems, flying limits, Airframe & engine manufacturers.

Aircraft Thermodynamics: First law of thermodynamics, Second law of thermodynamics, Airstandard cycles, Brayton cycle & its variants.

UNIT-II

Aircraft Propulsion: Thrust, Thrust equation, Propulsive efficiency, Factors effecting thrust, Fundamentals of gas turbine engines, Aircraft engine construction, Classification of compressors; centrifugal and axial compressor, Effect of pressure, velocity & temperature change through the compressor, classification of combustion chambers and performance, classification of gas turbines &operation, convergent/divergent nozzles, Type of aircraft engines; turbo jet, turbo-prop & turbo fanengines.

UNIT-III

Aerodynamics of Airplanes: Basics of aerodynamics, Wing airfoil profile and effects, Thrust, drag,lift & gravity, Control surfaces; aileron, elevator, rudder, slat, flap & spoiler, servo tab etc. Thrust reversers.

Engine Systems, Inspection& Maintenance: Fuel system, Lubrication system, Compressor air flow control system, Turbine vanes and blade cooling, Full authority digital electronic engine control, Engine starting and ignition, Fire protection system, Engine Inlet cowling anti icing, environmentalcontrol system, engine indicating system, Standard practices of aero engine maintenance, engine overhauling, Bore scope inspection.

UNIT-IV

Miscellaneous Aviation: Concepts and flight of Helicopter, Drone, Air taxi, Rocket etc. History &overview of air war fare, Difference between civil & fighter craft aerodynamics & engines,

Development &types of fighter crafts, fighter craft weapons & firing, Safety, maintenance &emergency features. Maritime fighters.

Course Outcomes:

CO1 To introduce the Principles of Flight.
CO2 To describe the Aircraft Thermodynamics.
CO3 To apply the concept of Aircraft Propulsion.
CO4 To impart knowledge of turbo fanengines
CO5 To know about the Aerodynamics of Airplanes.
CO6 To instruct about the Engine Systems, Inspection& Maintenance.
CO7 To explain the Concepts and flight of Helicopter.
CO8 Gained knowledge about Maritime fighters.

Mapping of Paper No. **PEC-ME -324**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	M	M	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	S	S	S	S	S	S	S	S	M	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S	S	S	S	S	S
CO6	S	S	S	S	S	M	S	S	S	S	S	S	S	M	S
CO7	S	S	M	S	S	S	S	S	S	S	S	S	S	S	S
CO8	S	S	S	M	S	S	M	S	S	M	S	S	M	S	S

S=Strong M=Medium W=Weak

References:

1. Kermode, A.C. Flight without formulae, Pearson Education; latest edition

2. Anderson, J.D. Introduction to flights, McGraw-Hill latest edition

3. Engineering Thermodynamics- P K Nag, Tata McGraw Hill

4. Thermodynamics: An Engineering Approach- Cengel and Boles, McGraw Hill Company

5. Hill P.G & Peterson, C.R. "Mechanics & Thermodynamics of propulsion" Pearson education latestedition

6. United Technologies' Pratt & Whitney, "The Aircraft Gas Turbine Engine and its Operation

7. Kroes & Wild, "Aircraft Power Plants", 7th Edition- McGraw Hill, New York, latest edition

8. Mekinley, J.L and R.D. Bent, Aircraft Power Plants, McGraw Hill latest edition

9. Teager, S, "Aircraft Gas Turbine Technology, McGraw Hill latest edition

10. Aviation Maintenance Technician Hand Book- Power Plant Volume -2 FAA-H-8083-32.

Course code	**PEC-ME -326**				
Category	Professional Elective Courses				
Course title	**RELIABILITY, AVAILABILITY & MAINTAINABILITY**				
Scheme and Credits	L	T	P	**Credits**	Semester-VI
	3	0	0	3	
Objectives:	The objective of the course is to provide the students with the fundamental concepts, the necessary knowledge and the basic skills related to systems reliability, availability and maintainability.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Introduction to Reliability Availability and Maintainability (RAM), Development of RAM Engineering, Reliability Availability and Maintainability utilization factors, down time consequences.Failure data analysis, MTBF, MTBR, MTTR, Reliability improvement and apportionment;

UNIT-II

Concept of terro-technology; Statistical distribution associated with reliability engineering.; Quantitative measures of reliability, Bath tub curve; Quantitative; Fault tree analysis (FTA),Failuremode and effect analysis (FMEA), Failure mode, effect and criticality analysis (FMECA).

UNIT-III

Reliability engineering fundamentals and applications, Historical perspectives, Definition of Reliability, Role of Reliability evaluation, Reliability assessment, relationship between Different Reliability functions, typical Hazard functions, Mean time to failure, Cumulative Hazard function andaverage failure rate.

Application of Probability distribution function in Reliability evaluation combinational Aspects of Reliability, Markov models optimization of system Reliability, Heuristic Methods applied to optimalsystem Reliability.

UNIT-IV

Maintainability : Definition and application of Maintainability Engineering, Factors affecting Maintainability. Maintainability design criteria,

operating and down time categories, Mean time to activity restore equipment, Mean Maintenance man hours, Mean time for corrective and PreventiveMaintenance, measures of maintainability and measures to assure maintainability.

Availability, types of Availability, Steady state availability, approaches to increase equipmentAvailability, Markov analysis of availability.

Course Outcomes:

CO1 To introduce the RAM Engineering.
CO2 To describe the Fault tree analysis (FTA).
CO3 To apply the concept Failure data analysis.
CO4 To impart knowledge of Quantitative measures of reliability.
CO5 To know about the Application of Probability distribution function.
CO6 To instruct about the Heuristic Methods.
CO7 To explain the approaches to increase equipment Availability.
CO8 Gained knowledge about Markov analysis of availability.

Mapping of Paper No. **PEC-ME -326**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	M	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	M	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	M	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO6	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S
CO7	S	S	M	S	S	S	S	S	S	S	S	S	S	S	S
CO8	S	S	S	S	S	S	M	S	S	M	S	S	M	S	S

S=Strong M=Medium W=Weak

References:

1. Reliability Engineering Fundamentals R. Ramakumar2 Maintainability, Availability and Dimitri

Kececelogu

3. Reliability Engineering Govil

4. Reliability Engineering Balguruswamy

5. Elsayed A. Elsayed, Reliability is Engineering, Addison Wesley, latest edition

6.Cher Ming Tan, “Reliability Assessment of Integrated Circuits and its misconception”, NovaScience Publisher, Inc, latest edition

Course code	**HSMC-02**				
Category	**HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES (HSMC)**				
Course title	**ORGANIZATIONAL BEHAVIOUR**				
Scheme and Credits	L	T	P	**Credits**	Semester-V
	2	0	0	2	
Objectives:	The objective of this course is to expose the students to basic concepts of management and provide insights necessary to understand behavioral processes at individual, team and organizational level.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Introduction of Management- Meaning, definitions, nature of management; Managerial levels, skills and roles in an organization; Functions of Management: Planning, Organizing, staffing, Directing & Controlling, Interrelationship of managerial functions, scope of management & Importance of management. Management and social responsibility, difference between management and administration.

UNIT-II

Introduction of organization:-Meaning and process of Organization, Management v/s Organization; Fundamentals of Organizational Behavior: Concepts, evolution, importance and relationship withother Fields; Contemporary challenges and opportunities of OB.

Individual Processes and Behavior-Personality- Concept, determinants and applications; Perception- Concept, process and applications, Learning- Concept ,theories ; Motivation- Concept, techniques and importance.

UNIT-III

Interpersonal Processes- Teams and Groups- Definition of Group, Stages of group development, Types of groups, meaning of team, merits and demerits of team; difference between team and group, Conflict- Concept, sources, types, management of conflict; Leadership: Concept, function, styles & qualities of leadership.

Communication – Meaning, process, channels of communication, importance, barriers and overcomeof communication.

UNIT-IV

Organizational Processes: Organizational structure - Meaning and types of organizational structure and their effect on human behavior; Organizational culture - Elements, types and factors affecting organizational culture. Organizational change: Concept, types & factors affecting organizational change, Resistance to Change.

Course Outcomes:

CO1 To introduce the Management.
CO2 To describe the difference between management and administration.
CO3 To apply the Fundamentals of Organizational Behavior.
CO4 To impart knowledge of Individual Processes.
CO5 To know about the Teams and Groups.
CO6 To instruct about the Communication.
CO7 To explain the Organizational structure.
CO8 Gained knowledge about Organizational change.

Mapping of Paper No. **HSMC-02**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	M	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO4	M	S	S	S	S	M	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	M	S	S	S	S	S
CO6	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO7	S	S	S	M	S	S	S	S	S	S	S	S	S	M	S
CO8	S	S	S	S	S	S	M	S	S	S	S	S	M	S	S

S=Strong M=Medium W=Weak

References:

1. Robbins, S.P. and Decenzo, D.A. Fundamentals of Management, Pearson Education Asia, NewDelhi.
2. Stoner, J et. al, Management, New Delhi, PHI, New Delhi.
3. Satya Raju, Management – Text & Cases, PHI, New Delhi.
4. Kavita Singh, Organisational Behaviour: Text and cases. New Delhi: Pearson Education.
5. Pareek, Udai, Understanding Organisational Behaviour, Oxford University Press, New Delhi.
6. Robbins, S.P. & Judge, T.A., Organisational Behaviour, Prentice Hall of India, New Delhi.
7. Ghuman Karminder, Aswathappa K., Management concept practice and cases, Mc Graw Hilleducation.
8. Chhabra T. N., Fundamental of Management, Sun India Publications-New Delhi.

Course code	**HSMC-04**				
Category	**HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES (HSMC)**				
Course title	**HUMAN RESOURCE MANAGEMENT**				
Scheme and Credits	L	T	P	**Credits**	Semester-V
	2	0	0	2	
Objectives:	1. To acquaint the students with the concept and function of human resource management 2. To learn the various human resource systems and programme in an organization to achieve higher productivity 3. To acquaint the students with knowledge of career planning and development, occupational safety, health and wellbeing and union management relationship.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Human Resource Management: concept and scope; Roles, responsibilities and competencies of HR manager; Challenges to HR professionals; Human Resource Planning & Forecasting: significance andprocess.

UNIT-II

HR Sourcing: Recruitment, Selection and Induction. Job Analysis: job Description and job Specification; Job Design: concept and methods; Job Evaluation-concept &methods; Performanceappraisal and counselling.

UNIT-III

Training: training process and methods; Career planning and Development; Succession planning;Employee Compensation: basic concepts & determinants;

UNIT-IV

Industrial Relations and Grievance Handling; Employee welfare; Dispute Resolution; InternationalHuman Resource Management; Contemporary Issues in HRM. HR Audit &Accounting, ethics & corporate social responsibility.

Course Outcomes:

CO1 To introduce the Human Resource Management.
CO2 To describe the Human Resource Planning.
CO3 To apply the HR Sourcing.
CO4 To impart knowledge of Job Evaluation-concept &methods.
CO5 To know about the training process and methods.
CO6 To instruct about the Employee Compensation.
CO7 To explain the Industrial Relations.
CO8 Gained knowledge about HR Audit &Accounting.

Mapping of Paper No. **HSMC-04**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	M	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	M	S	S	S	S	S	S	S	S	S	S	S
CO4	M	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	M	S	S	S	S	S
CO6	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO7	S	S	S	S	S	S	S	S	S	S	S	S	S	M	S
CO8	S	S	S	S	S	M	S	S	S	S	S	S	M	S	S

S=Strong M=Medium W=Weak

Suggested Readings:

1) K. Aswathapa Human resource Management: Text and cases, 6th edition, Tata McGraw Hill,New Delhi,2012
2) Uday Kumar Haldar &Juthika Sarkar(2012) Human resource Management New Delhi,Oxford University Press.
3) De Cenvo, Da & Robbins S.P.(2010) Fundamentals of Human Resource Management, 9thedition, New York, John Wiley & Sons.
4) Gary Dessler (2008) Human Resource Management, 11th edition New Delhi: PearsonPrentice Hall.
5) Tanuja Agarwala, Strategic Human resource Management, Oxford University Press 2007.

References:

1) 1.Handbook of Industrial and Organizational Psychology: Personnel Psychology(Vol. 1).New Delhi: Sage Publications, New Delhi. Armstrong, M. latest edition
2) 2.A Handbook of Human Resource Management Practice (9th ed.). New Delhi : Kogan PageIndia, Aswathappa, K. latest edition
3) 3.Managing Human Resources. India: Thomson Asi Private Limited. Bratton, J. & Gold, J.latest edition
4) 4.Human Resource Management Theory and Practice (4th ed.), New York, NY: PalgraveMacmillan. Cascio, W.F &Aguinis, H. latest edition

Course code	**HSMC-06**				
Category	**OPEN ELECTIVE COURSES(OEC)**				
Course title	**INDUSTRIAL PSYCHOLOGY**				
Scheme and Credits	L	T	P	**Credits**	Semester-V
	2	0	0	2	
Objectives:	1. To acquaint students with the applications of psychometric tools and inventories in organizations 2. To acquaint the students with the tools of behavioral and organizational interventions & develop the skills to analyze behavioral issues in organizations. 3. To gain an understanding of the functioning of an organizations through organized field visit. 4. To gain firsthand experience through focused group discussions.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Structured Experience Students need to learn to plan, design and conduct the structured exercises in any of the following areas under supervisor supervision: self-awareness, team building, interpersonal skills, leadership skills, perception, decision-making and problem solving, creativity, power and politics, communication skills, conflict, stress management, motivation and goal setting, or any recent developments.

UNIT-II

HRD Instruments: (any five: administered, scored, interpreted and discussed) Role efficacy, role stress, coping styles, HRD climate, TOBI, SPRIO, MAOB, emotional intelligence, ENNEAGRAM, conflict management styles, OCTAPACE, leadership, trust, life and goal planning or any recent developments.

Field Visit: Students will get firsthand experience of the organization. Can take up any project given by the organization and write a report. A student can undertake specific or overall activity of the organizations in consultation with the supervisor. The student can choose any organization and write a report: education sector, government sector, health sector, conflict management styles, service industry, NGO, or any recent developments.

UNIT-III

Force-field Analysis and Appreciative Inquiry Students will conduct with the help of supervisor all the steps of force field analysis (identifying the problem and identifying the desired state; identifying the forces involved, and determining the strengths of each force. Action plans for

increasing driving forces and reducing restraining forces and appreciative inquiry (4 D approach: discovery, dreaming, designing and destiny) as an OD intervention. After conducting the same students will write the reportof the same.

UNIT-IV

Focused Group Discussion Either students conduct a focus group based on need diagnostic or problem focused group study in any area of consumer behavior (customers of sales, retail, banking, insurance, aviation etc) or industrial / organizational psychology/human resource and submit a report.

a) Select the team b) Select the participants c) Decide on time and location d) Prepare for and conductfocus group discussion e) Submit a report .

Course Outcomes:

CO1 To introduce the HRD Instruments.
CO2 To describe the stress management.
CO3 To understand the NGO.
CO4 To impart knowledge of leadership.
CO5 To know about the field Analysis.
CO6 To instruct about the 4 D approach.
CO7 To explain the Group Discussion.
CO8 Gained knowledge about industrial / organizational psychology.

Mapping of Paper No. **HSMC-06**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	M	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	M	S	S	S	S	S
CO6	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO7	S	S	M	S	S	S	S	S	S	S	S	S	S	S	S
CO8	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

References:

1. Barbour, R. (2007). Doing Focus Groups. Los Angeles: Sage Publications. Clark, A.W. latestedition
2. Experimenting with organizational life: The action research approach. New York: PlenumPress. Cooperrider, D.L., Whitney, D. &Stavros, J.M. latest edition
3. Appreciative Inquiry Handbook: For Leaders of Change (2nd ed.). San Francisco, USA:Berrett – Koehler Publishers Inc. French, W.L., Cecil, H.B., & Vohra, V. latest edition
4. Organizational Development: Behavioral Science Interventions for Organization Improvement (latest ed.). New Delhi: Prentice Hall. Krueger, R.A., Casey, M.A. latest edition
5. Focus Groups: A practical guide for Applied Research (latest ed.). Los Angeles: SagePublications, Los Angeles. Litosselitti, L. latest edition
6. Using Focus Groups in Research. New York, NY:Continuum. Pareek, U. & Purhoit, S. latestedition
7. Training Instruments in HRD and OD (3rd ed.). New Delhi: Tata McGraw Hill. Pfeiffer, J.W.&Jones, J.E. latest edition
8. A Handbook of structured Experiences for Human Relations Training. San Diego, CA:University Associates Inc. Sayeed, O.B & Pareek, U. latest edition
9. Actualizing Managerial Roles: Studies in Role Efficacy. New Delhi: Tata McGraw – HillPublishing Company Limited. Watkins, J.M., Bernard, J., Kelly, M.R. latest edition
10. Appreciative Inquiry: Change at the Speed of Imagination (2nd ed.). USA: John Wiley andSons Inc.

Course code	**HSMC-08**				
Category	**HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES (HSMC)**				
Course title	**FUNDAMENTALS OF MANAGEMENT**				
Scheme and Credits	L	T	P	**Credits**	Semester-V
	2	0	0	2	
Objectives:	Students will be able to understand the how evolution of Management and contribution of Management thinkers. The importance of staffing and training ;the concept of material management and inventory control; the components of marketing and advertising ;various sources of finance and capital structure.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Meaning of management, Definitions of Management, Characteristics of management, Managementvs. Administration. Management-Art, Science and Profession. Importance of Management.

Development of Management thoughts. Principles of Management. The Management Functions, Inter-relationship of Managerial functions. Nature and Significance of staffing, Personnel management, Functions of personnel management, Manpower planning, Process of manpower planning, Recruitment, Selection; Promotion - Seniority Vs. Merit. Training - objectives and typesof training.

UNIT-II

Production Management : Definition, Objectives, Functions and Scope, Production Planning and Control; its significance, stages in production planning and control. Brief introduction to the conceptsof material management, inventory control; its importance and various methods.

UNIT-III

Marketing Management - Definition of marketing, marketing concept, objectives & Functions of marketing. Marketing Research - Meaning; Definition; objectives; Importance; Limitations; Process. Advertising - meaning of advertising, objectives, functions, criticism.

UNIT-IV

Introduction of Financial Management, Objectives of Financial Management, Functions and Importance of Financial Management. Brief Introduction to the concept of capital structure andvarious sources of finance.

Course Outcomes:

CO1 To introduce the Management.
CO2 To describe the Principles of Management.
CO3 To understand the Production Management.
CO4 To impart knowledge of inventory control.
CO5 To know about the Marketing Management.
CO6 To instruct about the Marketing Research.
CO7 To explain the Financial Management.
CO8 Gained knowledge about capital structure.

Mapping of Paper No. **HSMC-08**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	M	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	M	S	S	S	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S	M	S
CO6	S	M	S	S	S	S	S	S	S	S	S	S	S	S	S
CO7	M	S	S	S	S	S	S	S	S	S	S	M	S	S	S
CO8	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

TEXT BOOKS:

1. Principles and Practice of Management - R.S. Gupta, B.D.Sharma, N.S.Bhalla.(Kalyani Publishers)

2. Organisation and Management - R.D. Aggarwal (Tata Mc Graw Hill)

REFERENCES:

1. Principles & Practices of Management – L.M. Prasad (Sultan Chand & Sons)

2. Management – Harold, Koontz and Cyrilo Donell (Mc.Graw Hill).

3. Marketing Management – S.A. Sherlikar (Himalaya Publishing House, Bombay).

4. Financial Management - I.M. Pandey (Vikas Publishing House, New Delhi)

5. Management - James A.F. Stoner & R.Edward Freeman, PHI.

Indira Gandhi University MeerpurRewari

(A State University established under Haryana Act No.29 of 2013)

Examination Scheme & Syllabus for B.Tech (Mechanical Engineering)
Semester- 7th & 8th

OUTCOME BASED EDUCATION SYSTEM / LEARNING OUTCOME CURRICULUM FRAMEWORK OBES / LOCF,

CBCS CURRICULUM (w.e.f. 2021-22)

VISION AND MISSION OF THE DEPARTMENT

VISION

To make contribution in the development of nation and evolution of technology by creating highly ethical professionals in Mechanical Engineering who are technically competent and are aware of their social responsibilities

MISSION

- To produce highly qualified, socially responsible, ethical and motivated students having sound theoretical and practical knowledge of Mechanical Engineering as well as communicative skills who can serve the nation as well as at global level.
- To inspire students to be a part of research and development activities.
- To encourage students to participate in conferences, workshops, seminars and research activities.

COURSE CODE AND DEFINITIONS:

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
OEC	Open Elective Courses
PCC	Professional Core Courses
LC	Laboratory Courses
MC	Mandatory Courses
PT	Practical Training
S	Seminar
TH	Theory
Pr	Practical
PROJ	Project
INTPR	Industrial Training Project

General Notes:

1. Mandatory courses are non credit courses in which students will be required passing marks in internalassessments.
2. Students will be allowed to use non programmable scientific calculator. However, sharing of calculator will notbe permitted in the examination.
3. Students will be permitted to opt for any elective course run by the department. However, the department shall offer those electives for which they have expertise. The choice of the students for any elective shall not be binding for the department to offer, if the department does not have expertise. To run the elective course a minimum of 1/3rdstudents of the class should opt for it.

Indira Gandhi University, Meerpur, Rewari

Scheme of Studies and Examination B.TECH (Mechanical Engineering) – 7th Semester

w.e.f. 2021-22

Sr. No.	Category	Course Code	Course Title	Hours per week			Total Contact hrs/week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
				L	T	P			Internal Assessment	Theory	Practical	Total	
1.	Professional Elective Courses		Professional Elective Courses(PEC) : Refer List-II	3	0	0	3	3	25	75		100	3
2.	Professional Core Courses	PCC- ME-401	Design of Machine Element-II	3	0	0	3	3	25	75		100	3
3	Professional Core Courses	PCC- ME-402	Automobile Engineering	3	0	0	3	3	25	75		100	3
4	Professional Core Courses	PCC- ME-403	Entrepreneurship Development	3	0	0	3	3	25	75		100	3
5	Professional Elective Courses		Professional Elective Courses(PEC) : Refer List-III	3	0	0	3	3	25	75		100	3
	Open Elective Courses(OEC)	OEC	Refer OECList-IV	3	0	0	3	3	25	75		100	3
6	Practical	LC- ME-403	Workshop Lab-III	0	0	2	2	1	25		25	50	3
7	Seminar	PCC- ME-405	Seminar	0	0	2	2	1	25		25	50	3
8.	Practical Training	PT-ME-409	Practical Training-II	0	0	1	1	Refer Note:1 (Grading)					
9.	Mandatory courses(non-credit)	MC-317	Constitutionof India	2	0	0	2	Refer Note:2 (Grading)					
TOTAL CREDIT								**20**	**200**	**450**	**50**	**700**	**3**

Note:

1. The evaluation of Practical Training-II(PT-ME-409G) will be based on seminar, viva-voce, report submitted by the students. According to performance, the students are awarded grades A, B, C, F. A student who is awarded 'F' grade is required to repeat .

Practical Training. Excellent: A; Good : B; Satisfactory: C; Not Satisfactory: F.

2 The students will be awarded grades A, B, C &F in Evaluation of Constitution of India. A student who is awarded 'F' grade is required to repeat.

Excellent: A; Good : B; Satisfactory: C; Not Satisfactory: F.

3. Choose any one subject from Professional Elective Courses(PEC) (Semester-VII) LIST-II and LIST-III

PROFESSIONAL ELECTIVE COURSES(PEC) (Semester-VII) LIST-II

S.No.	Code	Name of Course	No. of ContactHours	Credits
1.	PEC-ME-401	Refrigeration & Air Conditioning	3	3
2.	PEC-ME-403	Project Management	3	3
3.	PEC-ME-405	Numeric Control of Machine Tools and Robotics	3	3
4.	PEC-ME-407	Finite Element Analysis	3	3

Note: Students will have to select any one out of the list.

PROFESSIONAL ELECTIVE COURSES(PEC) (Semester-VII) LIST-III

S.No.	Code	Name of Course	No. of ContactHours	Credits
1.	PEC-ME-409	Noise and Vibrations	3	3
2.	PEC-ME-411	Solar Energy Engineering	3	3
3.	PEC-ME-413	Tribology	3	3
4.	PEC-ME-415	Composite Materials	3	3

OPEN ELECTIVE COURSES(OEC)-LIST-IV

List-IV (Semester VII)

S.No.	Code	Name of Course	No. of ContactHours	Credits
1.	OEC –ME-402	Operation Research	3	3
2.	OEC –ME-410	Quality Engineering	3	3
3.	OEC –EE-412	Electrical Power Generation	3	3
4.	OEC-CSE-430	Computer Communication	3	3
5.	OEC-CE- 448	Traffic Engineering and Road Safety	3	3
6.	OEC-CE- 450	Disaster Management	3	3
7.	OEC –ECE-453	Microprocessor Application in Automobiles Sector	3	3

Note:

Students will have to select any one out of the list.

1. An elective paper will be offered to the students when at least 15 students will choose that subject and thee xpertise of the same is available in the Department/Institute.

SCHEME OF STUDIES & EXAMINATIONS

B.TECH (Mechanical Engineering)SEMESTER –8th w.e.f. 2021-22

Sr. No.	Category	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
				L	T	P			Marks of Class work	Theory	Practical	Total	
1	Professional Core Course	INTPR-ME-402	Industrial Training/Institutional Project	0	0	6	6	10	200	-	300	500	
		TOTAL CREDIT						10	200	-	300	500	

2 Hours per week per batch for one teacher and batch size will be decided by the HOD/Chairperson of thedepartment.

Procedure for Examination and continuous Assessment

(A) External Exam Marks

1. Project Evaluation 100 Marks
2. Project Seminar 100 Marks
3. Project Viva 100 marks

(B) Continuous Assessment Marks

1. Assessment by Internal Examiner and Viva by Chairman of the Department) 150 Marks(Before the Committee Constituted
2. Assessment by Industrial Guide/Chairperson 50 Marks

NOTE: It is Optional. A student can earn at most 6 credits during the duration of the 8th semester subject to the passing of at least two MOOC/NPTEL courses (carrying minimum 2/3 credits). The MOOC/NPTEL chosen by the student should not be on offer/scheme of the degree. These credits will be considered in the Final Mark sheet of the students.

Course code	**PCC-ME-401**				
Category	Professional Core Courses				
Course title	**Design of Machine Element-II**				
Scheme and Credits	L	T	P	**Credits**	Semester-VII
	3	0	0	3	
Objectives:	1. To understand the Design for Production and for variable loading. 2. Impart in depth knowledge of designing of screws and different types of fasteners. 3. How to design bearings, selection of bearings for different aspects & lubricants with their properties. 4. Knowledge of gears, design of different types of gears with consideration of maximum power transmission and gear lubrication. Learn in depth knowledge of flywheels and their design.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note:1. Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Design for Production ; Erogonomic and value engineering considerations in design, Role of processing in design, Design considerations for casting, forging and machining.

Variable Loading : Different types of fluctuating/ variable stresses, Fatigue strength considering stress concentration factor, surface factor, size factor, reliability factor etc., Fatigue design for finite and infinite life against combined variable stresses using Goodman and Soderberg's Criterion, Fatigue design using Miner's equation, Problems.

UNIT-II

Shafts:Detailed design of shafts for static and dynamic loading, Rigidity and deflection consideration.

Springs: Types of Springs, Design for helical springs against tension and their uses, compression and fluctuating loads, Design of leaf springs, Surging phenomenon in springs, Design Problem.

UNIT-III

Bearings : design of pivot and collar bearing , Selection of ball and roller bearing based on static and dynamic load carrying capacity using load-life relationship, Selection of Bearings from manufacturer's catalogue, types of lubrication – Boundary, mixed and hydrodynamic lubrication, Design of journal bearings using Raimondi and Boyd's Charts, Lubricants and their properties, Selection of suitable lubricants, Design Problems.

UNIT-IV

Gears : Classification, Selection of gears, Terminology of gears, Force analysis, Selection of material for gears, Beam & wear strength of gear tooth, Form or Lewis factor for gear tooth, Dynamic load on gear teeth -Barth equation and Buckingham equation and their comparison, Design of spur, helical, bevel & worm gear including the Consideration for maximum power transmitting capacity, Gear Lubrication, Design Problems.

Course Outcomes (COs): At the end of the course, the student shall be able to:

CO 1- Expose the students to the Design for Production and for variable loading.

CO 2- Impart in depth knowledge of designing of screws and different types of fasteners.

CO 3- Design bearings, selection of bearings for different aspects & lubricants with their properties.

CO 4- Knowledge of gears, design of different types of gears with consideration of maximum power transmissionand gear lubrication.

CO 5- Learn in depth knowledge of flywheels and their design.

Mapping of Paper No. **PCC-ME-401**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO3	M	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	M	S	M	S	S	S	S	S	M	S	S	S	S
CO5	S	S	S	M	S	M	S	S	M	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Note:

The paper setter will be required to mention in the note of the question paper that the use of following Design Databook is permitted:

(i) Design Data Handbook (In SI and Metric Units) for Mechanical Engineers by Mahadevan
(ii) Design Data Book PSG College of Technology Coimbatore

Text Books:

1.Mechanical Engg. Design- Joseph Edward Shigley-Mc Graw Hill Book Co.

2.Design of Machine Elements – V.B. Bhandari – Tata McGraw Hill, New Delhi.

Reference Books :

1.Engineering design – George Dieter, McGraw Hill, New York.

2.Product Design and Manufacturing –: A.K.Chitale and R.C.Gupta, PHI, New Delhi.

3.Machine Design An Integrated Approach: Robert L.Norton,Second Edition –Addison Wisley Longman 8. MachineDesign : S.G. Kulkarni , TMH , New Delhi.

Course code	**PCC-ME-402**				
Category	Professional Core Courses				
Course title	**AUTOMOBILE ENGINEERING**				
Scheme and Credits	L	T	P	**Credits**	Semester-VII
	3	0	0	3	
Objectives:	It has been at the forefront of creating new platforms that impact the nation's competitiveness in manufacturing and infrastructure. Automation Industry has been propelling economies internationally by enabling manufacturing and infrastructure to meet the growing needs across the globe. This cross disciplinary segment is the key to enhanced productivity, reliability and quality in multiple domains.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Introduction to Automobiles : Classification, Components, Requirements of Automobile Body; Vehicle Frame, Separate Body & Frame, Unitised Body, Car Body Styles, Bus Body & Commercial Vehicle Body Types; Front Engine Rear Drive & Front Engine Front Drive Vehicles, Four Wheel Drive Vehicles, Safety considerations; Safety features of latest vehicle; Future trends in automobiles.

Clutches : Requirement of Clutches – Principle of Friction Clutch – Wet Type & Dry Types; Cone Clutch, Single Plate Clutch, Diaphragm Spring Clutch, Multi plate Clutch, Centrifugal Clutches, Electromagnetic Clutch, Over Running Clutch; Clutch Linkages.

UNIT-II

Power Transmission: Requirements of transmission system; General Arrangement of Power Transmission system; Object of the Gear Box; Different types of Gear Boxes; Sliding Mesh, Constant Mesh, Synchro- mesh Gear Boxes; Epi-cyclic Gear Box, Freewheel Unit. Overdrive unit-Principle of Overdrive, Advantage of Overdrive, Transaxle, Transfer cases.

Drive Lines, Universal Joint, Differential and Drive Axles: Effect of driving thrust and torque reactions; Hotchkiss Drive, Torque Tube Drive and radius Rods; Propeller Shaft, Universal Joints, Slip Joint; Constant Velocity Universal Joints; Front Wheel Drive; Principle, Function, Construction & Operation of Differential; Rear Axles, Types of load coming on Rear Axles, Full Floating, Three quarter Floating and Semi Floating Rear Axles.

UNIT-III

Suspension Systems : Need of Suspension System, Types of Suspension; factors influencing ride comfort, Suspension Spring; Constructional details and characteristics of leaf springs.

Steering System : Front Wheel geometry & Wheel alignment viz. Caster, Camber, King pin Inclination, Toein/Toe- out; Conditions for true rolling motions of Wheels during steering; Different types of Steering Gear Boxes; Steering linkages and layout; Power steering – Rack & Pinion Power Steering Gear, Electronics steering.

UNIT-IV

Automotive Brakes, Tyres & Wheels : Classification of Brakes; Principle and constructional details of DrumBrakes, Disc Brakes; Brake actuating systems; Mechanical, Hydraulic, Pneumatic Brakes; Factors affecting Brake performance, Power & Power Assisted Brakes; Tyres of Wheels; Types of Tyre & their constructional details,Wheel Balancing, Tyre Rotation; Types of Tyre wear & their causes.

Emission Control System & Automotive Electrical : Sources of Atmospheric Pollution from the automobile, Emission Control Systems – Construction and Operation of Positive Crank Case Ventilation (PVC) Systems, Evaporative Emission Control, Heated Air Intake System, Exhaust Gas Recirculation (ECR) Systems, Air Injection System and Catalytic Converters; Purpose construction & operation of lead acid Battery, Capacity Rating & Maintenance of Batteries; Purpose and Operation of Charging Systems, Purpose and Operations of the StartingSystem; Vehicle Lighting System.

Course Outcomes : At the end of the course, the student shall be able to:

CO1 - Identify the different parts of the automobile

CO2 - Explain the working of various parts like engine, transmission, clutch, brakes.CO3 - Describe how the steering and the

suspension systems operate.

CO4 - Understand the environmental implications of automobile emissions.

CO5 - Understand the function of each automobile component and also have a clear idea about the overall vehicleperformance.

CO6 - Develop a strong base for understanding future developments.

Mapping of Paper No. **PCC-ME-402**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	S	S	S	M	S	M	S	S	S	S	S	S	M
CO3	M	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	M	S	M	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	M	S	S	M	S	S	S	S	S	S
CO6	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M

S=Strong M=Medium W=Weak

Text Books:

1) Automobile Engineering by Anil Chhikara, Satya Prakashan, New Delhi.
2) Automobile Engineering by Dr. Kirpal Singh, standard Publishers Distributors.

Reference Books:

1) Automotive Mechanics – Crouse / Anglin, TMH.
2) Automotive Technology – H.M. Sethi, TMH, New Delhi.
3) Automotive Mechanics – S.Srinivasan, TMH, New Delhi.
4) Automotive Mechanics – Joseph Heitner, EWP.
5) Motor Automotive Technology by Anthony E. Schwaller – Delmer Publishers, Inc.
6) The Motor Vehicle – Newton steeds Garrett, Butter Worths.

Course code	**PCC-ME-403**				
Category	Professional Core Courses				
Course title	**Entrepreneurship Development**				
Scheme and Credits	L	T	P	**Credits**	Semester-VII
	3	0	0	3	
Objectives:	To familiarize the students with the basics of Entrepreneurship Development.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Entrepreneurship : Concept and Definitions; Entrepreneurship and Economic Development; Types of Entrepreneurs; Factor Affecting Entrepreneurial Growth – Economic, Non-Economic Factors; EDP Programmes; Entrepreneurial Training; Traits/Qualities of an Entrepreneurs; Manager Vs. Entrepreneur, types of entrepreneurships, Entrepreneurial myths.

UNIT-II

Opportunity Identification and Product Selection: Entrepreneurial Opportunity Search & Identification;Criteria to Select a Product; Conducting Feasibility Studies; Sources of business ideas, launching a new product; export marketing, Methods of Project Appraisal, Project Report Preparation; Project Planning and Scheduling. Sources of finance for entrepreneurs.

UNIT-III

Small Enterprises and Enterprise Launching Formalities : Definition of Small Scale; Rationale; Objective;Scope;SSI; Registration; NOC from Pollution Board; Machinery and Equipment Selection , Role of SSI in Economic Development of India; major problem faced by SSI,MSMEs – Definition and Significance in Indian Economy; MSME Schemes, Challenges and Difficulties in availing MSME Schemes.

UNIT-IV

Role of Support Institutions and Management of Small Business : Director of Industries; DIC; SIDO;SIDBI; Small Industries Development Corporation (SIDC); SISI; NSIC; NISBUD; State Financial Corporation SIC; Venture Capital : Concept, venture capital financing schemes offered by various financial institutions in India, Legal issues –Forming business entity, considerations and criteria, requirements for formation of a Private/Public Limited Company,

Course Outcomes (CO'S): At the end of the course, the student shall be able to:

CO1 - Students will be able understand who the entrepreneurs are and what competences needed

CO2 - Students will be able to understand insights into the management, opportunity search, identification of aproduct, market flexibility studies, project finalization etc. required for small business enterprise.

CO3- Students will be able to write a report and do oral presentation on the topics such as product identification,business ideas, export marketing etc.

CO4 - Students will be able to know the different financial and other assistance available for establishing smallindustrial units.

Mapping of Paper No. **PCC-ME-403**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	S	S	S	M	M	S	S	S	S	S	S	S	S
CO3	M	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Text Books & Reference Books :

1. "Entrepreneurship development small business enterprises", Pearson, Poornima M Charantimath,2013.
2. Roy Rajiv, "Entrepreneurship", Oxford University Press, 2011.
3. "Innovation and Entrepreneurship",Harper business- Drucker.F, Peter, 2006.
4. "Entrepreneurship", Tata Mc-graw Hill Publishing Co.ltd new Delhi- Robert D. Hisrich, Mathew J.Manimala, Michael P Peters and Dean A. Shepherd, 8th Edition, 2012
5. Enterpreneurship Development- S.Chand&Co.,Delhi- S.S.Khanka 1999
6. Small-Scale Industries and Entrepreneurship. Himalaya Publishing House, Delhi –Vasant Desai 2003.
7. Entrepreneurship Management -Cynthia, Kaulgud, Aruna, Vikas Publishing House, Delhi, 2003.
8. Entrepreneurship Ideas in Action- L. Greene, Thomson Asia Pvt. Ltd., Singapore, 2004.

Course code	**PEC-ME-401**				
Category	Professional Elective Courses (PEC))**(Semester-VII) LIST-II**				
Course title	**REFRIGERATION & AIR CONDITIONING**				
Scheme and Credits	L	T	P	**Credits**	Semester-VII
	3	0	0	3	
Objectives:	1. To familiarize with the terminology associated with refrigeration systems and air conditioning 2. To understand basic refrigeration processes 3. To understand the basics of psychrometry and practice of applied psychrometrics . 4. To acquire the skills required to model, analyse and design different refrigeration as well as air conditioning processes and components				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Introduction: Definition of refrigeration & air conditioning; Necessity; Methods of refrigeration; Unit of refrigeration; Coefficient of performance (COP), Fundamentals of air-conditioning system; Refrigerants-Definition, Classification, Nomenclature, Desirable properties, Comparative study, secondary refrigerants, Introduction to eco- friendly Refrigerants; Introduction to Cryogenics.

Air Refrigeration System: Carnot refrigeration cycle. Temperature. Limitations; Brayton refrigeration or the Bell Coleman air refrigeration cycle; Necessity of cooling the aero plane; Air craft refrigeration systems, Simple cooling and Simple evaporative types, Boot strap and Boot strap evaporative types, Regenerative type and Reduced Ambienttype system, Comparison of different systems, problems.

UNIT-II

Vapour Compression (VC) Refrigeration Systems: (A) Simple Vapour Compression (VC) Refrigeration systems- Limitations of Reversed Carnot cycle with vapour as the refrigerant; Analysis of VC cycle considering degrees of sub cooling and superheating; VC cycle on p-v, t-s and p-h diagrams; Effects of operating conditions on COP; Comparison of VC cycle with Air Refrigeration cycle.

Multistage Ref. Systems- Necessity of compound compression, Compound VC cycle , Inter-cooling with liquid sub –cooling and / or water inter cooler: Multistage compression with flash inter-cooling and / or water inter-cooling; systems with individual or multiple expansion valves; Individual compression system with individual or multiple expansion valves; Individual compression systems with individual or multiple expansion valves but with and without intercoolers.

Other Refrigeration Systems: (A) Vapour Absorption Refrigeration Systems – Basic Systems, Actual COP of the System, Performance, Relative merits and demerits; Properties of aqua ammonia; Electrolux Refrigeration; Problems. Steam Jet Refrigerating System- Introduction, Analysis, Relative merits and demerits, PerformanceApplications, Problems.

UNIT-III

Psychrometry of Air & Air Conditioning Processes: Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temp., Thermodynamics wet bulb temp., Psychrometric chart; Psychrometry of air-conditioning processes, Mixing Process,Basic processes in conditioning of air; Psychrometric processes in air washer, Problems.

Air- Conditioning Load Calculations: Outside and inside design conditions; Sources of heating load; Sources of cooling load; Heat transfer through structure, Solar radiation, Electrical applications, Infiltration and ventilation, Heat generation inside conditioned space; Apparatus selection; Comfort chart, Problems.

UNIT-IV

Air Conditioning Systems with Controls & Accessories: Classifications, Layout of plants; Equipment selection; Air distribution system; Duct systems Design; Filters; Refrigerant piping; Design of summer air-conditioning and Winter air conditioning systems; Temperature sensors, Pressure sensors, Humidity sensors, Actuators, Safety controls; Accessories; Problems.

Refrigeration and Air Conditioning Equipments: Type of compressors and their performance curves; Types of Condensers, Heat transfer in condensers; Types of expansion devices; types of evaporators, Cooling and Dehumidifying coils, Problems.

Course Outcomes (COs): At the end of the course, the student shall be able to:

CO 1- Understand the air refrigeration, vapour compression refrigeration, vapour absorption, steam jet refrigerationsystems and different type of refrigerants.

CO 2- Expedite the working of single stage, multistage and cascade refrigeration.

CO 3- Knowledge of psychrometry and different psychrometric processes. Understand and evaluate cooling andheating load and design of HVAC system.

CO 4- Develop and design RAC systems and evaluate different expansion and control devices.

Mapping of Paper No. **PEC-ME-401**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	S	S	S	M	S	M	S	S	S	S	S	S	M
CO3	M	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Text Books :

1. Refrigeration & Air conditioning –R.C. Jordan and G.B. Priester, Prentice Hall of India. .
2. Refrigeration & Air conditioning –C.P. Arora, TMH, New Delhi.

Reference Books:

1. A course in Refrigeration & Air Conditioning – Arora & Domkundwar, Dhanpat Rai & Sons.
2. Refrigeration & Air conditioning –W.F. Stocker and J.W. Jones, TMH, New Delhi.
3. Refrigeration & Air conditioning- Manohar Prasad Wiley Estern limited, New Delhi.

Course code	**PEC-ME-403**				
Category	Professional Elective Courses (PEC)) **(Semester-VII) LIST-II**				
Course title	**PROJECT MANAGEMENT**				
Scheme and Credits	L	T	P	**Credits**	Semester-VII
	3	0	0	3	
Objectives:	The students completing this course are expected to understand the concepts of Project Management, how it work.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Project Management :Project Management Concepts, Project Planning, Resource Scheduling, Critical Chain Scheduling, Project Quality Management, Project performance Measurement and Control, Project Closure/ Termination, Managing Project Teams, IT in Projects, International Projects: Issues in managing international projects, Selection and training of employees, cross cultural considerations.

UNIT-II

Theory & Background : Definitions, hard & soft projects, multi project management, program management , project phases, project control project groups. Go/no go decisions.

Idea Phase : Idea selction, development of project contract, determination of project organization, development of project order.

UNIT-III

Defintion Phase : Phase steps : Project description, project results, work breakdown structure, Input management,Project leader ship.

Planning Phase : Development of responsibility matrix, detail project planning, risk & change analysis, arranginginput.

UNIT-IV

Implementation Phase : Project monitoring & control, project adjustment, dealing with people.

Implementation & After Care : Evaluation and closure of a project.

Course Outcomes

CO1 To introduce the Project Management Concepts.
CO2 To describe the hard & soft projects.
CO3 To apply the concept of Phase steps.
CO4 To impart knowledge of Implementation Phase.
CO5 To know about the Evaluation and closure of a project.

Mapping of Paper No. **PEC-ME-403**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	M	S	S	M	S	S	S	S	S	S	S	S	S
CO3	M	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Reference Books:

1. Project Management handbook, Cleland , D.I. and W.R. King, USA.
2. Project Management Body of Knoweldge (PMBOK), Project.
3. Handbook for project oriented organization, Rath S. Hoogland, R. and Turner, J.R.
4. Clifford F Gray, Erik W Larson, “Project Management-The Managerial Process”, Tata Mcgraw-HillPublishing Co Ltd
5. Jack Meredith, Samuel J. Mantel Jr. “Project Management- A Managerial Approach”, John Wiley and Sons
6. John M Nicholas “Project Management For Business And Technology” Prentice Hall of India Pvt Ltd
7. James P Lewis “Project Planning, Scheduling And Control” Tata Mcgraw-Hill Publishing Co Ltd.

Course code	**PEC-ME-405**				
Category	Professional Elective Courses (PEC)) **(Semester-VII) LIST-II**				
Course title	**NUMERIC CONTROL OF MACHINE TOOLS AND ROBOTICS**				
Scheme and Credits	L	T	P	**Credits**	Semester-VII
	3	0	0	3	
Objectives:	The students completing this course are expected to understand the basic knowledge of machine tools and robotics and also automation concepts.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Fundamentals of Numerical Control: Introduction to numerical control, Classification of NC/CNC machines and axis nomenclature, PTP and Continuous Contouring, Absolute and Incremental Programming, Difference between NC and CNC, Different types of software's in CNC.

Control system fundamentals: feedback, transfer function, system stability. Open Loop and Closed Loop control:Servo Mechanism, Position and Velocity feedback.

Engineering Analysis of NC/CNC systems: Computations of total number of pulses and pulse frequency in OpenLoop and Closed Loop control, Precision in NC/CNC: Resolution, Accuracy and Repeatability.

Interpolation in NC and CNC: Linear and Circular, Tolerance Analysis: Inward, Outward and Secantial. Systemcomponents: Machine Control Unit (MCU), Transducers, Actuators.

UNIT-II

Design considerations of NC/CNC machine tools: Re-circulating ball screw, lost motions in NC systems, TurningCenters and Machining Centers.

Part Programming: Manual programming: Different G codes and M codes, Stock Removal Cycle, Canned Cycles.Computer assisted Part Programming. Tool path generation from CAD models, CNC Toolings.

Process optimization: Online condition monitoring in CNC,

Adaptive control: ACC, ACO & GA. DNC: Direct and Distributed Numerical Control, Merits of DNC, Concept ofBTR, Data Multiplexing.

UNIT-III

Automation & Robotics; Spatial Descriptions & Transformations, Manipulator Kinematics – Forward and Inverse; Jacobians: Velocities & Static Forces. Robot Arm Dynamics: Lagrange-Euler formulation of manipulator dynamics. Trajectory Planning: Joint-interpolated trajectories, Geometric problems

with Cartesian paths, Collision-free path planning. Robot Control Systems: Feedback and Closed-loop control, Transfer Functions, Control of Second-order systems, Non-linear & time varying systems, Adaptive.

UNIT-IV

Robotic Prehension**:** Dexterous manipulation; ANN approach in prehension, Sensors in Robotics: Machine vision, Force & Torque sensors. Robot programming: simulators and languages, Tele-robotics and virtual interfaces for task specification and programming, Concept of nanorobotics, Performance analysis of industrial robots and their manufacturing applications, Economics of robotics, Social issues & future of robotics.

Course Outcomes:

CO1 To introduce the Fundamentals of Numerical Control.
CO2 To describe the Engineering Analysis of NC/CNC systems.
CO3 To apply the Automation & Robotics.
CO4 To impart knowledge about ANN approach.
CO5 To know about the Concept ofBTR.

Mapping of Paper No. **PEC-ME-405**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	S	S	S	M	S	M	S	S	S	S	S	S	S
CO3	M	M	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	M	S	S	S	S	S	S	S	M	S

S=Strong M=Medium W=Weak

Text Book:

1. Robotics for Engineers by Y. Koren, McGraw Hill New York
2. Robotics Technology and Flexible Automation by S.R.Deb, TMH.
2. Numerical Control and Computer Aided manufacturing by R. S. Pressman & J. E. Williams, John Wiley & Sons
3. Computational Geometry for Design and Manufacture, by I. D. Faux and M. J. Pratt, Ellis Horwood, Chichester,1979.
4. Numerical Control in Manufacturing by F. W. Wilson, McGraw-Hill Book Company New York.
5. Mittal R. K. &Nagrath I. J., "Robotics and Control", TMH, 2003 (Reprint 2007 or later).
6. Groover, M. P., et al., "Industrial Robotics", MGHISE, 1986
7. Computer Control of Manufacturing Systems by Y. Koren, McGraw-Hill
8. Industrial Robotic Technology - Programming and Application by M.P.Groover et. al., McGrawHill
9. Robotics: Control, Sensing, Vision and Intelligence by Fu, Lee and Gonzalez, McGraw Hill New York.

Course code	**PEC-ME-407**				
Category	Professional Elective Courses (PEC) **(Semester-VII) LIST-II**				
Course title	**FINITE ELEMENT ANALYSIS**				
Scheme and Credits	L	T	P	**Credits**	Semester-VII
	3	0	0	3	
Objectives:	1. To illustrate the principle of mathematical modeling of engineering problems 2. To introduce the basics and application of Finite Element Method.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Historical Background, Mathematical modeling of field problems in engineering, governing equations, discrete and continuous models, boundary and initial value problems, Weighted Residual Methods, Variational formulation of boundary value problems, Ritz technique, Basic concept of Finite Element Method.

UNIT-II

One dimensional second order equation, discretization, linear and higher order elements, derivation of shapefunctions, Stiffness matrix and force vectors, assembly of elemental matrices, solution of problems from solid mechanics and heat transfer, longitudinal vibration and mode shapes, fourth order beam equation, transversedeflections and natural frequencies.

UNIT-III

Two dimensional equations, variational formulation, finite element formulation, triangular elements- shape functions, elemental matrices and RHS vectors; application to thermal problems, torsion of non-circular shafts, quadrilateral and higher order elements. Plane stresses and plane strain problems, body forces and thermal loads, plate and shell elements.

UNIT-IV

Natural coordinate systems, isoparametric elements and shape functions, numerical integration and application toplane stress problems, matrix solution techniques, solution of dynamic problems, introduction to FE software.

Course Outcomes:

CO1 To introduce the Mathematical modeling.
CO2 To describe One dimensional second order equation.
CO3 To apply the Natural coordinate systems.
CO4 To impart knowledge of Two dimensional equations.
CO5 To know about the introduction to FE software.

Mapping of Paper No. **PEC-ME-407**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO3	M	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	M	S	S	M	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Text Books:

1. Reddy J.N., An Introduction to Finite Element Method, 3rd ed., Tata McGraw Hill, 2005.
2. Seshu P., Text Book of Finite Element Analysis, Prentice Hall, New Delhi, 2007.
3. Rao S.S., The Finite Element Method in Engineering, 3rd ed., Butterworth Heinemann, 2004.
4. Chandraputla&Belegundu, Introduction to Finite Elements in Engineering, 3rd ed., Prentice Hall, 1990.

Course code	**PEC-ME-409**				
Category	**PROFESSIONAL ELECTIVE COURSES(PEC)** (Semester-VII) LIST-III				
Course title	**NOISE AND VIBRATIONS**				
Scheme and Credits	L	T	P	**Credits**	Semester-VII
	3	0	0	3	
Objectives:	CO1 - Understand the fundamentals of mechanical vibrationsleading to analysis of first degree of freedom CO2 - To introduce the basics concept of two degree of vibrationand vibration isolation and transmissibility CO3 - Analyse experimental methods for vibration analysis.CO4 –To learn the influence and stiffness coefficients. CO5 - Analyse the concept of the non-linearity in vibrations and also concept of noise.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Fundamentals : Importance of Study of Vibrations, Classifications of Vibrations, Free and Forced, Undamped and Damped, Linear and Non-linear, Deterministic and Random, Harmonic Motion, Vector and Complex Number Representations, Definitions and Terminology, Periodic Functions, Harmonic Analysis, Fourier Series Expansion.

Free and Damped Vibrations : Single Degree of Freedom system, D'Alemberts Principal, Energy Methods, Rayleighs Method, Application of these Methods, Damped Free Vibrations, Logarithmic Decrement, Under Damping, Critical and Over Damping, Coulomb Damping.

UNIT-II

Harmonically Excited Vibrations : Forced Damped Harmonic Vibration of Single Degree of Freedom Systems, Rotating Unbalance, Rotor Unbalance, Critical Speeds and Whirling of Rotating Shafts, Support Motion, Vibration Isolation, Energy Dissipated by Damping, Equivalent, Viscous Camping, Structural Damping Sharpness of Resonance, Vibration Measuring Instruments.

Transient Vibrations : Impulse Excitation, Arbitrary Excitation, Response to Step Excitions, Base Excitation Solution by Laplace Transforms, Response Spectrum, Runge-Kutta Method.

UNIT-III

Two Degrees of Freedom Systems : Introduction to Multi-Degree of Freedom Systems, Normal Mode Vibrations, Coordinate Coupling, Principal Coordinates, Free Vibrations in Terms of Initial Conditions, Forced Harmonic Vibrations, Vibration Absorber, Centrifugal Vibration Absorber, Vibration Damper.

Multi degrees of Freedom Systems and Numerical Methods Introduction, Influence Coefficients, Stiffness Matrix, Flexibility Matrix, Natural Frequencies and Normal Modes, Orthogonality of Normal Modes, Dunkerley's Equation,Method of Matrix Iteration, The Holzer Type Problem, Geared and Branched Systems, Beams.

UNIT-IV

Normal Mode Vibration of Continuous System: Vibrating String, Longitudinal Vibrations of Rod, TorsionalVibrations of Rod, Lateral Vibrations of Beam.

Noise**:** Noise characteristics, Sources of noise, noise level measurement techniques, vehicular noise level, enginenoise, transmission noise, brake squeal, structural noise, noise in auxiliaries, wind noises etc.

Noise Testing & Noise Control:Mechanization of noise generation, noise control methodologies, noise controlmeasures, environmental noise management. Road vehicle noise standards .

Course Outcomes (CO'S): At the end of the course, the student shall be able to:

CO1 - Understand the fundamentals of mechanical vibrations leading to analysis of first degree of freedom
CO2 - To understand the concept of two degree of vibration and vibration isolation and transmissibility
CO3 - Analyse experimental methods for vibration analysis.
CO4 - Understanding the influence and stiffness coefficients.
CO5 - Analyse the concept of the non-linearity in vibrations and also concept of noise.

Mapping of Paper No. **PEC-ME-409**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	M	S	S	M	S	S	S	S	S	S	S	S	M
CO3	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	M	S	S	M
CO5	S	S	S	S	S	M	S	S	M	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Text Books :

1. Theory of Vibrations with Applications W.T. Thomson, Prentice Hall of India.
2. Mechanical Vibration : G.K. Grover and S.P. Nigam, Nem Chand and Sons
3. Noise, Pollution & Control – S. P. Singal, Narosa Publishing House, New Delhi

Reference Books :

1. Theory and Practice of Mechanical Vibrations J.S. Rao and K. Gupta, Wiley Eastern Ltd.
2. Mechanical Vibrations S.S. Rao, Addison – Wesely Publishing Company.

Course code	**PEC-ME-411**				
Category	**Professional Elective Courses**(Semester-VII) (List-III)				
Course title	**SOLAR ENERGY ENGINEERING**				
Scheme and Credits	L	T	P	**Credits**	Semester-VII
	3	0	0	3	
Objectives:	To provide an overview of solar system and the associated energy conversion issues.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Solar Radiation: Introduction, solar system – sun, earth and earth-sun angles, time, derived solar angles, estimation of solar radiation (direct and diffuse), measurement systems – phyrheliometers and other devices. Effect of Solar radiation upon structures: Steady state heat transmission, solar radiation properties of surfaces, shading of surfaces, periodic heat transfer through walls and roofs.

UNIT-II

Solar Collectors: Flat plate and concentrating – comparative study, design and materials, efficiency, selective coatings, heliostats. Heating Applications of Solar Energy: Air and Water heating systems, thermal storages, solar bonds, solar pumps, solar lighting systems, solar cookers, solar drying of grains.

UNIT-III

Cooling Applications of Solar Systems: Continuous and Intermittent vapour absorption systems for cooling applications, absorbent – refrigerant combination, passive cooling systems.

UNIT-IV

Solar Electric Conversion Systems: Photovoltaics, solar cells, satellite solar power systems. Effects on Environment, economic scenario, ozone layer depletion, green house effect, global warming, Remedial measures by international bodies.

Course Outcomes:

CO1 Understand the concept and principles of solar system.
CO2 Utility and applications of solar system and the associated with energy conversion issues.
CO3 To apply the Cooling Applications of Solar Systems.
CO4 To impart knowledge of Photovoltaics.
CO5 To know about ozone layer depletion, green house effect, global warming.

Mapping of Paper No. **PEC-ME-411**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S
CO3	M	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	M	M	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Text Books:

1. Solar Energy – S P Sukhatme, Tata McGraw Hill
2. Solar Energy Process – Duffie and Bechman, John Wiley

References Books:

1. Applied Solar Energy – Maniel and Maniel, Addison Wiley
2. Solar Energy: Fundamentals and Applications – R P Garg and Jai Prakash, TMH.

Course code	**PEC-ME-413**				
Category	**PROFESSIONAL ELECTIVE COURSES(PEC)** (Semester-VII) LIST-III				
Course title	**TRIBOLOGY**				
Scheme and Credits	L	T	P	**Credits**	Semester-VII
	3	0	0	3	
Objectives:	The students completing this course are expected to understand the basic concept of tribology and use of engine, wear, friction .				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Introduction: Introduction of Tribology – General tribological considerations in the design of bearings, gears,cams, reciprocating components, etc.
Engine tribology basics - tribology / aspects of engine components such as bearings, piston assembly, valve trainand drive train components etc.

UNIT-II

Friction: Natural of metal surfaces – Surface properties – Surface parameters and measurements. Friction – Sliding friction – Rolling friction characteristics of common metals and non-metals – friction under environments. Engine friction – Losses and engine design parameters.
Wear: Economic role of wear – type of wear- wear mechanism, factors affecting wear, selection of materials for different wear situations, measurement of wear, tribometers and tribometry. Engine wear, mechanisms, wear resistance material and coatings and failure mode analysis.
Bearings and Lubrication: Lubricants, type of lubricants, properties and testing, service classification of lubricants, lubrication of tribological components, lubrication system, lubricant monitoring, SOAP, ferrography and other rapid testing methods for lubricants contamination.

UNIT-III

Hydrodynamic Lubrication: Theory of hydrodynamic lubrication, generalized Reynolds equation, slider bearings, fixed & pivoted shoe bearings, hydrodynamic journals bearings, short and finite bearings, thrust bearings, sintered bearing, non-circular bearings and multi side surface bearings.
Externally (Externally – pressurized) lubrication: Hydrostatic bearing, basic concepts, bearing pads, coefficients,restrictors, capillary, orifice and flow control valve, bearing characteristics number and performance coefficients, flat, conical and spherical pad thrust bearing, multi-recess journal and thrust bearings, air and gas lubricated bearings.

UNIT-IV

Elasto – hydrodynamic lubrication: Ball and roller element bearings, classification, selection and life estimation, fatigue, monitoring of ball / roller bearings, diagnostics.
Rheodynamics (Static) lubrication: Non-Newtonian fluids, characteristics, general recommendations of lubricants, SAE & other cloud numbers, thixotopic, materials and Bingham solids, grease lubrication and care stability, tribology components in extreme environments like vacuum, pressure,

temperature, tribology matching andselection, tribolo-testing and standards.

Course Outcomes:

CO1 To introduce the Tribology.
CO2 To describe tribometers and tribometry.
CO3 To apply the generalized Reynolds equation.
CO4 To impart knowledge of Ball and roller element bearings.
CO5 To know about the Rheodynamics (Static) lubrication.

Mapping of Paper No. **PEC-ME-413**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO3	M	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	M	S	S	M	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Reference Books:

1. Friction and Lubrication, Bowden F.P. & Tabor D., Heinemann Edu. Books Ltd. 1974
2. Friction & Wear of Material, Ernest Rabinowiez
3. Tribology – Handbook, Neal M.J., Butterworth, 1973
4. Standard hand Book of Lubrication Engg., O'Connor J.J. & Boyd J., McGraw Hill, 1968.
5. Theory of Hydro-dynamic Lubrication, Pinkus O, & Sternlincht B., McGraw Hill, 1961.
6. Theory & Practice of Lubrication of Bearing, Fuller D.D., McGraw Hill, 1947. 7. Analysis & Lubrication ofBearings, Shaw M. C., Macks F., McGraw Hill, 1947.

Course code	**PEC-ME-415**				
Category	**PROFESSIONAL ELECTIVE COURSES(PEC)** (Semester-VII) LIST-III				
Course title	**COMPOSITE MATERIALS**				
Scheme and Credits	L	T	P	**Credits**	Semester-VII
	3	0	0	3	
Objectives:	1. To understand the mechanical behaviour of composite materials 2. To get an overview of the methods of manufacturing composite materials and their fabrication methods and testing.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Definition and applications of composite materials, Fibers- glass, carbon, ceramic and aramid fibers; Matrices- polymer, graphite, ceramic and metal matrices; characteristics of fibers and matrices. Lamina- assumptions, macroscopic viewpoint, generalized Hooke;s law, reduction of homogeneous orthotropic lamina, isotropic limit case, orthotropic stiffness matrix, commercial material properties, rule of mixtures, transformation matrix, transformed stiffness.

Manufacturing of composite materials, bag moulding, compression moulding, pultrusion, filament welding, other manufacturing processes .

UNIT-II

Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, cross ply laminates, laminate structural moduli, evaluation of lamina properties, determination of lamina stresses, maximum stress and strain criteria, von Mises Yield criterion for isotropic materials, generalized Hill's criterion for anisotropic materials,TsaiHill's criterion for composites, prediction of laminate failure, thermal analysis of composite laminates

Analysis of laminated plates- equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies

UNIT-III

Fabrication methods: Processing of Composite Materials: Overall considerations, Autoclave curing, Other Manufacturing Processes like filament welding, compression molding, resin-transplant method, pltrusion, pre-peg layer, Fiber-only performs, Combined Fiber-Matrix performs, Manufacturing Techniques: Tooling and Specialty materials, Release agents, Peel plies, release films and fabrics, Bleeder and breather plies, bagging films

UNIT-IV

Testing of Composites: Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing etc.

Course Outcomes:

CO1 To introduce the composite materials.
CO2 To describe Manufacturing of composite materials.
CO3 To apply the symmetric laminates.
CO4 To impart knowledge of equilibrium equations of motion.
CO5 To know about the Testing of Composites.

Mapping of Paper No. **PEC-ME-415**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	M	S	M	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	M	S	S	S	S	S	M	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Text Books:

1. Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill, 1994.
2. Hyer M.W., Stress Analysis of Fiber- Reinforced Composite Materials, McGraw Hill, 1998
3. Materials characterization, Vol. 10, ASM hand book
4. Mechanical Metallurgy by G. Dieter Mc-Graw Hill
5. Thermal Analysis of Materials by R.F. Speyer, Marcel Decker
6. Engineering Materials: Polymers, Ceramics and Composites A.K Bhargava Prentice Hall India

Course code	**LC- ME-403**				
Category	Professional Core Courses				
Course title	**Workshop Lab-III**				
Scheme and Credits	L	T	P	**Credits**	Semester-VII
	0	0	2	1	
Objectives:	Understand the vapour compression refrigeration system and vapour absorption system. Application of different compressors used in refrigeration system. Understand functioning of various control devices Evaluate the COP of various refrigeration system such as vapour compression refrigeration system and vapour absorption system. Knowledge of how the loading condition changes the COP of the system.				
Internal Practical Class Marks	25 Marks				
External Practical Class Marks	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiments : (Refrigeration & Air Conditioning Lab)

1) To study the vapour compression Refrigeration System and determine its C.O.P. and draw P-H and T-Sdiagrams.
2) To Study the Mechanical heat pump and find its C.O.P.
3) To study the Air and Water heat pump and find its C.O.P.
4) To study the cut- sectional models of Reciprocating and Rotary Refrigerant compressor.
5) To study the various controls used in Refrigerating & Air Conditioning systems.
6) To study the Ice- plant, its working cycle and determine its C.O.P and capacity.
7) To study the humidification, heating, cooling and dehumidification processes and plot them onPsychrometric charts.
8) To determine the By-pass factor of Heating & Cooling coils and plot them on Psychrometric charts ondifferent inlet conditions.
9) To determine sensible heat factor of Air on re-circulated air-conditioning set up.
10) To study the chilling plant and its working cycle.

Course Outcomes (COs): At the end of the course, the student shall be able to:

CO 1- Understand the vapour compression refrigeration system and vapour absorption system.
CO 2- Application of different compressors used in refrigeration system.
CO 3- Understand functioning of various control devices
CO 4- Evaluate the COP of various refrigeration system such as vapour compression refrigeration system andvapour absorption system.
CO 5- Knowledge of how the loading condition changes the COP of the system.

Mapping of Paper No. **LC- ME-403**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	S	S	M	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO3	M	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	M	S	S	M	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Note :

1) At least six experiments are to be performed in the semester.
2) At least seven experiments should be performed form the above list. Remaining two experiments may eitherbe performed from the above list or as designed & set by the concerned institute as per the scope of the syllabus.

Course code	**PCC- ME-405**				
Category	Professional Core Courses				
Course title	**SEMINAR**				
Scheme and Credits	L	T	P	**Credits**	Semester-VII
	0	0	2	1	
Objectives:	To teach the student how to face interview and presentation given and remove their hesitation and improve their communications skills and overall personal developments.				
Internal Class Marks	25 Marks				
External Class Marks	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Selecting of Seminar Topics by Teacher or concerned to teacher by students. A seminar topic given by students insemester.

Course code	PT-ME-409				
Category	Engineering Science Courses				
Course title	PRACTICAL TRAINING-II				
Scheme and Credits	L	T	P	**Credits**	Semester-VII
	0	0	2	0	
Objectives:	• Achieving the objectives of the University and its colleges and departments in practical training. • Providing students with practical skills, which match the requirements of the job market and allow them to directly enter the work community in a serious and constructive manner. • Providing students with experience to help them take decisions pertaining to their future career objectives. • Providing college students the full opportunity to apply theoretical knowledge (gained during their studies) in a real work environment at a later stage of their studies. • Developing the student's understanding of the needs of the job market and reaching this understanding successfully				
Internal Practical Training Marks	25 Marks				
External Practical Training Marks	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

PRACTICAL TRAINING VIVA-VOCE:

1) Assessment of Practical Training-II, undergone at the end of VI semester, will be based on seminar, viva-voce,report and certificate of practical training obtained by the student from the industry/ Professional organization/ Research Laboratory with the prior approval of the Director-Principal/ Mechanical Software /Automobile Workshop. **According to performance letter grades A, B, C, F are to be awarded: Excellent : A ; Good : B ; Satisfactory : C ; Not satisfactory : F.** A student who has been awarded 'F' grade will be required to repeat the practical training.

2) Each student has to undergo practical training of 4/6 weeks during summer vacation and its evaluationshall be carried out in the VII semester.

Course code	**MC-317**				
Category	Mandatory Course				
Course title	**Constitution of India**				
Scheme and Credits	L	T	P	**Credits**	Semester-VII
	2	0	0	0	

MC-317G is mandatory non-credit course in which the students will be awarded grades.

Note: 2 The students will be awarded grades A, B, C &F in Evaluation of Constitution of India. A student who is awarded 'F' grade isrequired to repeat .

Excellent: A; Good : B; Satisfactory: C; Not Satisfactory: F.

Course Objectives: Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlementto civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and itsimpact on the initial drafting of the Indian Constitution.

UNIT-I

Philosophy of Indian Constitution: Salient features of Indian Constitution, Preamble, and Nature of Indian Constitution, Procedure for amendment of the Constitution.

UNIT-II

Federal structure and distribution of legislative and financial powers between the Union and the States

UNIT-III

Organs of Governance: President – Qualification and Powers of the President, GovernorQualification and Powers ofGovernor, Parliament: Composition, Qualifications and Disqualifications, Judiciary: Appointment, Tenure and Removal of Judges.

UNIT-IV

Fundamental Rights: Origin and development of Fundamental rights, Need for fundamental rights. Introduction to Right to equality , Right to freedom, Right against exploitation, Right to freedom of religion, Cultural and Educationrights and Fundamental duties.

Course Outcomes: Students will be able to:

CO1.Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

CO2.Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

CO3.Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

CO4.Discuss the passage of the Hindu Code Bill of 1956.

Mapping of Paper No. **MC-317**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	M	S	M	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	M
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

The examination of the regular students will be conducted by the concerned college/Institute internally.

References:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S.N. Busi, Dr. B.R. Ambedkar framing of Indian Constitution, latest Edition
3. M.P. Jain, Indian Constitution Law, Lexis Nexis, latest edition
4. D.D. Basu, Introduction to Constitution of India, Lexis Nexis, latest edition.

Course code	OEC –ME-402				
Category	Open Elective Courses (OEC) (Semester-VII) List-IV				
Course title	**OPERATIONS RESEARCH**				
Scheme and Credits	L	T	P	**Credits**	Semester-VII
	3	0	0	3	
Objectives:	The aims of operation research include: solving operational questions, solving questions related to resources' operations, and solving decision-making questions. Operational research has a relation with different areas of study and it has several applications. Operation research is considered as a tool of productivity. In comparison to traditional approaches, operation research provides more extensive, quantitative, and detailed information about different issues and managers can implement their decisions based on quantitative analyses. Operation research will be a good assistance for managers in different areas.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Introduction: Definition, role of operations research in decision-making, applications in industry. Concept on O.R. model building –Types & methods.
Linear Programming (LP): Programming definition, formulation, solution- graphical, simplex GaussJordan reduction process in simplex methods, BIG-M methods computational, problems.

UNIT-II

Deterministic Model: Transportation model-balanced & unbalanced, north west rule, Vogel's Method, least cost or matrix minimal, Stepperg stone method, MODI methods, degeneracy, assignment, traveling salesman, problems.
Advanced Topic Of LP: Duality, PRIMAL-DUAL relations-its solution, shadow price, economic interpretation, dual-simplex, post-optimality & sensitivity analysis, problems.

UNIT-III

Waiting Line Models: Introduction, queue parameters, M/M/1 queue, performance of queuing systems, applications in industries, problems.
Project Line Models: Network diagram, event, activity, defects in network, PERT & CPM, float in network, variance and probability of completion time, project cost- direct, indirect, total, optimal project cost by crashing of network, resources leveling in project, problems.

UNIT-IV

Simulation: Introduction, design of simulation, models & experiments, model validation, process generation, timeflow mechanism, Monte Carlo

methods- its applications in industries, problems.
Decision Theory: Decision process, SIMON model types of decision making environment- certainty, risk,uncertainty, decision making with utilities, problems.

Course Outcomes (COs): At the end of the course, the student shall be able to:
CO 1- Discuss the role of operations research in decision-making, and its applications in industry and should be ableto formulate and design real-world problems through models & experiments.
CO 2- Knowledge of various types of deterministic models like linear programming, transportation model etc.
CO 3- Explore various types of stochastic models like waiting line model, project line model, simulation etc.
CO 4- Deduce the relationship between a linear program and its dual and perform sensitivity analysis.
CO 5- Describe different decision making environments and apply decision making process in the real worldsituations

Mapping of Paper No. OEC –ME-402

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	M	S	S	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	M	S	S	M
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Text Books:

1) Operation Research – TAHA, PHI, New Delhi.
2) Principle of Operations Research – Ackoff, Churchaman, arnoff, Oxford IBH, Delhi.

Reference Books :

1) Operation Research- Gupta & Sharma, National Publishers, New Delhi.
2) Quantitative Techniques- Vohra, TMH, New Delhi 8. Principles of operation Research (with Applicationsto Managerial Decisions) by H.M.Wagher, Prentice Hall of India, New Delhi.
3) Operation Research – Sharma, Gupta, Wiley Eastern, New Delhi.
4) Operation Research – Philips, Revindran, Solgeberg, Wiley ISE.

Course code	OEC-ME-410				
Category	Open Elective Courses (OEC) (Semester-VII) List-IV				
Course title	**QUALITY ENGINEERING**				
Scheme and Credits	L	T	P	**Credits**	Semester-VII
	3	0	0	3	
Objectives:	To understand the concept of Quality Engineering which emphasizes growth, creativity, and analytical thinking.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Section A

Basic Concepts of Quality: Definitions of Quality and its importance in industry, Quality function, Quality Characteristics, Quality process, Quality Traits, Applications of Quality Concept, Introduction to quality control, Computer aided quality control, Total quality control(TQC) and its implementation, Elements of TQC, Quality Circle, Objectives of quality circle, Role of management in quality circle, Quality in service organizations, characteristics of a service organization, Important service dimensions, Design of service quality.

Section B

Basic Statistical Concepts: The Concept of variation, Distinction between variables and attributes data, The frequency distribution, graphical representation of frequency distribution, Quantitative description of distribution, the normal curve, concept of probability, laws of probability, probability distributions, hyper geometric distribution, binomial distribution, The Poisson distribution.

Section C

Quality systems: Quality systems, Need for quality System, Need for standardization, History of ISO:9000 series standards and its features, steps to registration, India and ISO:9000, Automated inspection systems technologies, Different forms of Inspection, Industrial inspection,

Section D

Total Quality Management: Introduction o TQM, Concepts, Characteristics of TQM, Relevance of TQM, Approaches to TQM Implementation, TQM philosophies, Taguchi Philosphy, JIT, Kaizen, Six Sigma approach, 5-S approach

Course Outcomes: Upon completion of this course the student will be able to:

CO1 - Attain the basic techniques of quality improvement, fundamental knowledge of statistics and probability

CO2 - Use control charts to analyze for improving the process quality.

CO3 - Describe different sampling plans

CO4 - Acquire basic knowledge of total quality management CO5 - Understand the modern quality management techniques.

Mapping of Paper No. OEC-ME-410

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	M	S	M	S	S	S	S	S
CO2	S	S	S	M	S	M	S	S	S	S	S	S	S	S	M
CO3	S	S	S	S	S	S	S	M	M	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Text Books:

1. Quality planning and Analysis, Juran and Gryna, TMH, New Delhi
2. Quality Management, Kanishka Bed, Oxford University Press, New Delhi
3. Introduction to SQC, Montgomery DC, 3e, Wiley, New Delhi
4. Fundamentals of quality control and improvement, A Mitra, Mcmillan pub. Company, NY

Reference Books:

1. Fundamentals of Applied Statistics, Gupta and Kapoor, Sultan Chand and Sons, New Delhi.

Course code	OEC –EE-412				
Category	Open Elective Courses (OEC) (Semester-VII) List-IV				
Course title	**ELECTRICAL POWER GENERATION**				
Scheme and Credits	L	T	P	**Credits**	Semester-VII
	3	0	0	3	
Objectives:	The aims of Electrical power generation include: The aim of subject is to get knowledge about power generation and its related issues.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 10 parts of marks from all units and remaining eight questions of 12.5 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Section-A

INTRODUCTION: Energy sources, their availability, recent trends in Power Generation, InterconnectedGeneration of Power Plants.

Section-B

POWER GENERATION PLANNING: Load forecasting, load curves, load duration curve, Base load and Peak load Power Plants, connected Load, maximum demand, demand factor, Group diversity factor, load factor, significance of load factor, plant factor, capacity factor, selection of unit size, No. of Units, reserves, cost of power generation, Depreciation, tariff.

Section-C

CONVENTIONAL ENERGY SOURCES: Selection of site, capacity calculations, classification, Schematic diagram and working of Thermal Power Stations, Hydro Electric Plant, Nuclear Power Plant and Diesel Power Stations.

Section-D

ELECTRIC ENERGY CONSERVATION & MANAGEMENT: Energy management, Energy Audit, EnergyEfficient Motors, Co-generation.

Course Outcomes:

CO1 To introduce the Energy sources.
CO2 To describe significance of load factor.
CO3 To apply the capacity calculations.
CO4 To impart knowledge of Power Stations.
CO5 To know about the Energy management.

Mapping of Paper No. OEC –EE-412

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	M	S	M	S	M	S	S	S
CO2	S	S	S	M	S	M	S	S	S	S	S	S	S	S	M
CO3	S	S	M	S	S	S	S	M	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	M	S	S	S	S	S

S=Strong M=Medium W=Weak

TEXT BOOKS:

1. Electric Power Generation, B.R.Gupta
2. Power Generation, Operation and Control, Wood and Wollenberg, John Wiley &Sons,1984.

REF. BOOKS:

1. A Course in Electric Power System, Soni, Gupta, Bhatnagar, Dhanpat Rai & Sons
2. Power System Engineering, Nagrath & Kothari, Tata Mc-Graw Hill, New Delhi
3. Power Plant Engg: G.D. Rai
4. Electric Power: S.L. Uppal (Khanna Publishing)

Course code	OEC-CSE-430				
Category	Open Elective Courses(OEC) (Semester VII) List-IV				
Course title	**COMPUTER COMMUNICATION**				
Scheme and Credits	L	T	P	**Credits**	Semester-VII
	3	0	0	3	
Objectives:	1. To Build an understanding of the fundamental concepts of computer networking and familiarizing the student with the basic taxonomy and terminology of the computer networking and data communication. 2. To outline various models, topologies and devices of Computer Networks. 3. To explain the functions of various layers in Network Reference Model. 4. To apply different network concepts in various network communication protocols.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions fromeach unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Introduction to Data Communication: Need, components, Data representations communication model,Characteristics of an effective Communication system, Transmission modes: Simplex, Half Duplex and Full Duplex.Serial and parallel transmission. Unicasting, Multicasting, Broadcasting, Amplitude Modulation (AM), Frequency Modulation (FM), Phase Modulation (PM), Amplitude Shift Keying, Frequency Shift Keying, Phase Shift Keying,

MULTIPLEXING: FDM, WDM, TDM, packet switching and circuit switching.**Transmission Media**: Copper cable, Twisted-Pair Cable, Coaxial Cable, Fiber-Optic Cable. Introduction to Computer Network: applications, benefits and problems, Types of Networks: PAN, LAN, MAN and WAN.

UNIT-II

Network Topologies: Introduction to Computer Network Topologies: Mesh Topology, Bus Topology, Star Topology, Ring Topology, Tree Topology, Hybrid Topology, Irregular – Topology.

OSI and TCP/IP Model: Layering architecture of networks, OSI model, Functions of each layer, Services and Protocols of each layer.

UNIT-III

Media Access Control, Random Access: ALOHA, CSMA and CSMA/CD. Controlled Access: Reservation,Polling and Token Passing.

Channelization: FDMA, TDMA and CDMA

Ethernet: Features and types of LANs, Types of Ethernets- Thicknet, Thinnet, Fast Ethernet and Gigabit and 10GEthernet etc. Concept of Carrier Sense Multiple Access (CSMA)/CD in Ethernet.

Network addressing: Physical addressing, logical addressing and port addressing, MAC addressing in Ethernet, IP V4 addressing: concept of subnet, network and host address, IP address Classes- A, B, C, D and E classes. Introduction to classless addressing.

UNIT-IV

LAN interconnecting devices: Repeater, Hubs, Switches, Bridges, Routers, Gateways.

Internet and E-mail: Concept of Internet, Advantages of Internet, Security issues in using internet. Application of Internet in various fields: Scientific, Business, Research, Sports, Medicine & Health Care, Engineering, Teaching. HTTP and FTP

Email : concept, Protocols: SMTP, POP, IMAP.

Course Outcomes:

CO1.Independently understand basic computer network technology.
CO2.Understand and explain Data Communications System and its components.
CO3.Identify the different types of network topologies and protocols.
CO4.Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.
CO5.Identify the different types of network devices and their functions within a network

Mapping of Paper No. OEC-CSE-430

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S		S	S	S	S	S	M	M	M	S	M	S	S	S
CO2	S	S	S	M	S	M	S	S	S	S	S	S	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	M	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	M	S	S	S	S	S

S=Strong M=Medium W=Weak

Text Book:

1. 1.Andrew S Tanenbaum, Computer Networks, 5th Edition, Pearson publications, 2010.
2. Forouzan, Data Communication and networking ,5th Edition, Tata McGrawHill, 2012.
3. William Stalling, Data & Computer Communication 6th edition, LPE Pearson Education, 2013.

Reference Books:

1. Data Communications, Computer Networks and Open Systems (4th edition), Halsall Fred, 2000, AddisonWesley, Low Price Edition.
2. Computer Networks – A System Approach, Larry L. Peterson & Bruce S. Davie, 2 Edition
3. Computer Networking – ED Tittel , 2002, T.M.H.

Course code	**OEC-CE- 448**				
Category	Open Elective Courses(OEC) (Semester VII) List-IV				
Course title	**Traffic Engineering and Road Safety**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	3	**0**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

COURSE OBJECTIVES:

- Acquaint the students to basic concepts of Traffic and their significance.
- To stimulate the students to think systematically and objectively about various traffic problems

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Module-1: Traffic Characteristics: Importance of traffic characteristics. Road user characteristics. Vehicularcharacteristics. Max dimensions and weights of vehicles allowed in India.

Module-2: Traffic Studies: Traffic volume study, speed study and origin and destination study. Speed and delaystudy.

Unit-II

Module-3: Traffic Accidents: Accident surveys. Causes of road accidents and preventive measures.Capacity and Level of Service.

Module-4: Relationship between speed, volume and density,PCU, Design service volume, Capacity of non-urban roads. IRC recommendations, Brief review of capacity of urban roads.

Unit-III

Module-5: Traffic Control Devices: Signs, Signals, markings and islands. Types of signs, Types of signals,Design of Signal, Intersections at grade and grade separated intersections. Types of grades separatedintersections, Parking surveys: On street parking, off street parking.

Unit-IV

Module-6 Road safety audit, RSA team, RSA Report, Elements of RSA,Vehicular air pollution and Situation in India, Motor vehicle act, Vehicular emission norms in India and abroad, Alternate fuels, Factors affecting fuel consumption.

COURSE OUTCOMES:

CO1.To realize the significance of traffic engineering in today life.
CO2.To understand the processes involved in traffic studies.
CO3.To appreciate the role of Traffic regulations.
CO4.To understand the role of RSA team.
CO5.To find the role of Traffic signs.

Mapping of Paper No. **OEC-CE- 448**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	M	M	S	S	S	S	S	S
CO2	M	S	S	M	S	M	S	S	S	S	S	S	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	M	S	S	S	S	S

S=Strong M=Medium W=Weak

RECOMMENDED BOOKS:

- Principles of Transportation Engineering by Chakroborty & Das, Prentice Hall, India.
- Highway Engg by S.K.Khanna & C.E.G. Justo, Nem Chand Bros., Roorkee.
- Traffic Engg and Transport Planning by L.R.Kadiyali, Khanna Publishers, Delhi.
- Principles of Transportation and Highway Engineering by G.V.Rao, Tata McGraw-Hill Publishing Co. Ltd. N.Delhi.

Course code	**OEC-CE- 450**				
Category	Open Elective Courses(OEC) (Semester VII) List-IV				
Course title	**Disaster Management**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	3	**0**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

COURSE OBJECTIVES:

- To provide basic conceptual understanding of disasters and its relationships with development.
- Provide an understanding of the social nature of natural hazards and disasters
- Increase awareness of hazards and disasters around the world and the unequal social consequences stemming from disaster events.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Introduction: Terminology,Global and Indian scenario, role of engineer, importance of study in human life, long term effects of disaster. Geological Mass Movement and land disasters, Atmospheric disasters, Disaster Mitigation

Unit-II

Natural Disaster: Nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea levelrise, ozone depletion

Man-made Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.

Unit -III

Case Studies: Damage profile analysis- Uttarkashi/Bhuj/Latur earthquakes, Kerala floods, cyclone Fani and Amphan, Bihar floods, Covid 19.

Unit IV

Disaster Management: Importance of public awareness, Preparation and execution of emergency management programme. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India.Applications of GIS, Remote sensing and GPS in this regard.

COURSE OUTCOMES:

After completing this course, students should be able:

CO1.To know natural as well as manmade disaster and their extent and possible effects on the economy.

CO2.To Plan national importance structures based upon the previous history.

CO3.To acquaint with government policies, acts and various organizational structures associated with an emergency.

CO4.To know the simple dos and don’ts in such extreme events and act accordingly.

Mapping of Paper No. **OEC-CE- 450**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	M	S	S	S	S	S	M	S	S	S	S	S	S	S
CO2	S	S	S	M	S	M	S	S	S	S	S	S	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

REFERENCE BOOKS:

1. Singhal J.P. Disaster Management, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, Disaster Science and Management, McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi,2011.

Course code	**OEC –ECE-453**				
Category	Open Elective Courses (OEC) (Semester-VII) List-IV				
Course title	**MICROPROCESSOR APPLICATION IN AUTOMOBILES SECTOR**				
Scheme and Credits	L	T	P	**Credits**	Semester-VII
	3	0	0	3	
Objectives:	This course deals with the systematic study of the Architecture and programming issues of 8085-microprocessor family and interfacing with other peripheral ICs and coprocessor. The aim of this course is to give the students basic knowledge of the microprocessors needed to develop the systems using it.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Architecture: General 8 bit microprocessor and its architecture 8085,Z-80 and MC 6800 MPU and its pin functions-Architecture-Functions of different sections.

UNIT-II

Instruction Set: Instruction format-addressing modes-instruction set of 8085 MPU-T-STATE Machine cycle and instruction cycles-Timing diagrams-Different machine cycles-Fetch and execute operations-estimation of execution times.

UNIT-III

Assembly Language Programming: Construct of the language programming-Assembly format of 8085-Assembly Directive-Multiple precision addition and subtraction-BCD to Binary and Binary to BCD Multiplication, Division, Code conversion using look up tables-stack and subroutines. Data Transfer Schemes: Interrupt structure- Programmed I/O, DMA-Serial I/O.

UNIT-IV

Interfacing Devices: Types of interfacing devices-Input/Output ports 8212, 8255,8251,8279. Octal latches and tristate buffers-A/D and D/A converters-Switches, LED's ROM and RAM interfacing. Applications: Data acquisitions-Temperature control-Stepper motor control Automotive applications engine control, Suspension system control, Driver information systems, Development of a high speed, high precision learning control system for the engine control.

Course Outcomes:

CO1 To introduce the MC 6800 MPU.
CO2 To describe Fetch and execute operations.
CO3 To apply the Binary to BCD Multiplication.
CO4 To impart LED's.
CO5 To know about the Interfacing Devices.

Mapping of Paper No. **OEC –ECE-453**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	S	S	S	S	S	S	S	M	S	S	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S

S=Strong M=Medium W=Weak

Reference Books :

1. Ramesh, Goankar.S., Microprocessor Archietecture Programming and Applications, Wiley Eastern Ltd.,NewDelhi,1986.
2. Aditya .P. Mathur, Introduction to Microprocessors, III Edition Tata McGraw Hill Publishuing Co Ltd NewDelhi,1989.
3. Ahson. S. I., Microprocessors with Applications in Process Control,Tata McGraw Hill New Delhi,1986.
4. Jabez Dhinagfar .S., Microprocessor Applications in Automobiles.
5. L. Bianco and A. Labella., Automotive Micro Electronics, Elsevier science Publishers,1986.