DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS

BACHELOR OF TECHNOLOGY

Effective from 3rd semester onwards for 2017 admitted batch
Effective from 1st semester onwards for 2018 admitted batch
ME1193 Tinkering Lab is applicable from 2019 admitted batch
Open Electives are applicable from 2016 admitted batch

SMIT SIKKIM MANIPAL UNIVERSITY
SIKKIM MANIPAL INSTITUTE OF TECHNOLOGY

B.TECH 1ST SEMESTER (PHYSICS GROUP)							
Sl. No.	**Sub Code**	**Sub Name**	**Teaching Deptt**	**Contact Hrs/wk**			**C**
				L	T	P	
1	MA 1101	Engineering Mathematics I	MATHS	3	1	0	4
2	CE 1102	Mechanics of Solids	CE	2	1	0	3
3	PH 1103	Engineering Physics	PHY	3	1	0	4
4	ME 1105	Engineering Graphics	ME	1	0	3	3
5	BA 1106	Communication Skills	MGT	3	0	0	3
6	ME 1161	Workshop Practice I	ME	0	0	3	1.5
7	PH 1162	Engineering Physics Lab	PHY	0	0	3	1.5
8	ME1193	Tinkering Lab	ME	-	-	3	0
Total Credit for the semester : 20							

B.TECH 2nd SEMESTER (PHYSICS GROUP)							
Sl. No.	**Sub Code**	**Sub Name**	**Teaching Deptt**	**Contact Hrs/wk**			**C**
				L	T	P	
1	MA 1201	Engineering Mathematics II	MATHS	3	1	0	4
2	CH 1108	Engineering Chemistry	CHEM	3	1	0	4
3	EE 1109	Elements of Electrical Engineering	EE	2	1	0	3
4	CS 1110	Computer Programming using C	CSE	3	1	0	4
5	*CH 1191	Environmental Science	CHEM	2	0	0	0
6	CH 1163	Engineering Chemistry Lab	CHEM	0	0	3	1.5
7	CS 1164	Computer Programming Lab	CSE	0	0	3	1.5
Total Credit for the semester : 18							

***Mandatory audit course**

B.TECH IST SEMESTER (CHEMISTRY GROUP)

Sl. No.	Sub Code	Sub Name	Teaching Deptt	Contact Hrs/wk			C
				L	T	P	
1	MA 1201	Engineering Mathematics II	MATHS	3	1	0	4
2	CH 1108	Engineering Chemistry	CHEM	3	1	0	4
3	EE 1109	Elements of Electrical Engineering	EE	2	1	0	3
4	CS 1110	Computer Programming using C	CSE	3	1	0	4
5	*CH 1191	Environmental Science	CHEM	2	0	0	0
6	CH 1163	Engineering Chemistry Lab	CHEM	0	0	3	1.5
7	CS 1164	Computer Programming Lab	CSE	0	0	3	1.5
Total Credit for the semester : 18							

B.TECH IIND SEMESTER (CHEMISTRY GROUP)

Sl. No.	Sub Code	Sub Name	Teaching Deptt	Contact Hrs/wk			C
				L	T	P	
1	MA 1101	Engineering Mathematics I	MATHS	3	1	0	4
2	CE 1102	Mechanics of Solids	CE	2	1	0	3
3	PH 1103	Engineering Physics	PHY	3	1	0	4
4	ME 1105	Engineering Graphics	ME	1	0	3	3
5	BA 1106	Communication Skills	MGT	3	0	0	3
6	ME 1161	Workshop Practice I	ME	0	0	3	1.5
7	PH 1162	Engineering Physics Lab	PHY	0	0	3	1.5
8	ME1193	Tinkering Lab	ME	-	-	3	0
Total Credit for the semester : 20							

***Mandatory audit course**

Note: Mandatory induction program for first 03 weeks.

FOUR-YEAR B. TECH (MECHANICAL ENGINEERING) DEGREE COURSE (CGPA SCHEME)

III[RD] SEMESTER – MECHANICAL ENGINEERING

Sl. No.	Sub Code	Sub Name	Teaching Deptt	Contact Hrs/wk			Hrs / wk	C
				L	T	P		
1	MA1305	Engg. Mathematics III	Maths	2	1	0	3	3
2	ME1307	Engg. Thermodynamics	ME	2	1	0	3	3
3	ME1303	Manufacturing Process I	ME	3	0	0	3	3
4	ME1309	Strength of Materials	ME	2	1	0	3	3
5	EE1307	Electro Technology	E & E	2	1	0	3	3
6	ME1305	Mechanical Drawing	ME	1	0	3	3	3
7	ME1361	Strength of Material Lab	ME	0	0	3	3	1.5
8	EE1364	Electro Technology Lab	E & E	0	0	3	3	1.5
9	ME1362	Computational Lab I	ME	0	0	3	3	1.5
10	*BP1391/ BP1392	Constitution of India/ Indian Traditional Knowledge		2	-	-	-	0
			Total	**14**	**4**	**12**		**22.5**

Upto one optional audit course/online course can be taken.

***Mandatory audit course**

IV[TH] SEMESTER - MECHANICAL ENGINEERING

Sl. No.	Sub Code	Sub Name	Teaching Deptt	Contact Hrs/wk			Hrs / wk	C
				L	T	P		
1	MA1405	Numerical Methods	MATHS	2	1	0	3	3
2	ME1407	Thermal Engg. – I	ME	2	1	0	3	3
3	ME1403	Fluid Mechanics	ME	2	1	0	3	3
4	ME1409	Theory of Machines I	ME	2	1	0	3	3
5	ME1405	Material Science	ME	3	0	0	3	3
6	ME1406	Manufacturing Process II	ME	3	0	0	3	3
7	ME1461	Workshop Practice II	ME	0	0	3	3	1.5
8	ME1462	Computer Graphics Lab	ME	0	0	3	3	1.5
9	ME1463	Thermal Engineering Lab I	ME	0	0	3	3	1.5
			TOTAL	**14**	**4**	**9**		**22.5**

Upto one optional audit course/online course can be taken.

VTH SEMESTER - MECHANICAL ENGINEERING								
Sl. No.	**Sub Code**	**Sub Name**	**Teaching Deptt**	**Contact Hrs/wk**			**Hrs / wk**	**C**
				L	T	P		
1	ME1501	Industrial Engg. & Mgt	ME	3	0	0	3	3
2	ME1502	Heat Transfer	ME	2	1	0	3	3
3	ME1508	Fluid & Hydraulic Machines	ME	2	1	0	3	3
4	ME1509	Machine Design I	ME	2	1	0	3	3
5	ME1505	Metrology	ME	3	0	0	3	3
6	ME1511	Mechanics of Solids I	ME	2	1	0	3	3
7	ME1562	Fluid Mechanics Lab	ME	0	0	3	3	1.5
8	ME1565	Manufacturing and Metrology Lab	ME	0	0	3	3	1.5
9	ME1566	Thermal Engg. Lab II	ME	0	0	3	3	1.5
10	ME1581	#Industrial Training I	ME	-	-	-	-	0.5
			Total	**14**	**4**	**9**		**23**

Upto one optional audit course/online course can be taken.

#Industrial Training I will be done after the completion of 4th semester during summer vacation for a duration of 2 weeks and will be evaluated along with the 5th semester examination.

VITH SEMESTER - MECHANICAL ENGINEERING								
Sl. No.	**Sub Code**	**Sub Name**	**Teaching Deptt**	**Contact Hrs/wk**			**Hrs / wk**	**C**
				L	T	P		
1	ME1609	Theory of Machines II	ME	3	1	0	4	4
2	ME1607	Thermal Engineering II	ME	2	1	0	3	3
3	ME1603	Machine Design II	ME	3	1	0	4	4
4	ME1604	Automobile Engg.	ME	3	0	0	3	3
5	ME16**	Elective I	ME	3	0	0	3	3
6	ME1662	Computational Lab II	ME	0	0	3	3	1.5
7	ME1663	Automobile Engg. Lab	ME	0	0	3	3	1.5
8	ME1671	Mini Project	ME	-	-	-	-	2
			TOTAL	**14**	**3**	**6**		**22**

Upto one optional audit course/online course can be taken.

VII[TH] SEMESTER - MECHANICAL ENGINEERING								
Sl. No.	**Sub Code**	**Sub Name**	**Teaching Deptt**	**Contact Hrs/wk**			**Hrs / wk**	**C**
				L	T	P		
1	ME1701	Mechanical Vibrations	ME	3	1	0	4	4
2	ME1710	Operations Research	ME	3	0	0	3	3
3	ME17**	Open Elective	ME	3	0	0	3	3
4	ME17**	Elective II	ME	3	0	0	3	3
5	ME17**	Elective III	ME	3	0	0	3	3
6	ME1761	Machine Dynamics Lab	ME	0	0	3	3	1.5
7	ME1762	CAE Lab	ME	0	0	3	3	1.5
8	ME1782	[@]Industrial Training II	ME	-	-	-	-	1
			Total	**15**	**3**	**6**		**20**

Upto one optional audit course/online course can be taken.

[@]Industrial Training II will be done after the completion of 6th semester during summer vacation for a duration of 4 weeks and will be evaluated along with the 7th semester examination.

VIII[TH] SEMESTER - MECHANICAL ENGINEERING								
Sl. No.	**Sub Code**	**Sub Name**	**Teaching Deptt**	**Contact Hrs/wk**			**Hrs / wk**	**C**
				L	T	P		
1	ME1875	Major Project	ME	-	-	-	-	12
			TOTAL	**-**	**-**	**-**	**-**	**12**

Upto one optional audit course/online course can be taken.

List Of Electives			
EL I (Elective I)	**Open Elective**	**EL II (Elective II)**	**EL III (ELECTIVE III)**
ME1631 LATEST TRENDS IN MECHANICAL ENGG	ME1721 PERSONAL MANAGEMENT AND INDUSTRIAL RELATIONS	ME1731 POWER PLANT ENGG	ME1735 TOOL ENGINEERING AND DESIGN
ME1632 MECHATRONICS	ME1722 FINITE ELEMENT METHOD	ME1732 REFRIGERATION AND AIRCONDITIONING	ME1736 TOTAL QUALITY MANAGEMENT
		ME1733 ENERGY MANAGEMENT	ME1738 COMPUTER INTEGRATED MANUFACTURING
		ME1737 ROBOTICS AND AUTOMATION	ME1739 PRODUCTION AND OPERATION MANAGEMENT
		ME1740 INTERNAL COMBUTION ENGINE	ME1741 ADVANCED MANUFACTURING TECHNIQUES
			ME1742 COMPUTER-AIDED DESIGN AND MANUFACTURING

NOTE: Students will have to choose either elective subject floated by the department or online elective offered by the external agency. There shall be two options for each elective, one floated by the department and the other by external agency. The subjects given in the lists above are the first set of subjects and will be offered by the department.

Online courses offered by external agencies shall also be treated as credit elective courses. Students have the option of choosing elective subject either offered by the dept or online courses. If a student selects elective from the list proposed by external agencies then the student is required to register for that course and fill up a form providing details of the course chosen by the student and submit it to the department for record. All the examinations for online courses shall be conducted by Sikkim Manipal University. The student is required to produce mark details and course completion certificate in order to consider him/her eligible for award of grade in that particular course.

ENGINEERING GRAPHICS

Subject Code	**: ME1105**
L: T: P: C	**: 1: 0: 3: 3**
No. of questions to be set	**: 4 each from Unit I and Unit II.**
No. of questions to be answered	**: 5 full questions selecting at least 2 from each unit**

Objectives: This course emphasizes on the basic of Engineering Drawing, It is a building step for designing in this course various concepts of projections, scales, section of solids and development of solids are taught.

Pre-requisite: Basic concepts of dimensions, units and its conversion to other units, Polygons, Various shapes of solid.

Learning Outcomes: On successful completion of this course students will be:

1. Able to indicate the link between the engineering graphics and other subjects of study in B.Tech course.
2. Able to identify the notations used in a drawing as per BIS.
3. be able to identify the correctness of engineering drawing dimensioned and dimension the same as per the BIS
4. Able to apply principles of geometrical construction.
5. Able to identify the applications of these constructions in engineering practice.

UNIT I

Scales: Representative fraction, construction of plain and diagonal scales.

Projections of lines: Projections of lines in different positions with respect to the reference planes, true length, angle of inclination of lines with reference planes.

Projection of planes: Projection of plane lamina of different geometrical shapes in different positions with respect to the reference planes.

Projection of solids: Projection of solids of different geometrical shapes by change of position method.

UNIT II

Section of Solids: Section of solids of different geometrical shapes by change of position method.

Development of Surfaces: Development of parallel lines, Right Prisms, Oblique Prisms, Right Cylinders, Oblique Cylinders, Right pyramids, Oblique Pyramids, Right Cones and Oblique Cones.

Orthographic Projection: Conversion of pictorial views into orthographic projections of simple machine parts.

Isometric Projection: Isometric axes, lines, planes and Isometric scale, Isometric Projections of prisms, pyramids, cylinders, cones and simple machine parts

Text books:

1. **Engineering Drawing** by N.D.Bhatt**,** Charotar Publishing House Pvt.Ltd.
2. **Engineering Drawing Vol. I & II**, by K. R. Gopalakrishna, Subhas Publications

Reference books:

1. **Machine drawing** by N.D.Bhatt, Charotar Publishing House Pvt.Ltd.
2. **Engineering drawing and computer graphics by** M. B. Shah & B.C.Rana, Pearson Education
3. **Engineering Graphics by** B. Agarwal & C. M. Agarwal, McGrawHill Publication
4. **Text book on Engineering Drawing by** K.L. Narayana & P. Kannaiah, McGrawHill Publication

WORKSHOP PRACTICE I

Subject Code : ME1161
L: T: P: C : 0: 0: 3: 1.5
Duration of examination : 3 hours
Objective: This course emphasizes on the working of basic conventional machines, models are made by the use of conventional machines/machine tools.
Pre-requisite: Basic concepts of Dimensioning.
Learning Outcomes: On successful completion of this course students will:

1. Be able to demonstrate the ability to work in the carpentary,fitting,plumbing and soldering section.
2. Understand the importance of team work.
3. Be able to differentiate the various carpentry, fitting, plumbing, soldering tools.

Carpentry: Use of carpentry tools, preparation of joints involving the following operations: plaining, chipping, tenoning and mortising. Minimum two models to be prepared; Demonstration of wood working machines
Plumbing: Use of plumber's tools, various pipe fittings, exercises in thread cutting on pipes.
Fitting: Use of fitter's tools; Exercises involving the following operations: measuring and marking, chipping, filing, drilling, tapping, and external threading. Minimum two models to be prepared
Soldering: Use of soldering tools, exercises involving sheet metal joints and electrical circuits/ cable joints.

The broad areas for conduct of experiments. However, the specific list of experiments is as follows. Students are required to perform minimum 12 experiments during semester in the workshop.

List of Experiments:-

1. To mark the given dimensions on given job/wood piece, as per specifications for making Tee-Dovetail joint.
2. To perform planning operation on the given wooden piece for making Tee-Dovetail joint.
3. To perform sawing operation on the wood piece for making-Dovetail joint.
4. To prepare a Tee-dovetail carpentry joint.
5. To prepare a Tee-bridle carpentry joint.
6. To perform external threading on G.I/PVC pipe.
7. To perform lay out marking on a given mild steel specimen for fitting.
8. To perform filing operation on mild steel specimen for fitting job.
9. To perform hack sawing operation on the given mild steel specimen.
10. To perform drilling operation on given mild steel specimen.
11. To perform soldering on G.I. (Galvanized Iron) sheet to form a lap joint.
12. To perform soldering on G.I. (Galvanized Iron) sheet to form a butt joint.

Reference books:

1. **S. K. Hajra Choudhury & Others:** Elements of Workshop Technology (Vol. I), MPP

ENGINEERING MATHEMATICS III

Subject Code : **MA1305**
L: T: P: C : **2: 1: 0: 3**
Questions to be set : **4 from each unit**
Questions to be answered : **5 full questions selecting at least 2 from each unit**

Objective: The objective of this paper is to give some concept about topics like vectors, gradient, divergence, curl, line surface and volume integral, Fourier series, PDE, and Numerical Methods. All these topics are very helpful for engineering studies. The concept of gradient, divergence, curl and PDE are required in different subjects of B.Tech. Fourier series is used to approximate the periodic functions, Fourier transform is used to solve differential equations. In higher studies, to get analytical solution to mathematical problem like integration, system of linear equations (with large number of variables) are not always possible or not so easy, so numerical methods are helpful for them to resolve it.

Pre-requisites: Basic concept of vectors, coordinate geometry, calculus, multiple integral, ordinary differential equations, linear algebra.

Learning Outcomes: On successful completion of this course students will be:

1. Able to understand the important of mathematical equations in various fields of engineering.
2. Able to implement these concepts in mathematical modelling of real life engineering problems.

UNIT I

Vector calculus: Vector-calculus-gradient, divergence and curl, their physical meaning and identities. Line, surface and volume integrals, Green's theorem, Divergence theorem and Stoke's theorems - Simple applications.

Fourier analysis: Periodic functions, Fourier series, Fourier series of odd and even functions, functions with arbitrary period, Fourier integrals, Fourier transforms, Fourier sine and cosine transforms, Convolution theorem. Application of Fourier series to forced vibration problems, Parseval's identity : application of Fourier integral and Fourier transform to solve heat equation.

(18L)

UNIT II

Basic probability theory and applications: Introduction to Probability, Finite sample space, conditional probability and independence, Baye's theorem, one dimensional random variable, mean, variance and expectation. Distributions: Binomial, Poisson, Uniform, Normal.

Partial differential equations: Definition, degree, order of a PDE. Formation of PDE. Linear and nonlinear PDE. Solution of first order linear PDE. One dimensional wave equation (vibrating string): its derivation and solutions by using method of separation of variables, D ' Alembert's solution of' wave equation. Derivation of one dimensional heat equation and its solution by using method of separation of variables. Solution of two dimensional Laplace's equation.

(18L)

Text books:

1. **C. E. Weatherburn :** Elementary Vector Analysis; G. Bell
2. **Erwin Kreyszig :** Advanced Engineering Mathematics
3. **S.S. Sastry:** Introductory methods of numerical analysis
4. **I. Sneddon**, Elements of Partial Differential Equations

Reference books:

1. **M. K. Jain and S.R.K. Iyengar and R. K. Jain:** Numerical methods for scientific and engineering computations.
2. **Murray R. Spigel :** Vector Analysis, Schaum's Outline Series

ENGINEERING THERMODYNAMICS

Subject Code : ME1307
L: T: P: C : 2: 1: 0: 3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objectives: This course emphasizes on the various laws of Thermodynamics and the behavior of pure substances/ Ideal Gases. It also explores the concept of entropy and interaction of heat.

Pre-requisite: Basics knowledge of Heat, work and energy, Laws of Motions, Various gas laws. And knowledge of Element of Mechanical Engineering.

Learning Outcomes: On successful completion of this course students will:

1. Be able to develop the concept of thermodynamics and various laws governing it.
2. Be able to understand the concept of entropy, available and unavailable energy.
3. Appreciate the concept of Ideal and real Gases.
4. Be able to solve numerical of steam power plant using steam tables/Mollier chart.

UNIT I

Introduction: Units and dimension, system and continuum, scope and limitations of thermodynamics, macroscopic and microscopic point of view, thermodynamic state, properties and cycles, intensive and extensive properties.

Zeroth law of thermodynamics: Concept of thermodynamic equilibrium and temperature, temperature scales.

Energy Interactions: Work transfer of different forms, heat transfer – specific heat and latent heat; First law of thermodynamics, closed and open systems, concept of internal energy and enthalpy, specific heats at constant volume and constant pressure, perpetual motion machine of the first kind (PMMI), Steady flow energy equation and its applications.

Second law of thermodynamics: Limitations of the first law, heat engines, reversed heat engines and their performance, Kelvin-Planck's and Clausius' statements of the second law, reversible and irreversible processes, conditions for reversibility, Carnot cycle and Carnot's theorem, absolute zero temperature.

Entropy: Clausius' inequality – the property, entropy principle, entropy and disorder, calculation of entropy changes, T-s and h-s diagrams for various processes, concept of third law of thermodynamics.

(18 L)

UNIT II

Availability: Available and unavailable energy, Helmholtz and Gibbs functions, Maxwell's relations, Clausius – Clapeyron equation.

Pure substance: Definition, p-v, p-T, T-s and h-s diagrams for pure substances, tabulated properties and process calculations, properties of steam – sensible heat and latent heat, saturation temperature and pressure, quality or dryness fraction - wet, dry, saturated and superheated steam, use of steam tables and Molier chart.

Ideal Gases: Definition, Avogadro's law, internal energy, enthalpy and specific heats and their calculation from simple kinetic theory, entropy changes of ideal gases, reversible adiabatic and polytropic processes; Mixing of ideal gases – Dalton's law of partial pressure, evaluation of properties of ideal gases (example – air water vapour mixture), use of psychometric chart.

(18 L)

Text books:

1. **P K Nag:** Engineering Thermodynamics, Tata McGraw Hill
2. **R K Rajput:** A Text Book of Engineering Thermodynamics, Laxmi Publications, New Delhi

Reference books:

1. **M W Zemansky:** Heat and Thermodynamics, McGraw Hill
2. **Joseph H. Kennen:** Thermodynamics, John Wiley
3. **Sontag, Borgnakke and Van Wylen:** Fundamentals of Thermodynamics, John Wiley
4. **C P Arora:** Thermodynamics, Tata McGraw Hill

MANUFACTURING PROCESS I

Subject Code : ME1303
L: T: P: C : 3: 0: 0: 3
Questions to be set : 4 from each unit.
Questions to be answered : 5 full questions selecting at least 2 from each unit.

Objectives: In this course emphasizes on different manufacturing processes, concepts of casting, welding, types of furnaces, mechanical working of metals, Concept of Rolling, Extrusion and Drawing, Forging, Sheet metal forming, Presses, Non- Destructive Testing.

Pre-requisite: Elementary knowledge of manufacturing process.

Learning Outcome: On successful completion of this course:

1. Students will demonstrate the various manufacturing processes.
2. Students will demonstrate the various types of casting, furnace, welding techniques.
3. Students will demonstrate the mechanical working of metals, rolling, forging, extrusion, non destructive testing of metals.

UNIT I

Casting: Definition, classification of casting processes – advantages and limitations.

Sand Casting: Types of sand, patterns – types and allowances, Green sand properties, Green sand molding, sand testing – permeability, hardness, grain size, compressive and shear strength; types of cores and core making.

Special Casting Processes: Brief description of CO_2 molding, Shell molding, Die casting, Centrifugal casting, Continuous casting, Investment casting – with applications.

Casting defects: Causes and remedies.

Welding: Definition, classification, weldability, welding joints and edge preparation.

Resistance Welding: Spot, seam, projection, percussion – equipments and application.

Gas Welding: Equipments, types of flames, gas cutting.

Arc Welding: Carbon arc welding, shielded arc welding, TIG, MIG and submerged arc welding – basic equipments and working principles, welding electrodes.

(18L)

UNIT II

Special welding processes: Thermit welding, electron beam welding, laser welding – working principles and applications, principles and application of brazing and soldering defects.

Mechanical Working of Metals: Definition, classification, hot working and cold working, recrystallisation.

Rolling, Extrusion and Drawing: Principles, types, methods and applications.

Forging: Methods and processes, forging presses and dies, impact forging, press forging, upset forging, forge welding, power hammers – spring, pneumatic and drop type.

Sheet metal forming: Processes, sheet metal dies – simple, compound and combination dies.

(18L)

Text books:

1. **P.N. Rao:** Manufacturing Technology – Foundry, Forming and Welding, TMH
2. **R.K.Jain**:Production Technology, Khanna Publishers
3. **Hajra Choudhary,** Elements of Workshop Technology –Vol. I, Media Promoters and Publishers

Reference books:

1. **J.S. Campbell:** Principles of Manufacturing Materials and Processes, TMH
2. **Roy A. Lindberg:** Processes and Materials of Manufacture-PHI
3. **O.P.Khanna :** Foundry Technology, Dhanpat Rai Publications
4. **B.S.Raghuwanshi:** A course in Workshop Technology-Dhanpat Rai & Sons
5. **W.A.J.Chapman:** Workshop Technology-Part I & II – CBS Publications

STRENGTH OF MATERIALS

Subject code : ME 1309
L: T: P: C : 2: 1: 0: 3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objectives: i) Understand the concept and calculate stresses and strains on oblique plane using different methods. ii) Understand the concept of strain energy .iii) To provide the fundamental of torsion, design of spring and SFD/BMD.

Pre-requisite: basic knowledge of Mechanics of Solid I.

Learning Outcome: On completion of this course students will:

1. Be able to calculate direct, tangential, resultant stress and maximum and minimum principal stresses and their directions on oblique planes inclined at different angles.
2. Understand the concept of strain energy and also find out the energy in different stress systems i.e. uniaxial, biaxial, triaxial, bending and torsion.
3. Understand the basic of deflection of beam with different loading condition.

UNIT I

Introduction: Concept of mechanics of deformable solids; concept of stress developed against external force/pressure; Deformation of axially loaded members, statically determinate and indeterminate problems. Relation between shear modulus and Young's modulus.

Principal stresses and strains: Mohr's circle for stresses on an oblique section of a body subjected to direct stresses in two mutually perpendicular directions, Mohr's circle for stresses on an oblique section of a body subjected to direct stress in one plane accompanied by a simple shear stress, Mohr's circle for stresses on an oblique section of a body subjected to direct stresses in two mutually perpendicular directions accompanied by a simple shear stress, Mohr's circle for strain.

Strain energy concepts: Introduction, Resilience, Proof resilience, modulus of resilience, Types of loading: gradually applied, suddenly applied, impact.

Elastic strain energy and energy methods: Elastic strain energy in a uniaxial stress system, Elastic strain energy in shear , Strain energy in 3D stress system , strain energy in axially loaded bar , strain energy in bending , strain energy for shaft in torsion, Castiglianos theorem, Maxwell's reciprocal theorem, application of Castiglianos theorem in solution of statically indeterminate problem. (18L)

UNIT II

Torsion: Torsion formula for circular cross-sections, Maximum normal and shear stresses, Angle of twist, combined bending & torsion of solid & hollow shafts

Springs: Deflection of springs by energy method, helical springs under axial load and under axial twist (respectively for circular and square cross sections) axial load and twisting moment acting simultaneously both for open and closed coiled springs.

Shear Force and Bending Moment Diagrams: Definition of bending moment and shear force at a section, sign convention, relationship between bending moment, shear and load intensity, shear force diagrams (SFD) and bending moment diagrams (BMD) for statically determinate beams subjected to point loads, uniformly distributed loads uniformly varying loads and couples. Loading diagram corresponding to the given SFDs. stresses in beams of various cross sections.

(18L)

Textbooks:

1. **S.S. Ratan** - Strength of materials, TataMcgrawhill.
2. **Beer, Johnston and Dewolf**–Mechanics of materials-TataMcgrawhill
3. **Timoshenko & Young -** Elements of Strength of Materials - East west press.
4. **Ramamrutham& S Narayan**–Strength of Materials-Dhanpat Rai& Publications.
5. **Nag & Chanda**- Fundamentals of Strength of Materials, Wiley India.
6. **G.H.Ryder** - Strength of materials, Macmillan India

Reference Books:

1. **KamalKumar,RCGhai**–AdvancedMechanicsofMaterials-Khanna Publishers
2. **L S Srinath**-Advanced Mechanics of Solids-TMH

MECHANICAL DRAWING

Subject Code : ME1305
L: T: P: C : 1: 0: 0: 3
Questions to be set : 4 from Unit – I and 2 from Unit-II
Questions to be answered : 3 full questions in all selecting 2 from Unit I and 1 from Unit II

Objectives: In this course concepts of sectional views and Proportionate drawings of various mechanical parts are taught. A greater depth in assembly drawing of various mechanical devices is provided.

Pre-requisite: Basic technical drawing

Learning Outcome: On successful completion of this course students will:

1. Be able to design a proportional drawing of screw threads and bolts.
2. Be able appreciate the concept of Assembly Drawing.
3. Be able to draw the assembly drawing of various mechanical devices.

UNIT I

Orthographical sectional views: Drawing orthographical sectional views (only two views) from the given pictorial views of various machine parts and simple machine assemblies.

Proportionate drawings: (appropriate views to be considered) of the following

a) Screw thread forms and Threaded fasteners, drawing different forms of screws, square and hexagonal headed bolts, stud bolts, nuts, locking arrangements and foundation bolts.
b)Riveted joints: Lap joints, butt joints
c)Joints and Couplings: Cotter Joint, Knuckle Joint, Flanged coupling, Flexible coupling, Universal and Oldham's coupling
d)Pipe joints: Cast iron pipe joint, Flange pipe joint, union joint
e)Stuffing Box, Plummer block, foot step bearing, bush bearing, bearing bracket

(18L)

UNIT II

Assembly Drawing

1.I C engine parts
2.Screw Jack
3.Machine Vice: 3 – jaw chuck, tailstock of lathe, swivel vice
4.Valves: 2 –way stop valve, spring loaded valves, Blow off cock, feed check valve

(18L)

Text Books:

1.**N D Bhat:** Machine Drawing, Charotar Publishing House

Reference books:

1.**K R GopalaKrishna:** Machine Drawing, Subhash Publications
2.**Sidheshwar:** Machine Drawing, Tata McGraw Hill
3.**Narayana: Kannaiah,&Venkata Reddy-**Machine Drawing –New Age
4. **K.Venugopal:** Engg.Drawing & AutoCAD-New Age

ELECTRO TECHNOLOGY

Subject Code : EE1307
L: T: P: C : 2: 1: 0: 3
Questions to be set : 4 from each unit
Questions to be answered : 5 full question selecting at least 2 from each unit

Objectives: To Introduce the Students the working of Operational amplifiers and its application in design of various analog circuits, characteristics of thyristors as a switch and its application in various fields such as speed control of motors and voltage control. Introduce the concept of DC Machines, their characteristics and provide a basic understanding for linear control systems.

Pre-requisite: Concepts of Electricity,Basic Electronics.

Learning outcomes: On successful completion of this course students will:

1. Be able to design circuits using op-amps; understand its theory and applications.
2. Understand the use of thyristors and its role in developing a controlled circuit.
3. Exposure to DC Machines and learning the characteristics will enable them to understand DC machines, which in-turn will help them to decide the type of dc machine to be used in a particular application.

UNIT I

DC motor: Construction, principle of operation, EMF & torque equation, types, characteristics, starting and speed control of DC motor.

Electric heating: Advantages of electric heating, classification of heating methods, transfer of heat, calculation of quantities of heat, core type induction furnace, resistance heating, designing of heating elements, dielectric heating.

Basic operation amplifier, characteristics of an ideal op amp, input offset voltage & current, CMMR, slew rate, feed back in operational amplifier circuit, closed loop voltage gain, application as inverting and non-inverting amplifier, voltage follower, summing amplifier, difference amplifier, comparator.

Thyristor: Members of thyristor family, SCR, two transistor analogy of SCR, V – I characteristics of SCR, triggering methods, application of SCR in motor speed control, light dimming control, heater control, inverters, Triac, operation, V-I characteristics, application.

(18L)

UNIT II

Introduction to Control System, open loop and closed loop controls, transfer function, block diagram s of control system.

Mathematical Models of physical systems: differential equations of physical systems, transfer function analysis, mechanical, translational and rotational systems, electrical systems, hydraulic systems.Standard test signals, types and order of a system, time response of first and second order systems, time response specification.

Stability: Necessary conditions for stability, Routh-Hurwitz stability criterion, Routh's test – difficulties and remedies, relative stability.

(18L)

Text books:

1. **I J Nagrathand D P Kothari:** Electric Machines, Tata McGraw Hill
2. **Albert Paul Malvino:** Electronic Principles (Third Edition), Tata McGraw Hill
3. **K Ogata:** Modern Control Engineering (Second Edition), Prentice Hall of India
4. **C L Wadhawa:** Generation, distribution and utilization of electrical energy,Wiley Eastern

STRENGTH OF MATERIALS LAB

Subject Code : ME1361
L: T: P: C : 0: 0: 3: 1.5
Duration of examination : 3 hours

Objectives: In this course the concept of various effects due to tension, compression, bending effects on material more precisely.

Pre-requisite: Mechanics of Solid I

Learning Outcomes: On successful completion of this course students will:

1. Demonstrate the various tests on the ductile and brittle materials.
2. Investigate the various effects on the materials after the tests.

Ultimate tensile strength (**UTS**): Determination of tensile strength of different materials (e.g. Aluminium and Mild steel)

Ultimate shear strength: Determination of shear strength of mild steel rod.

Compressive strength: Determination of compressive strength of mild steel rod, wooden block and brass rod.

Hardness: Hardness testing of mild steel specimen using Rockwell, Brinell's and Vickers hardness testing machine.

Impact strength: Strength testing of mild steel/Cast iron specimen using Charpy Impact Test and Izod Impact Test.

Torsional strength: Determination of modulus of rigidity of a mild steel specimen.

Fatigue strength: Determination of endurance limit of a mild steel specimen on fatigue or cyclic loading

Spring Testing: Determination of stiffness of the spring and modulus of rigidity of the spring wire

The broad area for conduct of experiments are given above. However, the specific list of experiments is as given below. Students are required to perform minimum 12 experiments during the semester in the Strength of Materials Lab.

List of Experiments:-

1. To find out the tensile strength of mild steel/aluminium specimen using Universal Testing Machine (UTM).
2. To determine the ultimate shear strength, in single shear and double shear of mild steel rod specimen
3. To determine the compressive strength of mild steel specimen under gradually increasing compressive load
4. To determine the compressive strength of wood specimen under gradually increasing compressive load.
5. To determine the compressive strength of brass specimen under gradually increasing compressive load.
6. To determine the indent's hardness of mild steel specimen using Rockwell Hardness Testing method.
7. To determine the indent's hardness of mild steel specimen using Brinell's and Vickers hardness testing method
8. To determine the impact resistance of mild steel/cast iron specimen using Charpy test
9. To determine the impact resistance of mild steel/cast iron specimen using Izod impact testing
10. To carry out torsional test on mild steel specimen and find its modulus of rigidity
11. To determine the endurance limit of the given specimen (mild steel) under fatigue or cyclic loading.
12. To determine the stiffness of the spring and modulus of rigidity of the spring wire.

Reference book:

1. **Timoshenko & Young -** Elements of Strength of Materials - East west press.

COMPUTATIONAL LAB I

Lab Subject Code : ME1362
L: T: P: C : 0: 0: 3: 1.5
Duration of examination : 3 hours

Objectives: i) To know the basic concepts problem solving using C++. ii) To understand the basic concepts of C++. iii) To develop the programming skills of students in C++.

Pre-requisite: C programming.

Program Outcomes: On successful completion of the course:

1. Students will become familiar with fundamentals of various science and technology subjects and thus acquire the capability to applying them in soft computing.
2. Students will become equipped with the knowledge and skills necessary for entry-level in IT companies

Object oriented paradigm: Introduction, Concept of objects, classes, Encapsulation of data and data abstraction, Merits and demerits of object- oriented methodology.

Data types, operators and expressions

Control flow: (i) If statement (ii) If-else statement (iii) Nested if-else statement (iv) For loop (v) While loop (vi) Do,, while loop (vii) Break statement (viii) Switch statement (ix) Continue statement (x) Go to statement

Arrays and strings, Programming with functions, Pointers and runtime bindings.

Operator overloading: (i) Unary operator overloading (ii) Binary operator overloading

Inheritance: (i) Constructors in derived classes (ii) Destructions in derived classes (iii) Abstract classes (iv)Multilevel, Multiple, Hierarchical, Multipath & Hybrid inheritance.

Virtual Functions, Poly Morphism.

Generic programming with templates: (i) Function template (ii) Overloaded function template (iii) Class templates

Input/output files

The broad areas for conduct of experiments are given above. However, the specific list of experiments is as given below. Students are required to perform minimum 12 experiments during the semester in the laboratory.

List of programs:-

1. Write a Program using class in C++ to add and subtract two matrices.
2. Write a Program using class in C++ to multiply two matrices.
3. Write a Program using class in C++ to add two complex numbers.
4. Write a Program using class in C++ to demonstrate different types of inheritance.
5. Write a Program using class in C++ to demonstrate polymorphism.
6. Write a Program using class in C++ to demonstrate operator overloading.
7. Write a Program using class in C++ to demonstrate function overloading.
8. Write a Program using class in C++ to pass object as parameter.
9. Write a Program using class in C++ to write to a file. (i.e., I/O operations).
10. Write a Program using class in C++ to demonstrate the use of template.
11. Write a Program using class in C++ to implement linear search.
12. Write a Program using class in C++ to implement binary search.

Note: For writing the above programs pointer may be used.

Text books:

1. **K.R. Venugopal, Rajkumar, T. Ravishankar:** Mastering C++ by**,** TMH

Reference book:

1. **Robert Lafore:** Object oriented programming in C++ by**,** Pearson
2. **Yashavant Kanetkar:** Let Us C**,** BPB Publications.
3. **E. Balaguruswamy:** Computer Concepts and Programming in C**,** McGraw Hill Education.

ELECTRO TECHNOLOGY LAB

Subject Code : EE 1364
L: T: P: C : 0: 0: 3: 1.5
Duration of examination : 3 hours
Objectives: To Introduce the practical application of various electronic/electrical devices.
Pre-requisite: Basic of Electricity, Electronics
Learning Outcomes: On successful completion of this course students will:

1. Able to design electronic circuits using op-amps, understand its theory and applications.
2. Able to understand the use of thyristors and its role in developing a controlling circuit.
3. Exposure to DC Machines and learning the characteristics.

DC machine: Speed characteristics of DC shunt motor in on load and no load condition. OCC of DC generator. **Amplifier:** Amplification using OP AMP amplifier.
Thyristor: Observation of V-I characteristics of SCR and Triac. Commutation of SCR. Motor control using SCR and Triac.
Rectifier: Study of half wave and full wave rectifier.

List of experiments:-

1. Speed Control of DC shunt motor
2. Load test on DC shunt motor
3. OCC of DC generator
4. External characteristics of DC generator
5. OP AMP – integrator and differentiator
6. OP AMP – Adder and subtractor
7. OP AMP – current to voltage and voltage to current converter.
8. V-I characteristics of MOSFET
9. V-I characteristics of IGBT
10. Commutation of SCR
11. AC phase control using SCR.
12. Study of single phase full controlled converter

Text books:

1. **I J Nagrathand D P Kothari:** Electric Machines, Tata McGraw Hill
2. **Albert Paul Malvino:** Electronic Principles (Third Edition), Tata McGraw Hill
3. **K Ogata:** Modern Control Engineering (Second Edition), Prentice Hall of India
4. **C L Wadhawa:** Generation, distribution and utilization of electrical energy,Wiley Eastern

CONSTITUTION OF INDIA

Subject code	**: BP1391**
L: T: P: C	**: 2: 0: 0: 0**
Questions to be set	**: 4 from each unit**
Questions to be answered	**: 5 full question selecting at least 2 from each unit**

UNIT I

Meaning of constitution law and constitutionalism

Evolution of Indian Constitution- Nationalist Movement and Philosophical Foundations; Preamble of Indian constitution.

Indian Federation- Features of federation; Centre – State Relations – Recent Trends; Fundamental Rights and Duties and Directive Principals of state policy.

Parliamentary form of government: Executive: President; Prime Minister and Council of Ministers -Election, Powers and Functions; **Legislature**: Lok Sabha and Rajya Sabha– Composition, Powers and Functions

Judiciary– Supreme Court, Composition, Powers, Functions and Judicial Review- Judicial Activism.

UNIT II

Amendment of the constitution: Powers and procedure; State Government – Governor, Chief Minister and Council of Ministers – Powers and Functions.

Party System: National and regional Parties; Trends in Party System Election Commission – Electoral Reforms and voting Behavior.

Rural Local Government: Evolution Structure and Function**;** Gram Sabha; Gram Panchayat; Panchayat Samiti; Zila Panchayat.

Urban Local government: Evolution structure and function; Municipal corporation**;** Nagar panchayat.

Text books:

1. **Our Constitution: An Introduction to India's Constitution and Constitutional law** by Kashyap Subhash
2. **Introduction to the Constitution of India** by D. D. Basu
3. **Encyclopedia of Social Sciences** (Vol.4, 1931)
4. **History of Political Theories from Luther to Montesquieu** by Dunning
5. **The Indian Constitution: Cornerstone of a Nation** by Austin Graville
6. **Indian Government and Politics** by S. S. Awasthy
7. **Contemporary Indian Politics** by Limaye Madhu
8. **Indian polity** by M. Laxmikanth

INDIAN TRADITIONAL KNOWLEDGE

SUBJECT CODE	**: BP1392**
L: T: P: C	**: 2: 0: 0: 0**
Questions to be set	**: 4 from each unit**
Questions to be answered	**: 5 full question selecting at least 2 from each unit**

UNIT I

Basic structure of Indian knowledge system. Basic features and importance of Vedic knowledge; Astadash Vidhya- 4 Vedas, (Rig-Veda, Sama-Veda, Yajur-Veda, and Atharva) 4 Upa Vedas (Dhanurveda, Gandharvaveda, Ayurveda and Arthasastra), 6 Vedangs (Siksha, Chhanda, Vyakarana, Nirukta, Jyotisha and Kalpa) And 4 Upangas (Dharma Sastra, Memangsa, Purana and Tarka Sastra)

Modern Science and Indian Knowledge: Basic features, significance and relevance in modern society.

The Idea of Zero, the Decimal System, Numeral Notations, Fibonacci Numbers, Binary Numbers, a Theory of Atom, Plastic Surgery and Ayurveda.

Yoga and holistic health care: Origin of Yoga & its brief development, Meaning of Yoga & its importance, Yoga as a Science of Art (Yoga Philosophy), Meaning of meditation and its types and principles.

Principles of Yogic Practices: Meaning of Asana, its types and principles, meaning of Pranayama, its types and principles, Meaning of Kriya its types and principles.

Case Study

UNIT II

Philosophical Traditions:

Serve Darsana Sangraha: meaning features and significance (Charvaka System,Bauddha System, Arhata or ,Jaina System, Ramanuja System, Purna-prajna System, Nakulis-Pasupata System,Saiva System, Pratyabhijna or Rcognitive System, Rasesvara or Mercurial System, Vaiseshika or Aulukya System, Akshapada or Nyaya System, Jaiminlya System, Papiniya System, Sankhya System)

Indian Linguistic Tradition: **Theoretical**:

Phonetics: Sounds of a language–Phonology: Sound patterns–Morphology: Word formation and structure–Syntax: Sentence structure–Semantics: Study of meaning. **Applied**–Understanding and teaching other languages, translation, speech therapy.

Indian Artistic Tradition: Basic features, significance and importance and region associated:

Chitra Kala , Murti Kala, Bastu Kala, and Sangit, (The Famous Traditional Art Forms in India: Warli Art, Gond Art, Madhubani, Miniature Paintings ,Tanjore Paintings, Kalamkari , Kalighat Pats Phad Pai)

Case Study

Text books:

1. V Shivakrishnan (Ed) : Cultural Heritage Of India Course Material Vidhya Bhawan Mumbai 5th Edition ,2014
2. The Sarva-Darsana-Samgraha, Or Review Of The Different Systems Of Hindu Philosophy By Madhava Acharya Publication Date 1882 ,Topics Hinduism ,Publisher London, Contributor Robarts - University Of Toronto.
3. K.S Subrahmanialyer, Vakyapadiya Of Bhartrihari(Brahman Kanda) Deccan College Pine 1965.
4. Panini Shiksha, Motilal Banarasidas
5. V.N Jha , Language, Thoughts And Reality.

6. Pramod Chandra, Indian Arts , Abhinav Publications 1897
7. Light on Yoga by B.K.S. Iyengar
8. The Heart of Yoga: Developing a Personal Practice by T.K.V. Desikachar
9. The Seven Spiritual Laws of Yoga by Deepak Chopra
10. The Secret Power of Yoga: A Woman's Guide to the Heart and Spirit of the Yoga Sutras by Nischala Joy Devi
11. Yoga: The Iyengar Way by Silva, Mira, and Shyam Mehta
12. Yoga: The Iyengar Way by Silva, Mira, and Shyam Mehta

ENGINEERING MATHEMATICS IV

Subject Code : **MA1405**
L: T: P: C : **2: 1: 0: 3**
Questions to be set : **4 from each unit**
Questions to be answered : **5 full questions selecting at least 2 from each unit**

Objectives: The objective of this paper is to give the concept of probability which will be helpful for them in further mechanical engineering studies while determining the favourable conditions in manufacturing process, Production management and total quality management. Also in Machine Deign probability is used to check the probability of failure or success of particular parts of the machine. In higher studies, to get analytical solution to various types of algebraic and transcendal equation, ODE's are not always possible or not so easy, so numerical methods are helpful for them to resolve it.

Pre -requisites: Set theory, Algebra, calculus, multiple integral, ordinary differential equations, linear algebra.

Learning Outcomes: On successful completion of this course students will:

1. Be able to understand the important of mathematical equations in various fields of engineering.
2. Be able to implement these concepts in mathematical modelling of real life engineering problems.

UNIT I

Interpolation and application : finite difference, central and divided differences, Newton -Gregory and Lagrange's interpolation formulae. Inverse interpolation. Numerical differentiation. Numerical integration: Trapezoidal rule, Simpson's one third and three eight rule.

Numerical solution of algebraic and transcendental equations using method of ordinary iteration. Regula Falsi and Newton Rapson's method. Simple examples, conditions for rate of convergence and multiple roots of polynomial equations. Solution of nonlinear equation by Newton Rapson's method. Simple examples.

(18L)

UNIT II

Solution of systems of linear equation: Direct Methods, Iterative Methods : Jacobi, GaussSeidal. Solution of tridiagonal systems. Eigen values and eigen vectors of matrices and elementary properties, computation of largest eigen value by power method.

Numerical solution of initial value problems in ordinary differential equations by Taylor series method, Picard's method, Euler's method, Modified Euler's method, Runge Kutta second and fourth order method, Predictor and Corrector Method: - Millne's, Adam Bashforth, Adam Moulton method.

(18L)

Text books:

1. **P.L. Meyer**: Introduction to Probability and Statistical Applications.
2. **S.S. Sastry**: Introductory methods of numerical analysis
3. **Erwin Kreyszig**: Advanced Engineering Mathematics
4. **A.V. Opponheim**: Digital signal processing

Reference books:

1. **Hogg and Craig**: Introduction to Mathematical Statistics
2. **S.M. Ross**: Introduction to probability and statistics for engineers and scientists.
3. **K.S. Trivedy**: Introduction to probability and statistics and queuing theory.
4. **M.K. Jain and S.R.K. Iyengar and R.K. Jain**: Numerical methods for scientific and engineering computations.

THERMAL ENGINEERING - I

Subject Code : **ME1407**
L: T: P: C : **2: 1: 0: 3**
Questions to be set : **4 from each unit**
Questions to be answered : **5 full questions selecting at least 2 from each unit**

Objectives: In this course concept of basic principles of vapour power cycle and gas power cycle are taught. The concept of working of reciprocating engines and nozzles. Analyzing the performance of Air-conditioning and refrigeration cycles.

Pre-requisite: Basics knowledge of thermodynamics, interaction of energy, various gas laws. And knowledge of Element of Mechanical Engineering.

Learning Outcome: On successful completion of this course students will:

1. Able to analyze the performance of vapour power and gas power cycles and to identify methods for improving thermodynamic performance.
2. Appreciate the working principle of Air compressor.
3. Able to analyze the performance of Air conditioning and refrigeration cycles and to identify methods for improving thermodynamic performance

UNIT-I

Gas Power Cycles: Introduction: Carnot Cycle, Stirling Cycle, Air Standard Cycles: Otto Cycle, Diesel Cycle, Dual Cycle, Comparison of Otto, Diesel and Dual Cycles, Brayton Cycle.

Vapour Power Cycles : Rankine Cycle, Actual vapour cycle processes, Comparison of Rankine and Carnot Cycles, Mean temperature of heat addition, Methods of increasing thermal efficiency, Reheat and Regenerative cycle, Feed water heater, characteristics of ideal working fluid, Binary vapour cycles.

Steam Nozzles: Type of nozzles, Flow of Steam through nozzles, Equation of continuity, Sonic Velocity and Mach number, Steady flow energy equation in nozzles, the momentum equation, Nozzle efficiency, effect of friction on the velocity of steam leaving the nozzles, mass of discharge through nozzle and condition for its maximum value for steam initially saturated/superheated, Critical pressure in nozzle flow, Critical pressure ratio.

(18L)

UNIT – II

Reciprocating Air Compressor: Single Stage Compressor, Work done by Air compressor with and without clearance, Volumetric efficiency, Isothermal efficiency, Methods adopted for increasing isothermal efficiency, Multistage compression, Condition for minimum work, Cylinder dimensions of multistage compression, Intercooler**.**

Psychrometry and Air Conditioning: Introduction, WBT, DBT, Relative, humidity, Specific humidity, Enthalpy of moist air, Adiabatic Saturation Process, Psychrometers, Psychrometric Charts, Application of 1^{st} Law to a psychrometric process, Mixing process – cooling, heating, humidifying, De humidifying, Basic processes in conditioning of air, Psychometric processes in Air Conditioning Equipment, Simple Air conditioning system, Summer Air conditioning, Winter Air Conditioning.

Refrigeration: Refrigeration systems, C.O.P. and Rating of refrigeration machine, Refrigerator and heat pump, Air Refrigeration system – Reversed Carnot Cycle, Bell Coleman Cycle, Simple vapour compression cycle, Actual vapour compression cycle, Mathematical analysis of vapour compression refrigeration; Vapour absorption system, Simple vapour absorption, system, Practical vapour absorption system, Desirable Properties of ideal refrigerant, Properties and uses of commonly used refrigerants. (18L)

Text books:

1. **P K Nag**:Engineering Thermodynamics, Tata McGraw Hill
2. **R K Rajput**: A Text Book of Engineering Thermodynamics, Laxmi Publications, New Delhi
3. **R Yadav**: Thermodynamics And Heat Engines, Central Publishing House

Reference books:

1. **M W Zemansky**: Heat and Thermodynamics, McGraw Hill
2. **Joseph H. Kennen**: Thermodynamics, John Wiley
3. **K Gupta and Rajendra Prasad**: Thermodynamics for Engineers
4. **C P Arora:** Refrigeration and Air conditioning, Tata McGraw Hill

FLUID MECHANICS

Subject Code : ME1403
L: T: P: C : 2: 1: 0: 3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objectives: i) Learn basic analysis methods of fluid mechanics theory and applications. ii) Learn the major problem-solving methods for devices and processes in which fluid flow is an important part. iii)Begin to develop a physical understanding of fluid mechanics. iv)Apply skills and understanding, and be able to solve standard fluid problems that occur in mechanical engineering applications.

Pre-requisite: Various laws of fluids like Archimedes' principle, Buoyancy, principle of floatation, engineering mathematics.

Learning Outcome: On successful completion of this course students will :

1. Know, understand and apply the basic concepts of Fluid Mechanics to carry out professional engineering activities in the field of fluids.
2. To build the necessary theoretical background for advanced fluid dynamics and hydraulic courses.
3. Encourages creative thinking and development of a deeper understanding and intuitive feel for fluid mechanics.

UNIT I

Basic concepts: Definitions, properties – physical and thermodynamic, classification of fluids – ideal, real and non-Newtonian fluids.

Fluid statics: Pressure at a point, Pascal's law, variation of pressure in a static fluid; Scales of pressure – absolute and gauge pressure; Measurement of pressure – mechanical gauges, manometers; Forces on plane and curved surfaces – center of pressure; Buoyant force, center of buoyancy, metacentre, determination of metacentric height, stability and equilibrium of floating and submerged bodies.

Kinematics of fluid flow: Types of fluid flow and types of flow lines; continuity equation (one and two dimensional), kinematics of fluid element, rotational flow, irrotational flow, velocity potential and stream function; circulation and vorticity.

Dynamics of Fluid Flow: Euler's equation of motion, Bernoulli's equation for real and ideal fluids, steady flow energy equation, derivation of Bernoulli's equation from energy equation, correction factors for non-uniform flows, application of Bernoulli's equation – orifice, mouthpiece, pitot tube, venturimeter, orifice meter and nozzle.

(18L)

UNIT II

Notches and weirs: Discharge over notches and weirs, velocity of approach, broad-crested weir.

Laminar flow: Reynolds experiment, laminar flow through circular pipe and annulus between parallel plates.

Flow through pipes: Losses in pipe flow, major losses (loss due to friction) and minor losses, hydraulic gradient – total energy line, pipes in parallel and series, branched pipes, equivalent pipe and power transmission through pipes.

Compressible flow: Thermodynamic concepts, equations for isothermal and adiabatic flow, basic equations for compressible flow – continuity equation, Bernoulli's equation and momentum equation, expression for velocity of sound, Mach number, Mach cone, Mach angle, propagation of pressure waves, stagnation properties.

(18L)

Text books:

1. **S.k. Som and G. Biswas**: Introduction to Fluid mechanics and Machinery, Tata McGraw Hill.
2. **K L Kumar**: Fluid Mechanics, Eurasia Publishing House, New Delhi
3. **L.Streeter: Bedford and E.Wylie**, Fluid mechanics, McGraw Hill
4. **A. K. Jain**: Fluid Mechanics: Including Hydraulic Machines, Khanna Publishers

Reference books:

1. **I. Shames**: Mechanics of Fluids, McGraw Hill

2. **Jagdish Lal:** Fluid mechanics, Metropolitan Book Co.
3. **B.S. Massey**: Mechanics of Fluids, ELBS – low priced edition
4. **S.M. Yahya**: Fundamentals of Compressible Flow, Wiley Eastern

THEORY OF MACHINES I

Subject Code : ME1409
L: T: P: C : 2: 1: 0: 3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objectives: This course emphasizes on the concept of velocity and acceleration analysis of mechanism, Kinematics of lower and higher pairs, concept of Inversions of mechanism, concept of various power drives.

Pre-requisite: Basics of mechanical engineering, Applied mechanics, Basic concepts of statics and dynamics.

Learning outcomes: On successful completion of this course students will:

1. Demonstrate the ability to analyze the basic four bar mechanism with velocity and acceleration analysis that will be helpful for designing various mechanism.
2. Students will demonstrate the ability to analyze the higher and lower pairs.
3. Understand the fundamental of various drives (e.g. Gear,belts and rope drives)

UNIT I

Introduction and definitions: Link, element, kinematic pairs – their classification and degrees of freedom, kinematic chain, mechanism, inversion and machine.

Kinematic chains and inversions: Four bar chain, mobility of a mechanism – Grashof's law for movability of a Four bar mechanism.

Other mechanisms: Quick return motion mechanisms, Pantograph, Hooke's joint, Ackermann and Davis steering gear mechanisms.

Velocity and acceleration analysis: Determination of velocity and acceleration in mechanisms by relative velocity and relative acceleration methods; relative velocity and relative acceleration of particles on a common link and coincident particles on separate links – Coriolis component of acceleration.

Instantaneous centre of rotation: Definitions, Aronhold–Kennedy's theorem of three centers and its application to locate instantaneous centers; Determination of velocity by instantaneous centre method. (18L)

UNIT II

Toothed gearing: Classification of gears, nomenclature for straight spur gears, fundamental law of gearing, conjugate teeth, involute and cycloidal tooth profiles, path of contact and arc of contact, interference in involute gears, methods of avoiding interference – undercutting.

Gear trains: Simple gear trains, compound gear trains for large speed reductions – gear box of an automobile; epicyclic gear trains, alternate methods of determining velocity ratio of epicyclic gear trains, tooth loads and torque calculations in epicyclic gear trains. Differential mechanism of an automobile.

Belt and Rope drive: Flat and V belts and ropes, limiting ratio of tensions, effective tension and power transmitted, centrifugal tension in a belt or rope, effect of centrifugal tension on power transmitted.

Friction: thrust bearings, single and multi-plate clutches, cone clutches, centrifugal clutches. (18L)

Text books:

1. **A. Ghosh and A.K. Mallik**: Theory of Mechanisms and Machines, East West Press
2. **Jagdish Lal**: Theory of Mechanisms and Machines, Metropolitan Book Co Delhi
3. **A.G. Ambekar**: Mechanism and Machine Theory, Jain Brothers, New Delhi
4. **V.P.Singh**: Theory of Machines, Dhanpat rai & Co.

Reference books:

1. **T. Bevan:** Theory of Machines, CBS Publishers
2. **Mabie and Reinholt:** Mechanisms and Dynamics of Machinery, John Wiley
3. **S.S.Rattan:** Theory of Machines, Tata McGraw Hill

MATERIAL SCIENCE

Subject Code : ME1405
L: T: P: C : 3: 0: 0: 3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objectives: i) Know Crystal Structure of Crystalline and amorphous solids and how it is determined, ii)Understand the different phases in solids, Iron-Carbon equilibrium diagram.iii)Understand and Appreciate how heat treatment is beneficial in changing the various properties of the materials.iv)Differentiate between Cast Iron and Steel and their practical applications.v) Learn about the properties and uses of Non-ferrous Alloys and Non-metallic materials.

Pre-requisite: Basics of mechanical engineering.

Learning Outcome: On successful completion of this course students will:

1. Demonstrate the ability to analyze the various Crystal Structures.
2. Demonstrate the ability to analyze the Iron-Carbon equilibrium diagram.
3. Be able to distinguish amongst various Heat treatment processes.
4. Be able to Classify the Types of Cast Iron and Steel, Non-ferrous Alloys and Non-metallic materials.They will also learn the various properties of these materials and their practical applications.

UNIT I

Crystal Structure: Crystalline and amorphous solids, unit cells – types, atomic packing factor, density (simple calculations), crystal imperfections – types, identification of planes and Miller indices.

Metallography: Specimen preparation, light microscope, electron microscope.

Solidification: Nucleation, single crystal growth and dendritic growth; solid solution – types.

Phases in Solids: Gibbs phase rule, Lever rule, binary phase diagram construction – their development for components with complete solubility and partial solubility, invariant reactions, inter-metallic compounds. (18L)

UNIT II

Iron Carbon System: Iron – Carbon diagrams with emphasis on invariant reactions, isothermal and continuous cooling transformation diagrams (TTT & CCT curves).

Heat Treatment of Ferrous Alloys: Annealing–types, normalizing, homogenizing, hardening – quench hardening, case hardening, hardenability and Jominy hardenability test, Tempering – types, austempering and martempering.

Classification and Types of Cast Iron and Steel: Composition, microstructure, properties and applications, effects of alloying elements on cast iron and steel.

Principles of precipitation or age hardening

Non-metallic materials: Properties and uses of polymers, ceramics and important composite materials. (18L)

Text Books:

1. **Avner Sidney:** Introduction to Physical Metallurgy, Tata McGraw Hill
2. **R.B. Choudhary**: Material Science and metallurgy, Khanna Publishers
3. **K.G. Aswani**: A text Book of Material Science, S. Chand & Co

Reference Books:

1. **W.F. Smith**: Principles of Material Science and Engineering, McGraw Hill
2. **Y. Lakhtin**: Engineering Physical Metallurgy, Mir Publishers, Moscow.

MANUFACTURING PROCESS II

Subject Code : ME1406
L: T: P: C : 3: 0: 0: 3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objectives: This course emphasizes on theory of metal cutting by conventional and non conventional machine tools.

Pre-requisite: Basics of manufacturing processes, Material Science.

Learning Outcome: On successful completion of this course students will:

1. Analyze& demonstrate the metal cutting, chip formation, geometry of single point cutting tools, cutting fluids, tool failure.
2. learn the various mechanism of lathe machine, drilling, shapers and milling machine which they imply in workshop practice lab.
3. Demonstrate the Concept of indexing, grinding wheel, and broaching machines
4. In projects the students utilizes the knowledge of this subject and apply it to make various live models which they develop in mini & major projects.

UNIT I

Theory of Metal Cutting: Tool nomenclature, geometry of single point cutting tool; orthogonal and oblique cutting, mechanism of chip formation, types of chips; cutting speed, feed, depth of cut and their selection; Merchant's circle diagram; tool wear and tool life.

Lathes: Constructional features, classification, accessories and attachment, types of lathe operations – turning, step turning, facing, boring, knurling, drilling, taper turning, thread cutting; simple calculations for cutting speed, feed, depth of cut and machining time.

Shaping and Slotting machines: Classification, constructional features, tool and work holding devices, quick return mechanism for shapers, calculations.

Drilling Machines: Constructional features, classification, tool and work holding devices, types of drill and their nomenclature, calculations.

(18L)

UNIT II

Milling Machines: Classifications, constructional features, milling cutters with nomenclature, milling operations like up milling, down milling, gang milling ,slab milling, straddle milling and end milling.

Indexing: Purpose of indexing, simple, compound, differential and angular indexing with calculations.

Grinding Machines: Classification, constructional features, operations, surface, cylindrical and centre less grinding machines.

Grinding Wheels: Types, specification, constructional features.

Advanced machining processes: Basics understanding about working and application of non traditional machining processes viz. WJM, AJM, AWJM, USM, ECM, EDM, LBM, IBM, and hybrid machining.

(18L)

Text books:

1. **P.N. Rao:** Manufacturing Technology – Metal Cutting and Machine Tools, TMH
2. **R.K. Jain:** Production Technology, Khanna Publishers
3. **Hajra Choudhary:** Elements of Workshop Technology –Vol-II, Media Promoters and Publishers
4. **E.P. Degarmo, J. Temple Black and Ronald A. Kohser:** Materials and Processes in Manufacturing, Prentice Hall of India
5. **P. K. Misra :** Nonconventional Machining, Narosa Publishing House,India

Reference books:

1. **J.S.C ampbell:** Principles of Manufacturing Materials and Processes, TMH
2. **A**. **Lindberg**: Processes and Materials of Manufacture-PHI
3. **Gary F. Benedict:** Non-Traditional Manufacturing Process, Marcel Dekkar Inc. New York.

WORKSHOP PRACTICE II

Subject Code : ME1461
L: T: P: C : 0: 0: 3: 1.5
Duration of examination : 3 hours

Objective: This couse emphesize on converting raw materials into finished products. Various processes, machinery, and operations will be examined with emphasis placed on understanding engineering materials and processing parameters that influence design considerations, product quality, and production costs.

Pre-requisite: Elements Of Mechanical Engineering, Manufacturing Processes, Material Science.

Learning Outcome: On completion of this course Students will:

1. Be able to learn various techniques available to make products and designs from various materials.
2. Students will be understood the methodologies to be followed in casting, fabrication, machining, materials, metallurgy and forming of engineering materials.
3. At the end of the course, students will be able to select and perform suitable method of producing a desirable component in industry.

Lathe: Basic of lathe, applications of different parts, use of various work-holding devices, operations such as taper turning by different methods, boring, drilling and thread-cutting – single start and multi-start.

Shaping & slotting machines: Demonstration of shaping operations, use of single point cutting tool, difference between shaping and planning operation, working over mild steel plate, cutting of slots and keyways.

Welding: Explanation of resistance welding and its classification, to conduct spot welding lap joint and butt joint**.** Explanation of arc welding.

Turning: Definition of machining, lathe demonstration and different operations to be performed over lathe (turning, facing, grooving, knurling), calculation of MRR and machining time for different operations.

Milling: Different types of cutters, different milling operations – machining of gears.

Casting: Casting definition, demonstration of a gating system, different casting defects.

The broad areas for conduct of experiments are given above. However, the specific lists of experiments is as given below. Students are required to perform minimum 12 experiments during the semester in the labrotrary.

List of experiments:-

1. To carry out facing operation on the given mild steel rod specimen on a lathe machine to a length of 130 mm.
2. To carry out straight turning operation on the mild steel rod specimen, on a lathe machine to a diameter of 30 mm for 115 mm length from one end and 15 mm diameter for the rest 15 mm of the length.
3. To carry out taper turning on the lathe for a length of 30 mm of the given faced work-piece of diameter 30 mm from one end to a ratio of 1:2, and then knurl the rest of the length of 85 mm.
4. To perform knurling operation on lathe machine.
5. To perform grooving operation on lathe machine.
6. To carry out shaping operation to make a rectangular block of square cross-section with a slot on one side of the given mild steel specimen.
7. To carry out shaping operation to make a block of rectangular cross-section with grooves on opposite sides of the given mild steel specimen.
8. To perform drilling and fitting operations on a rectangular mild steel test specimen.
9. To perform tapping operation on drilled mild steel test specimen.
10. To make a straight toothed spur gear from a cast or forged disc.
11. To make butt joint (e.g. U, I, V shape) by Arc welding.
12. To study casting defects and their recommended remedies.
13. To carry out spot welding on metal sheets/plates.

Reference books:

1. **S. K. Hajra Choudhury & Others:** Elements of Workshop Technology (Vol. I), MPP
2. **B.S. Raghuvanshi:** A Course in Workshop Technology, Dhanpat Rai & Co.

COMPUTER GRAPHICS LAB

Subject code : ME1462
L: T: P: C : 0: 0: 3: 1.5
Duration of examination : 3 hours
Objectives: i) Appreciate the concepts of front view, top view and side views. ii) Can develop the concept of designing 3D models.
Pre-requisite: Engineering Graphics & Machine Drawing
Learning Outcome: On completion of this course:

1. Students will be able to solve the problems related to various views of bulky designs
2. Students will be able to design 3d models by using drafting softwares.

Computer Graph – CADIAN
CADIAN Basics
Basic CADIAN commands, Co-ordinate, draw commands, editing, dimensioning Technical Drawings using CADIAN
Orthographic Projections, sectional views, isometric projections, 3D drawings, solid modeling

The broad areas for conduct of experiments are given above. However the specific lists of experiments are the following. Students are required to perform minimum 12 experiments during the semester in the Lab.

List of experiments:-

1. To draw orthographic projection of isometric object 1 using basic drawing tools.
2. To draw orthographic projection of isometric object 2 using basic drawing tools.
3. To draw orthographic projection of isometric object 3 using basic drawing tools.
4. To draw orthographic projection of isometric object 4 using basic drawing tools.
5. To draw orthographic projection of isometric object 5 using basic drawing tools.
6. To draw isometric projection of orthographic object 1 using drawing tools.
7. To draw isometric projection of orthographic object 2 using drawing tools.
8. To draw isometric projection of orthographic object 3 using drawing tools.
9. To draw isometric projection of orthographic object 4 using drawing tools.
10. To draw isometric projection of orthographic object 5 using drawing tools.
11. To draw solids 1 using 3D drawing tools.
12. To draw solids 2 using 3D drawing tools.
13. To draw solids 3 using 3D drawing tools.
14. To draw solids 4 using 3D drawing tools.

Text Books:

1. **N. D. Bhatt:** Engineering Drawing, Charotar Publishing House Pvt.Ltd.

Reference Books:

1. **Paul J. Drake Jr.**: Dimensionig and tolerancing handbook, McGraw-Hill Education;
2. **T. Jeyapoovan**: Engineering Drawing and Graphics using Autocad, Vikas Publishing House

THERMAL ENGINEERING LAB I

Subject code : ME1463
L: T: P: C : 0: 0: 3: 1.5
Duration of examination : 3 hours

Objectives: To understand the actual operation of IC engines and evaluation of their performance. This course also deals with the operation and performance analysis of air compressor, blower, fan, air-conditioning and refrigeration equipments. Demonstration of boiler and gas turbine parts.

Pre-requisite: Basics knowledge of thermodynamics, interaction of energy, various gas laws. And knowledge of applied thermodynamics.

Learning Outcome: On successful completion of this course students will:

1. Able to analyze the performance of IC engines and to identify methods for improving thermodynamic performance.
2. Able to analyze the performance of Air compressor, Blower and Fan which are generally used in all types of industries.
3. Able to analyze the performance of Air conditioning and refrigeration cycles and to identify methods for improving thermodynamic performance.

IC Engine: Study of C.I and S.I engine.Performance analysis of 2-stroke/4-stroke CI and SI engine.
Boiler: Demonstration of various kind of water tube and fire tube boiler.
Gas Turbine: Operation of gas turbine.
Reciprocating Air Compressor: Performance testing of two stage Reciprocating Air Compressor. Volumetric efficiency, Isothermal efficiency, Intercooler, Actual P-V diagrams for single-stage and two stage compressors, Power and efficiencies of a compressor**.**
Refrigeration: Mathematical analysis of vapour compression refrigeration. Performance of refrigerator, C.O.P. and Rating of refrigeration machine, volumetric efficiency.
Air Conditioning: Study of simple Air conditioning system. Performance testing of an air conditioner.
Air Blower/Fan: Working of centrifugal blower and axial fan.
The broad areas for conduct of experiments are given above. However, the specific lists of experiments is as given below. Students are required to perform minimum 12 experiments during the semester in the Lab.

List of experiments:-

1. Performance testing of a single cylinder four stroke diesel engine.
2. Performance testing of a multi cylinder four stroke petrol engine.
3. Performance testing of a multi fuel variable compression 4-stroke engine with petrol.
4. Performance testing of a multi fuel variable compression 4-stroke engine with diesel.
5. Performance testing of two stage reciprocating air compressor.
6. Performance testing of an air conditioner trainer.
7. Performance testing of a refrigeration trainer.
8. Performance testing of axial fan.
9. Performance testing of centrifugal blower with forward impeller.
10. Performance testing of centrifugal blower with backward impeller.
11. Performance testing of centrifugal blower with radial impeller.
12. Study of various kinds of boilers.
13. Study of Gas turbine.
14. Study of 2-stage/4-Stage petrol and diesel engine.

Reference books:

1. **P K Nag**:Engineering Thermodynamics, Tata McGraw Hill
2. **R K Rajput**: A Text Book of Engineering Thermodynamics, Laxmi Publications, New Delhi
3. **C P Arora:** Refrigeration and Air conditioning, Tata McGraw Hill

INDUSTRIAL ENGINEERING AND MANAGEMENT

Subject code : **ME1501**
L: T: P: C **: 3: 0: 0: 3**
Questions to be set **: 4 from each unit**
Questions to be answered **: 5 full questions selecting at least 2 from each unit**

Objectives: This course covers the basic engineering management functions of planning, organizing, leading, and controlling, as applied to project, team, knowledge, group/department and global settings, including discussion of the strengths and weaknesses of engineers as managers, and the engineering management challenges in the new economy. Emphasis is placed on the integration of engineering technologies and management. Students are to understand/practice the basic functions in engineering management, the broadened perspectives of engineering managers, and the required managerial competency, beyond technical skills, to become effective engineering leaders in the new millennium.

Pre-requisites: Manufacturing process, Basic Knowledge of managements.

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

1. Design and function of management.
2. Concept of productivity improvement.
3. Acquisition and absorption process in organization.
4. Develop ability to come up with innovative ideas of plant location, material handling, and production technology.

UNIT I

Management: Definition of management, various approaches to management, Functions of managers, managerial skills. Manegerial Planning, Steps in planning process, Types of planning, Principles of Organization, Factors for effective span. Departmentation and its classification {advantages and disadvantages}, Types of organizational structure {advantages and disadvantages}.Steps of the basic control process.

Materials Management, Purchasing or Procurement, Purchase Organisation, Buying Techniques, Purchasing Procedures, Receipts and issue of materials, Codification of Materials.

Inventory Control: Classification of Inventories, ABC analysis; Factors influencing inventory control - ordering cost, carrying cost, set up cost, lead time.Economic order quantity determination (Deterministic Models only)

(18L)

UNIT II

Plant layout: Factors affecting plant location, objectives & principles of a good plant layout. Process, product, combination & fixed layout.

Work Study: Productivity and work study, Introduction and definition of Work-study.

Method Study : Introduction, definition, procedure, Recording techniques, Flow Process Charts, man-machine chart, Motion economy principles, Micro motion study – Therbligs.

Work Measurement: Definition, Objectives, Techniques of Work measurement, Selection & timing the job, Rating, Allowances, Normal and standard time determination, Work sampling.

Job Shop Scheduling- Gantt charts, Shortest Processing time (SPT) rule, Earliest Due Date Rule (EDD) sequencing of ‘n’jobs through 2 machines (Johnson’s rule).

(18L)

Text Books:

1. **Harold Koontz-** Essentials of Management -Tata McGraw Hill
2. **O.P.Khanna-** : Industrial Engg & Mgmt-Dhanpat Rai and Sons
3. **Dr N.G.Nair & Latha Nair-** Personnel Management-S.Chand & Company.

Reference Books:

1. James MacGregor Apple - Plant layout and material handling; Wiley
2. **Philip E Hicks**- Industrial Engineering & Management –A new perspective, Mcgraw Hill
3**. N.J. Manek** Comprehensive Industrial Engineering- Laxmi Publication (P) Ltd.

4. **S. Dalela, Mansoor Ali**- Industrial Engineering and Management Systems –Standard Publishing Distributors.

ME1502

HEAT TRANSFER

Subject code : ME1502
L:T:P:C : 2:1:0:3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objective: i) To teach students the basic principles of conduction, radiation, and convection heat transfer. ii)To extend the basic principle of conservation of energy to systems which involve conduction, radiation, and heat transfer.iii)To train students to identify, formulate and solve engineering problems involving all modes of the heat transfer.

Pre-requisite: Basic Thermodynamics and Calculus and differential equations.

Learning Outcome: On successful completion of course students will:

1. Understand of the basic concepts of conduction, radiation, and convection heat transfer.
2. Understand of the concept of conservation of energy and its application to problems involving conduction, radiation, and convection heat transfer. This principle will be used to formulate appropriate mathematical models and associated thermal boundary conditions.
3. Able to deals with the various thermal energy exchanging equipments (e.g. heat pipe, heat exchanger, Boiler etc).

UNIT I

Introduction

Thermodynamics and heat transfer, modes of heat transfer – conduction, convection & radiation, laws of heat Transfer, thermal conductivity, heat transfer coefficient, concept of thermal resistance,

Heat conduction in solid

Generalized one dimensional heat conduction equation in rectangular, cylindrical and spherical co-ordinates system, simple steady state problems in heat conduction without and with heat generation – plane wall, long hollow cylinder, hollow sphere, composite slab, composite cylinder and composite sphere, overall heat transfer coefficient, three dimensional heat conduction equation in rectangular and cylindrical coordinates.

Extended Surfaces: Types of fins, heat transfer from fins, fin performance – fin efficiency and fin effectiveness,

Unsteady Conduction: Unsteady heat conduction for bodies with negligible temperature gradients – lumped system analysis, lumped system analysis with mixed boundary condition.

Free convection

Principles of natural convection, dimensionless parameters and empirical correlations for free convections

(18L)

UNIT II

Forced convection

Convective heat transfer in external flows, flow over a body, velocity and thermal boundary layer, drag coefficient for flow over a flat plate, heat transfer coefficient for flow over a flat plate, laminar, turbulent and combined laminar and turbulent flow over a flat plate, analogy between momentum and heat transfer , (Reynolds – Colburn analogy), heat transfer in fully developed flow through the ducts – laminar and turbulent flow, bulk mean temperature, thermally fully developed flow through a pipe subjected to (i) constant surface heat flux and (ii) constant surface temperature.

Heat exchanger

Classification of heat exchanger, temperature distribution in heat exchangers, overall heat transfer coefficient and fouling factor, LMTD method for heat exchanger analysis - parallel flow and counter flow , correction for LMTD in cross-flow, ε – NTU method for heat exchanger analysis – parallel and counter flow

Radiation

Nature of thermal radiation, emission characteristics – absorptivity, transmissivity and reflectivity, emissive power, emissivity, radiation from real surface, solid angle and intensity of radiation, heat exchange by radiation between two black surface elements and two finite black surfaces, concept of shape factor, radiation heat transfer through two diffuse gray surfaces – (i) two infinite parallel plates,

(ii) two infinitely long concentric cylinders; radiation network for grey surfaces exchanging energy, radiation shields, radiation from cavities

(18L)

Text books:

1. **D.S.Kumar**: Heat And Mass Transfer, S. K. Kataria & Sons
2 . **J.P. Holman.:** Heat Transfer, McGraw – Hills
3. **M.N. Ozisik:** Heat Transfer- A Basic Approach, Mc- Graw Hills
4. **C.P. Kothandaraman & Subramanyan:** Heat and Mass Transfer Data Book, New age Int.

Reference books:

1. **S.C. Arora, S Domkundwar:** Heat and Mass Transfer, Dhanpat Rai & Sons

FLUID AND HYDRAULIC MACHINES

Subject code : ME1508
L: T: P: C : 2: 1: 0: 3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objectives: i) Apply the dimensional analysis on hydraulic engineering problems. ii) Understand the governing equations and performance of turbines and pumps. iii) Demonstrate an ability to identify, formulate and solve complicated engineering problems related with Hydraulics.

Pre-requisite:

1. Calculus: integrals, derivatives, partial derivatives, vector calculus
2. Mechanics: force and momentum balances
3. Conservation of momentum, control volume analysis, simple differential analysis,
4. Engineering correlations and relationships commonly used in mechanical engineering for Internal and external flows, simple compressible flows

Learning Outcome: On successful completion of this course students will:

1. Be able to use Buckingham's Pi theorem to develop dimensionless groups and apply similarity and modeling procedures.
2. Gain knowledge of the operations of rotating and displacement pumps.
3. Gain knowledge of working of various hydraulic turbines and its components.
4. Understand basic principles of fluid mechanics as related to pipelines, rising the pressure head and generation of power from the water falling.

UNIT I

Turbulent Flow: Introduction, Frictional loss in pipes, Shear stress in turbulent flow, Velocity distribution in turbulent flow in pipes.

Boundary Layer Flow: Introduction, Definitions, Drag force on a flat plate due to boundary layer, Turbulent boundary layer, Total drag on a flat plate, Separation of boundary layer.

Dimensional Analysis: Dimensions – fundamental and derived quantities, dimensional homogeneity, methods of dimensional analysis – Rayleigh's Method, Buckingham pi theorem, similitude, and dimensionless numbers.

Impact of Jet on stationary and moving plates : Introduction, Force exerted by the jet on a stationary plate, on hinged plate and on moving plates,

Impulse Turbine: Introduction to turbines, Impulse and Tangential flow (Pelton type) turbine, difference between impulse and reaction turbine.

(18L)

UNIT II

Reaction Turbines: Radial and mixed flow (Francis type), and axial flow (Kaplan type), Expression for work done and flow rate, Blade speed ratio and flow ratio, Theory of draft tubes, Cavitation in turbines, Specific speed, Unit quantities, Characteristic curves of hydraulic machines, Turbine governing.

Hydraulic Pumps: Introduction of centrifugal pump: Work done, Heads and efficiencies, Specific speed, Priming, Characteristic curves, Cavitation,

Introduction of reciprocating pumps: Work done, Slip, Classification, Indicator diagrams.

(18L)

Text books:

1. **R. K. Bansal:** A Text Book of Fluid Mechanics and Hydraulic Machines; Laxmi Publications.
2. **R. K. Rajput:** Hydraulic Machines; S. Chand & Co.
3. **P. N. Modi & S.M. Seth:** Hydraulics and Fluid Mechanics; Standard Book House

Reference books:

1. **K. L. Kumar:** Fluid Mechanics; S. Chand & Co.
2. **S. K. Som & G. Biswas:** Introduction to Fluid Machanics and Machinery; TMH publishers

MACHINE DESIGN I

Subject Code : ME1509
L: T: P: C : 2: 1: 0: 3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objectives: i) To provide the ample knowledge of fundamentals of design criterion. ii) Understand the design of various mechanical coupling for power transmission. iii) Understand the design of various types of mechanical joints.

Pre-requisite: Fundamental of SOM, Material science.

Learning Outcome: On successful completion of this course students will:

1. Demonstrate the ability to analyze the design concepts of machine elements.
2. Demonstrate the ability to analyze the design of couplings.
3. Students will demonstrate the ability to analyze the design of brakes.
4. Various Projects have been developed so far where the students have used their concepts for designing from the content they studied from this subject.
5. Use of Design Data Handbook for designing of various mechanical parts.

UNIT I

Fundamentals: Working stresses, Stress-strain diagram for ductile and brittle materials. Factor of Safety. Ductile materials subjected to steady stresses. Members subjected to biaxial loading, principal stresses, stress concentration, theoretical stress concentration factor, and theories of failure. Endurance limit, variables affecting fatigue strength, combined stress concentration factor, members subjected to combined steady and alternating loads.

Keys and pins: Types of keys, stress in keys,design of square, rectangular and taper keys.

Couplings: Flange coupling bushed pin type flexible coupling, knuckle joint, cotter joint.

Shafting: Torsion of circular shafts, solid and hollow shaft. ASME and ISI codes equations for design of transmission shafts. Mises Hencky theory for transmission shafting, stress concentration. Design of shafts subjected to combined loads.

(18L)

UNIT II

Riveted joints: Types, modes of failure, strength and efficiency of riveted joints, pitch of rivets, design stresses, structural joints of lap and butt types, rivets subjected to eccentric loading, boiler joints.

Welded joints: Strength of welds, eccentric loaded welded joints, welded pressure vessels, some practical applications.

Threaded fasteners and power screws: Stresses in bolts, effect of initial tension, eccentric loading, power screws, stresses in power screws, force and torque required to lift a load in power screw jack.

Brakes: Energy equations block brake with short shoe, internal expanding brake, band brakes.

(18L)

Text books:

1. **K.Mahadevan and K.Balaveera reddy**:Design Data Handbook (SI Units), KREC, Surathkal
2. **Spotts**: Design Of Machine Elements, Prentice Hall(India)
3. **V B Bhandari**: Introduction to Machine Design, TMH
4. **Dr. P. C. Sharma & D. K. Agarwal**: Machine Design, S. K. Kataria & Sons

Reference books:

1. **J.Shigley**: Mechanical Engineering Design, McGraw Hill
2. **Martin J. Siegel, Vladmir L. Maleev & J.B. Hartman**: Mechanical Design, International Textbook Co.
3. **Sadhu Singh**: Machine Design, Khanna Publishers.
4. **Ghosh:** Practical Machine Design, S. Bhattacharya Co.

METROLOGY

Subject code : ME1505
L: T: P: C : 3: 0: 0: 3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objectives: i) Develop awareness, knowledge and basic skill necessary for the reliable measurement applications. ii) understand the measurement applications for Geometric Dimensioning and Tolerance GD&T) and assessment of measurement quality.iii) Studying the methods and instruments of length, angle, gear, thread measurements etc. iv) Differentiate between metrology and experimental engineering.

Pre-requisites: Basic knowledge of dimension and dimension measuring devices.

Learning Outcome: On successful completion of this course students will:

1. Be able to do thorough evaluations of newly developed products, to ensure that components designed are within the process and measuring instrument capabilities available in the plant.
2. Be able to minimize the cost of inspection by effective and efficient use of available facilities, and to reduce the cost of rejection and rework through application of Statistical Quality Control Techniques.
3. Be able to maintain the accuracies of measurements. This is achieved by periodical calibration of the metrological instruments used in the plant.
4. Arbitration and solution of problems arising on the shop floor regarding methods of measurement.

UNIT I

Introduction to Engineering Metrology: Basic concepts like Accuracy, Precision, Hysterisis, Sensitivity, Errors in measurement, Interchangeability.

Standards of Measurement: Line Standards, End Standard, Wavelength Standard, Subdivision of Standards.

Limit, Fit and Tolerances: Limit, Fits, Tolerances, Indian Standard (IS 919-1963), Numericals.

Gauges: Introduction, Types of Gauges–Plain Plug Gauges, Plain Ring Gauges, Snap Gauges, Taylor's Principle for Gauge design, Gauge Maker's tolerance, Numericals.

Slip Gauges: Grades, Wringing, and Selection of Slip Gauges for the required dimension.

Straightness, Flatness, Square ness, Parallelism and Circularity: Definition and Measurement of straightness, Flatness, Square ness, Parallelism and Circularity.

Comparator: Introduction, Mechanical comparator, Electrical and Electronics Comparator, Solex pneumatic gauge.

(18L)

UNIT II

Screw thread Metrology: Introduction, Errors in threads, Measurement of major diameter using Bench Micrometer, Measurement of Minor diameter using Micrometer with Vee pieces, Measurement of Effective diameter–Thread Micrometer method, Two wire and three wire method with derivation.

Measurement of Surface Finish: Definitions, Terminology, Symbols for specifying surface finish, Surface finish measuring instruments–Tomlinson Surface Meter, Taylor– HobsonTalysurf,Analysis of Surface Traces– RMS and CLA methods.

Gears: Gear Errors, Runout measurement–Parkinson Gear Tester, Backlash measurement, Gear Tooth thickness Measurement, Measurement of tooth thickness, Base pitch measuring instrument.

Measurement of Force: Balance, load cell, provingring, hydraulic load cell, pneumatic load cell.

Torque measurement: transmission dynamometer, absorption dynamometer, deflection type torque measurements

Measurement of Pressure: Bourdon gauge, Diaphragm selectrical resistance type secondary transducers, piezoelectric pressure transducer, McLeod gauge, thermal conductivity gauges

(18L)

Text books:

1. **R.K.Jain:** Engineering Metrology, Khanna Publishers–Delhi
2. **A.S.T.M.E.:**Handbook of Industrial Metrology, PrenticeHall of India, New Delhi.

Reference books:

1**.K.J.Hume:** Engineering Metrologym,KalyaniPublisheres,Ludhiana
2.**K.W.B Sharp:** PracticalEngineeringMetrology,Pitman,London
3. **M. R. Taher:** Metrology of Measuring Instruments, E.L.B.S.

MECHANICS OF SOLIDS-I

Subject code : ME1511
L: T: P: C : 2: 1: 0: 3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objectives: i) Understand the fundamental of structural design. ii) Understand the concept behind the deflection of beam, design of column and strut, design of cylinder, design of curve beam and rotating cylinder in various load conditions.

Pre-requisite: basic knowledge of Mechanics of Solid I, Engineering Mathematics, Material Science.

Learning Outcome: On successful completion of this course students will:

1. Understand different types of loading like point, udl and uvl on different types of beams like cantilever, simply supported and curved and find out their deflection for safety purpose.
2. Know the concept of stress systems in cylinders and rotating discs.
3. Be able to design and analyze the various structure.
4. Students have come out with various projects related to the subject.

UNIT I

Deflection of Beams: Curvature of bending beams, relation between slope, deflection and radius of curvature, method for slope and deflection at a section: Double integration method, Macualay's method, Area-moment method.

Column and Strut: Theory of columns; eccentric loading of short strut; column buckling: Euler load for columns with pinned ends and other end restraints; Euler's curve; empirical column formulae –(i) straight line, (ii) parabolic and (iii) Rankine Gordon.

(18L)

UNIT II

Thin & Thick Cylinders: Introduction, difference between thin walled and thick walled pressure vessels, thin walled spheres and cylinders, hoop and axial stresses and strain, volumetric strain. Stresses in a thick cylindrical shell- Lame'sequations, Compound cylinders-Stresses in compound thick cylinders, initial difference in radii at the junction of a compound cylinder for shrinkage.

Curved beams: Bars with large initial curvature, Link radius for standard section: Rectangular, Triangular, Trapezoidal, Circular Crane hooks, Rings, Chain links.

Rotating discs: Stress equilibrium equations in polar co- ordinates, Stresses in rotating discs, Solid disc, and with a central hole, rotating disc of variable thickness, rotating of uniform strength.

(18L)

Textbooks:

1. **Ferdinand P. Beer, E. R. Johnston Jr., J. T. Dewolf, D. F. Mazurek**–Mechanics of materials-Tata McGrawhill
2. **S. P. Timoshenko & D. H. Young -** Elements of Strength of Materials - East west press.
3. **S. Ramamrutham & R Narayan–**Strength of Materials-Dhanpat Rai& Publications.
4. **Nag & Chanda**- Fundamentals of Strength of Materials, Wiley India.
5. **S.S. Ratan** - Strength of materials, TataMcgrawhill.
6. **G.H.Ryder** - Strength of materials, Macmillan India

Reference Books:

1. **Kamal Kumar, R. C. Ghai**–Advanced Mechanics of Materials-Khanna Publishers
2. **L. S. Srinath**-Advanced Mechanics of Solids-TMH

FLUID MECHANICS LAB

Subject code : ME1562
L:T:P:C : 0:0:3:1.5
Duration of examination : 3 hours

Objectives: i) Understand the concept of various principles and mechanisms of fluid mechanics. ii) Understand the concept of working of pelton, francis, Kaplan turbine.iii) Convert the theoretical knowledge of fluid mechanics into practical knowledge.

Pre-requisite: Element of Mechanical Engineering, Fluid Mechanics, Fluid Mechanics & Hydraulic Machines.

Learning Outcome: On successful completion of this course students will:

1. be able to verify the Bernoulli's equation.
2. be able to demonstrate the working of various fluid & Hydraulics machines.
3. be able to evaluate the performance of turbines and pumps.

Fluid Properties: Viscosity measurement by red wood viscometer.

Fluid statics: Determination of metacentric height, stability and equilibrium of floating and submerged bodies.

Fluid Pressure: Calibration of pressure gauges.

Dynamics of Fluid Flow: Application of Bernoulli's equation –pitot tube, venturimeter, orifice meter and nozzle.

Notches and weirs: Discharge over various notches, coefficient of discharge of V-notch, rectangular notch, trapezoidal notch.

Flow through pipes: Losses in pipe flow, major losses (loss due to friction).

Impact of Jet on stationary and moving plates: Force exerted by the jet on a stationary plate, on hinged plate and on moving plates.

Hydraulic Turbines: Introduction of Impulse and Reaction turbines. Performance testing of different turbine such as Tangential flow (Pelton turbine), Radial and mixed flow (Francis turbine), and axial flow (Kaplan turbine).

Hydraulic Pumps: Performance testing of centrifugal pump- Work done, Heads generation, discharge, efficiencies, Specific speed, Priming, Characteristic curves etc. Performance testing of reciprocating pumps-Work done, Heads generation, discharge, slip, efficiencies etc.

The above are the broad area of conduction of experiments. However the specific lists of experiments are the following. Students are required to perform minimum 12 experiments during the Lab in a semester.

List of experiments:-

1. Determination of hydraulic power input, power output and overall efficiency of Pelton turbine.
2. Determination of output power and efficiency of a Francis turbine.
3. Determination of BP, WP, overall efficiency of Kaplan turbine.
4. Measurement of losses for pipes in different sections using pipe friction apparatus.
5. Determination of theoretical and actual co-efficient of discharge for a V-notch, rectangular notch, trapezoidal notch.
6. Experimental validation of Bernoulli's theorem.
7. Determination of Meta-centric height.
8. Determination of velocity of flow for fluid using pitot tube apparatus.
9. Determination of force exerted by jet of water on vanes.
10. Determination of kinematic viscosity by red wood viscometer.
11. Determination of overall efficiency of centrifugal pump.
12. Determination of total head, discharge, power output, shaft output, pumps efficiency, overall efficiency and volumetric efficiency of reciprocating pump.
13. Calibration of pressure gauges.

Reference books:

1. **R.K.Bansal:** Fluid Mechanics and Hydraulic Machines, Laxmi Publication

2. **D.S Kumar:** Fluid Mechanics and Fluid Power Engineering, S. K . Kataria & sons
3. **S.K.Agarwal:** Fluid Mechanics and Machinery, TMH
4. **S.K.Som, G.Biswas:** Introduction to Fluid Mechanics, TMH

MANUFACTURING AND METROLOGY LAB

Subject Code : ME1565
L:T:P:C : 0:0:3:1.5
Duration of examination : 3 hours

Objectives: i) To familiarize the students with the various types of manufacturing and measuring instruments. ii) To deals with the modern manufacturing technique to fulfill industrial demand. iii) The students will also understand the standardization of products.

Pre-requisite: Manufacturing process, Basic of measurement, Material Science.

Learning Outcome: On successful completion of this course students will be able:

1. To understand the operation of modern manufacturing machine tools dealing with high accuracy and precision that fulfills the high end technical demand.
2. To understand the important of precision, accuracy, and reliability.
3. To gain practical experience in using measuring tools, and where and how to use them.
4. To understand the difficulties in reliably measuring to high precision
5. To understand the sources of errors, and how to avoid or compensate for them.
6. To gain a good understanding of the various methods of preparing inspection drawings and reports

Grinding: Fundamentals of grinding operation, Applications of different bonded grinding wheel, G-ratio, grinding wheel specifications and surface grinding operation.
CNC Turning: Handling of a CNC machine, idea about G-code, M-code
Measurement of Cutting force: Measurement of cutting forces (P_x, P_y, P_z) associated during a turning operation.
EDM: Different parts of EDM machine, requirement of dielectric fluid and die-sinking operation.
LBM: Different parts of LBM, and demonstration on Laser Beam Machining.
Welding: TIG, MIG
Linear Measurement: Measurement using various kind of vernier caliper, calibration of various types of vernier caliper using slip gauges, measurement using micrometer.
Angular Measurement: Angular measurement using using Bevel Protractor and Sine Bar.
Limit Fit and Tolerances: Inspection using Plain Ring Gauges, Snap Gauges.
Calibration of Instruments: Calibration of Vernier caliper using slip gauges.
Slip Gauges: Grades, Wringing, Selection of Slip Gauges for the required dimension.
Flatness Measurement: Measurement of Flatness of Surface plate**.**
Diametral Measurement: Measurement of bore diameter using two sphere methods.
Screw thread Metrology: Measurement of thread parameter using profile projector.
Gears Measurement: Backlash measurement, Gear Tooth thickness Measurement, Checking involute shape of Gear, Base pitch measuring instrument.

The broad areas for conduct of experiments are above listed. However, the specific lists of experiments are as follows. Students are required to perform minimum 12 experiments during the semester in lab.

List of Experiments:-

1. Measurement of cutting forces (Pz and Px or Py) in turning with different feeds and cutting velocities using 3D force dynamometer and evaluation of shear angle.
2. To fabricate butt joint by TIG/MIG welding.
3. To perform grinding operations on a given job using surface grinding machine.
4. To perform turning operation as per given specification using CNC Lathe.
5. To study the characteristic features of LBM processes.
6. To evaluate the EDM performance characteristics by changing the input parameters.
7. To perform shaping/ slotting operation as per given dimensions.
8. To perform end milling operation to achieve given dimensions on a job.
9. Measurement and Calibration of Vernier Caliper using Slip gauge.
10. Measurement and Calibration of Vernier Height gauge.
11. Measurement and Calibration of Vernier Depth gauge

12. Measurement by using micrometer.
13. Angular measurement by using Bevel Protractor.
14. Angular measurement by using Sine Bar.
15. Measurement of thread parameter using profile projector.
16. Measurement of Flatness of Surface plate.
17. Measurement of Gear Elements.
18. Measurement by using slip gauge.
19. Measurement of bore diameter by two spheres method.
20. Inspection using ring limit gauges.
21. Checking the squareness of try square using slip gauge.

Reference books:

1. **W.A.J. Chapman:** Workshop Technology, Edward Arnold
2. **S. K. Hajra Choudhury:** Elements of Workshop Technology, Indian Book Distributing Co.
3. **B.S. Raghuvanshi:** A Course in Workshop Technology, Dhanpat Rai & Co. Ltd.
4. **K.J. Hume:** Engineering Metrology, Macdonald
5. **K. W. B Sharp:** Practical Engineering Metrology, Pitman
6. **M. R. Taher:** Metrology of Measuring Instruments, Ram Narayan and Bhani Prasad

THERMAL ENGINEERING LAB II

Subject code : ME1566
L:T:P:C : 0:0:3:1.5
Duration of examination : 3 hours

Objective: i) To verify the basic equations related with conduction, radiation, and convection heat transfer ii) To train students to identify, formulate and solve engineering problems involving all modes of the heat transfer.

Pre-requisite: Basic Thermodynamics, Heat Transfer and Calculus and differential equations.

Learning Outcome: On successful completion of course students will:

1. Understand of the basic concepts of conduction, radiation, and convection heat transfer.
2. Able to verify the basic equations related with conduction, radiation, and convection heat transfer.
3. Able to analyze the performance of energy exchanging equipments.

Heat conduction: Simple steady state problems in heat conduction without and with heat generation – plane wall, long hollow cylinder, hollow sphere, composite slab, composite cylinder and composite sphere, overall heat transfer coefficient. Extended Surfaces: Types of fins, heat transfer from fins, fin performance – fin efficiency and fin effectiveness,

Forced convection: Thermally fully developed flow through a pipe subjected to (i) constant surface heat flux and (ii) constant surface temperature, dimensional analysis applied to forced convection, empirical correlations

Free convection: Dimensional analysis applied to free convection, dimensionless parameters and empirical correlations for free convections.

Condensation and boiling: Condensation heat transfer, dropwise condensation and filmwise condensation, condensation on horizontal tubes, boiling heat transfer, regimes of boiling, nucleate and film boiling, correlations of boiling heat transfer.

Heat exchanger: Temperature distribution in heat exchangers, overall heat transfer coefficient and fouling factor, LMTD method for heat exchanger analysis - parallel flow and counter flow , correction for LMTD in cross-flow, ε – NTU method for heat exchanger analysis – parallel and counter flow

Radiation: Nature of thermal radiation, emission characteristics – emissive power, emissivity, radiation from real surface, heat exchange by radiation between two black surface elements.

The above are the broad area of conduction of experiments. However the specific lists of experiments are the following. Students are required to perform minimum 12 experiments during the Lab in a semester.

List of experiments:-

1. To study the heat transfer (conduction) through insulating powder.
2. To study the heat transfer through pin fin.
3. To study the heat transfer through insulating slab.
4. To study the heat transfer through lagged pipe.
5. To study the performance of a finned tube heat exchanger.
6. To study the heat transfer in shell and tube heat exchanger.
7. To Study of drop wise and film wise condensation.
8. To study the heat transfer through composite wall.
9. Determination of emissivity of test plate.
10. Determination of thermal conductivity of metal bar.
11. To study the Stefan Boltzmann apparatus.
12. Performance testing of parallel flow and counter flow heat exchanger.
13. Determination of heat transfer in Natural convection apparatus.
14. Determination of heat transfer in forced convection.

Reference books:

1. **D.S.Kumar**: Heat And Mass Transfer, S. K. Kataria & Sons
2. **J.P. Holman.:** Heat Transfer, McGraw – Hills
3. **M.N. Ozisik:** Heat Transfer- A Basic Approach, Mc- Graw Hills
4. **C.P. Kothandaraman & Subramanyan:** Heat and Mass Transfer Data Book, New age Int.
5. **S.C. Arora, S Domkundwar:** Heat and Mass Transfer, Dhanpat Rai & Sons.

INDUSTRIAL TRAINING I

Subject Code : ME1581
Objective: i) To familiarize the students with the actual operation in industry.
Pre-requisite: Knowledge of basics of Mechanical engineering
Learning Outcome: On successful completion of course students will:

1. Visualize the practical application of mechanical equipments.
2. Able to relate the theoretical knowledge with practical use.
3. Able to develop new concept of operations.

Students will carry out Industrial Training I of two weeks after the completion of fourth semester during summer vacation. Report and PPT to be evaluated by the department in 5^{th} semester examination.

THEORY OF MACHINES II

Subject code : ME1609
L: T: P: C : 2: 1: 0: 3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objective:i) Know different machine elements and mechanisms.ii)Understand Kinematics and Dynamics of different machines and mechanisms.iii) Appreciate concept of balancing and Vibration.iv)Develop ability to come up with innovative ideas.

Prerequisite: Theory Of Machines I & Differential Equations.

Learning Outcome: On successful completion of this course students will:

1. Demonstrate the ability to analyze the working mechanism of cam profile, mechanism of gyroscope.
2. Demonstrate the ability to analyze the dynamics of direct acting engine mechanism.
3. Demonstrate the ability to analyze the balancing of rotating and reciprocating masses.
4. Various Projects have been developed so far where the students have used their concepts for designing from various mechanism they studied from this subject.

UNIT I

Synthesis of Mechanisms: Introduction, Number synthesis – Grubler's criteria, function generation to co-ordinate displacements of input and output links, Chebyshev spacing of accuracy points, Freudenstein equation, function generation with three accuracy points for four bar mechanism and slider crank mechanism.

Cams- Introduction, classification of cams and followers, terminology for radial cams, types of follower motion –displacement, velocity and acceleration diagrams, synthesis of profiles of radial cams for radially translating and offset translating follower.

Dynamics of direct acting engine mechanism- displacement, velocity and acceleration of piston, D'Alemberts principle- inertia force and inertia torque, piston effort and crank effort, inertia of connecting rod, turning moment diagrams, fluctuation of speed and energy, flywheels, flywheels for punching press and design of rim type flywheel.

(18L)

UNIT II

Governors- Types of governors, Watt, Porter, Hartnell and Hartung governors; characteristics of centrifugal governors- controlling force, stability, sensitiveness isochronism, capacity and coefficient of insensitiveness; effort and power of governors.

Gyroscopic effects- Precessional motion and angular acceleration, gyroscopic couple, some typical cases illustrating gyroscopic action –effect on naval ship, stability of two wheelers and four wheelers vehicles.

Balancing of rotating masses-static and dynamic balancing, two plane balancing. Balancing of several masses rotating in the same plane and balancing of several masses rotating in different planes.

Balancing of reciprocating masses –identification of inertia, forces for reciprocating masses in engine mechanisms, partial primary balancing of single cylinder engines and locomotives, balancing of multi cylinder engines, V-twin engines and radial engines-direct and reverse crank methods.

(18L)

Text books:

1. **A. Ghosh and A.K. Mallik**: Theory of Mechanisms and Machines, East West Press
2. **Jagdish Lal**: Theory of Mechanisms and Machines, Metropolitan Book Co. N. Delhi
3. **A.G. Ambekar**: Mechanism and Machine Theory, Jain Brothers, New Delhi
4. **S.S. Rattan**: Theory of Machines, Tata McGraw Hill

Reference books:

1. **T. Bevan**: Theory of Machines, CBS Publishers
2. **J.E.Shigley:**Theory of Machines and Mechanisms-Tata McGraw Hill

THERMAL ENGINEERING - II

Subject Code : ME1607
L: T: P: C : 2: 1: 0: 3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objectives: This course is designed for providing comprehensive understanding and thermodynamic analysis of boilers, thermal turbo machines used in power generation, I.C engines and jet propulsion.

Pre-requisite: Basics knowledge of Heat, work and energy, Laws of Motions., various gas laws. Knowledge of Element of Mechanical Engineering and Basic Thermodynamics is required.

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

1. Understand the thermodynamic working as well as performance of thermal boilers ,turbo power machinery and I.C engines.
2. Select various thermal devices required for aforesaid applications.

UNIT I

Steam Generators: Introduction, Classification of boilers, Boiler details, Fire Tube boilers, Water tube boilers, High Pressure boilers, Essentials of a Good boiler.

Draught: Definition and classification of draught, Natural draught Chimney, Chimney height and diameter, Condition for maximum discharge through chimney, Efficiency of a chimney, Draught losses, Artificial draught – Forced draught, Induced draught, and Balanced draught, Power required to drive fan.

Performance of Steam Generators: Evaporation capacity, Equivalent evaporation, Factor of evaporation, Boiler efficiency, Heat losses in a boiler plant, Boiler Trial and Heat Balance.

Steam Turbine – Impulse Turbines: Classification, Velocity diagrams for impulse turbine, Forces on blades, blade or diagram efficiency in single stage turbine, gross stage efficiency, efficiency of multistage impulse turbine with single row wheel impulse blade section, Velocity compounded impulse turbine, Velocity diagram for velocity compounded impulse turbine, Most economical ratio of blade speed to steam speed for a two row velocity compounded wheels.

Impulse Reaction Turbine: Meaning of Impulse-reaction, Degree of reaction, Impulse-reaction turbine with similar blade sections and half degree reaction (Parsons Turbine), Gross stage efficiency and condition for maximum efficiency, Reaction blade profile and Height of reaction blading.

Turbine Performance at Varying Loads: Methods of governing.

(18L)

UNIT II

Gas Turbine: Cycle Arrangements- Introduction, Open Cycle Arrangements, Closed Cycle, Assumptions in ideal cycle analysis, Simple Gas Turbine Cycle, Heat Exchanger cycle, Reheat Cycle, Intercooled cycle, intercooled cycle with heat exchanger and reheat.

Practical Cycles and their analysis: Assumptions, Stagnation properties, Compressor and turbine efficiency, Pressure Loss, Heat Exchanger effectiveness, Variation of Sp. Heat, Mechanical Losses, Incomplete combustion Loss, Cycle efficiency, Polytropic efficiency, Performance of actual cycle.

Jet Propulsion cycles and their analysis: Criteria of performance, Ram and propelling nozzle efficiencies, Turbo jet engine – Thrust, Thrust power, Propulsive power, Propulsive efficiency, Critical pressure ratio

(18L)

Text books:

1. **C . P . Kothandaraman, A. V. Domkunwar:** A course in Thermal Engineering; Dhanpat Rai & Sons
2. **P. L. Ballaney:** Thermal Engg. Khanna Publishers

Reference books:

1. **V. Ganeshan:** I.C. Engines, TMH publisher
2. **B.K. Sarkar:** Thermal Engineering: TMH publisher

MACHINE DESIGN II

Subject code : ME1603
L: T: P: C : 2: 1: 0: 3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objectives:i) To apply the concepts of stress analysis, theories of failure and material science to analyze, design and/or select commonly used machine component.ii)To give the assurance that his designs will never failure at any circumstances.iii) To apply mechanical engineering design theory to identify and quantify machine elements in the design of commonly used mechanical system.iv) To develop ability to come up with innovative ideas.

Pre-requisites: Basics of strength of materials & Material science, Elementary design

Learning Outcome: On successful completion of this course students will:

1. Demonstrate the ability to make proper assumptions, perform correct analysis while drawing upon various mechanical engineering subject areas.
2. Demonstrate the ability to seek and learn new material in addition to the class topics through the completion of an open-ended project.
3. Demonstrate the ability to take technical, safety, legislative and other issues such as environmental into account when selecting and designing mechanical systems.
4. Demonstrate the preceding abilities by performing correctly:
   - The design, analysis and sizing of shafts
   - The selection, sizing and analysis of springs
   - The selection of bearing types, and sizing and analysis of rolling element bearings
   - The selection of gear types, sizing, analysis and material selection of gear systems
   - The selection, sizing, design, and analysis of other mechanical components/systems

UNIT I

Spur Gears: Review of involute characteristics, standard systems of gear tooth, force analysis, gear tooth failures , loads on gear teeth- dynamic loads, beam strengths, Lewis equation, Lewis form factor, effective load on gear teeth, dynamic load, wear strength, Buckingham's equation, gear design for maximum, power transmitting capacity.

Helical gears: Terminology, virtual number of teeth, tooth proportions, force analysis, beam strength, effective load, wear strength.

Bevel Gears: Terminology, force analysis, beam strength, effective load, wear strength.

Worm Gears: Terminology, proportions of worm and worm gears, force analysis, strength rating and wear rating of worm gears, thermal considerations.

Pressure Vessels: Classification- thin cylinders and thick pressure vessels subjected to internal pressure, thick cylinder shells- Lami's equation, Clavariono's equation and Birni's equation, compound cylindrical shells, cylinder heads and cover plates.

(18L)

UNIT II

Springs: Types, materials, end connections fort helical springs, stresses and deflection of helical springs of circular wire, design of springs subjected to static and fluctuating load, springs in series and parallel, concentric springs, helical torsion springs, leaf springs, nipping of leaf springs, length of leaves.

Rolling contact bearings: Types, Stribeck's equation, static and dynamic carrying capacity, equivalent bearing load, load- life relationship, selection of radial bearings, reliability of a bearing, lubrication of ball and roller bearings.

Journal Bearing: Hydrodynamic lubrication and Reynold's equation, wedge film and squeeze film journal bearing, bearing characteristic number and bearing module for journal bearing, co-efficient of friction, critical pressure, Sommerfield Number, Heat generated in journal bearing, Design procedure.

(18L)

Text books:

1. **V B Bhandari:** Design of machine elements, TMH
2. **P. C. Sharma & D. C. Agarwal :** Machine Design, S. K. Kataria and sons
3. **R.S. Khurmi & J.K. Gupta:** Machine Design, S Chand Publications
4. **K.Mahadevan and K.Balaveera reddy:**Design Data Handbook (SI Units), KREC, Surathkal

Reference books:

1. **J.Shigley:** Mechanical Engineering Design, McGraw Hill
2. **Siegel, Maleev & Hartman:** Mechanical Design, International Textbook Co.
3. **Sadhu Singh:** Machine Design, Khanna Publishers.
4. **Ghosh:** Practical Machine Design, S. Bhattacharya Co.
5. **Spotts:** Design of Machine Elements, Prentice Hall (India)
6. **Abdulla Ed Shariff:** Handbook of properties of Engineering Materials and Design Data for Machine Elements, Dhanpat Rai & sons.

AUTOMOBILE ENGINEERING

Subject code : ME1604
L: T: P: C : 3: 0: 0: 3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objective:i) To know and understand the various mechanisms that apply to the operation of an Automobile.ii) To appreciate new concepts in Automobile Engineering.iii) To develop ability to come up with innovative ideas.

Pre-requisite: Basics of mechanical engineering and Theory of machines.

Learning Outcome: On successful completion of this course students will:

1. Demonstrate the ability to analyze the operation of various mechanisms and types of Automobile.
2. Appreciate new concepts in Automobile Engineering and develop ability to come up with innovative ideas.

UNIT I

Introduction: History, Classification, Components and operation of an Automobile

The engine: Description of parts and their functions (cylinder block, crankcase, cylinder head, piston, piston rings, piston pin, Connecting rod, crankshaft, flywheel, valve and valve mechanisms, valve tappet clearance, overhead valve, eccentric rocker arm, camshaft drive)

Multi cylinder engines: General consideration of engine balance, vibration, firing order, balance and firing order of various engines (1,2,4,6 cylinder engines). Power overlap.

MPFI: Introduction to multi point fuel injection. Supercharging and Turbo-charging.

Clutch: Purpose, Working principle of friction clutches and fluid flywheel. Operation of single plate clutch, multi-plate clutch, centrifugal clutch, wet clutch.

Gearbox: Operation of Sliding mesh gearbox, constant mesh gearbox, synchro-mesh gearbox, epicyclic gearbox, automatic gearbox. Overdrive.

Universal joint and propeller shaft: Introduction, types of universal joints.

Rear axle: Function, Main parts, Rear axle drives (working principle of Hotchkiss drive and torque tube drive). Differential, Four- wheel drive.

(18L)

UNIT II

Front axle: Steering geometry (camber, king pin inclination, castor, toe in and toe out). Correct steering angle. Steering mechanisms (Ackerman and Davis steering mechanisms). Undeersteer and Oversteer, Power steering.

Suspension systems: Purpose. Types of suspension springs, leaf spring, coil spring, torsion bar. Front suspension and Rear end suspension.

Brakes: Function and Operation. Principle of mechanical and hydraulic brakes, disc brake, air brakes.

Ignition systems: Requirement. Types (Battery ignition system and Magneto ignition system).Ignition timing. Spark plug. Distributor. Principle of Electronic ignition.

Starting systems: Starting motors. Bendix drive.

Wheels and tyres: Types of wheels. Rims. Types of tyres. Importance of maintaining tyre pressure.

Cooling system: Necessity. Methods of cooling (Direct cooling and Indirect cooling)

Emission control and Vehicle rules: Introduction, emission control systems (Crankcase emission control, Evaporative emission control, Exhaust emission control).

(18L)

Text books:

1. **Kirpal Singh:** Automobile engineering (volume I & II), Standard publishers distributors
2. **Dr. N. K. Giri:** Automobile Mechanics, Khanna publishers.
3. **V.Ganeshan:** I. C. Engines, TMH publishers

LATEST TRENDS IN MECHANICAL ENGINEERING

Subject code : ME1631
L: T: P: C : 3: 0: 0: 3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objectives: i) To know and understand the use of IOT in the field of Manufacturing, agriculture and energy management. ii) To know about the recent developments in thermos-fluid. Iii) To know about the recent advancement in industrial automation.

Pre-requisites: Manufacturing, Thermal, Fluid

Learning outcomes: On successful completion of course, students will:

1. Demonstrate the various uses of IOT in different sectors.
2. Develop new concepts in recent development in nano fluid and nano fluid energy coversion.
3. Describe block chain for industrial application.

UNIT I

Introduction to Internet Of Things (IOT) : - Sensing, Actuation, Basics of Networking, Communication Protocols, Sensor Networks, Machine to Machine communications, Connected Vehicles, Industrial IoT.

Rapid Prototyping: - Introduction to Rapid Manufacturing, Customization and Mass Customization, lassification of Rapid Manufacturing Processes (Additive/Subtractive/Formative), Part Deposition Orientation and its Importance, Direct Slicing and STEP related Details Data Format (STEP) and its details related non layered manufacturing processes, Classification of additive (layered) prototyping/tooling/manufacturing processes and some introduction, Fused Deposition Modelling of Polymers, Ceramics and Metals, Extruder deposition System, Laminated Object Manufacturing and Laminated Tooling Systems, Stereo lithography and other liquid based systems, 3D printing.

Micro-machining Techniques: Jet EMM, Capillary drilling, 3D EMM, Laser micromachining technique- Nanosecond pulse micromachining, Picoseconds pulse micromachining, femtosecond Pulse micromachining

Electron Beam micromachining- mechanism, importance of vaccum, process parameter, effect of cutting speed, machining of ferrite.

Recent Developments in Thermo-Fluid and Design

Fluid:-Introduction to micro fluids, lubrication theory, thin film dynamics, introduction to Nano fluids and Nano fluidic energy conversion.

Thermal:-Principle, design and performance of solar energy thermal system, solar ponds, solar cooker, solar green house, some passive architecture structures.

Design:-Engineering design and rapid prototyping using FEM.

(18L)

UNIT II

Advances in Industrial Automation -

Smart Materials – Shape memory alloy, Piezoelectric and Magnetostrictive actuators. Materials static and dynamic characteristics.

Micromechatronic systems: Microsensors, microactuators, Micro-fabrication techniques LIGA Process: Lithography, etching, micro-joining etc. Application examples: Mechatronic system from robotic manufacturing, machine diagnostics, road vehicles and medical technology.

Hyperloop Transportation:- Intoduction to Capsule, Geometry, Interior, Compressor, Suspension, Onboard Power, Propulsion. Tube- Geometry,construction, pylons and tunnels, Propulsion- Rotor, Stator, Energy Storage Components, Proulsion for Passenger plus Vehicle system. Safety and Reliablity- Onboard passenger Emergency, Power outage, Capsule Depressurization, Capsule Stranded in Tube, Structural Integrity of tube in Jeopardy, Earthquakes, Reliablity. Economic Considerations.

BlockChain for Industrial Application :-Re-shaping supply chain management through a public, direct peer-to-peer (P2P)manufacturing ecosystem, Incentivizing Change in Supply Chain Management, Smart Manufacturing Blockchain, Smart Contracts for Transparent Procurement

Processing, Smart Business Model for Decentralized Supply Chain Management, Manufacturing Utility Token: Incentivizing Blockchain Buy-in, Risk Factors. (18L)

Text books:

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press)
3. NPTEL Lecture Series and Coursera
5. Decentralized Manufacturing: Smart MFG Tech LTD, V16 - February 15, 2018
6. Hyperloop Alpha: Musk, Elon (August 12, 2013). "Hyperloop Alpha" (PDF). SpaceX. Retrieved August 13, 2013.

MECHATRONICS

Subject code : ME1632
L: T: P: C : 3: 0: 0: 3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objectives:i)Understand the Mechatronics system.ii)Know the CNC programming iii)Understand the hydraulic systems

Pre-requisite: Manufacturing process, fluid systems

Learning Outcomes: On successful completion of this course students will:

1. Be able to differentiate the various N/C machines.
2. Be able to design and develop a prototype using CNC lathe and milling machines.
3. Be able to interlink the mechanical and electrical system.
4. Appreciate the concepts of computer process interfacing.

UNIT I

Introduction to Mechatronic: Definition, Basic Concept and elements of Mechatronic system, need and benefit of mechatronic system.

Numerical Control of Machine Tools: Need for N/C machine tools, Basic Components of N/C system, Design Consideration of N/C Machine tools, N/C motion control system, Application of N/C machines.

Computer Control of N/C tools: Problems with N/C machines, Computer Numerical Control, Direct Numerical Control, Adaptive Control machining system, Flexible Manufacturing System

Manual ISO Part Programming: N/C coordinate systems, Preparatory Functions and Miscellaneous Functions, Examples of part programming with CNC Lathe and Milling Machine.

(18L)

UNIT II

Feedback devices: Logic Gates, Encoder, Resolver, Inductosyn, Tachometer.

Counting Devices: Flip Flops, Counters and Decoders.

Controller: Basic concept and elements of Microprocessor, Microcomputer and Assembly Languages.

Drives: Concept of Hydraulic System, Stepping Motor.

Computer–Process Interfacing : Manufacturing process data, System Interface hardware devices-Transducer, Sensors.

(18L)

Text Books:

1. **HMT Handbook**: Mechatronics, Tata McGraw Hill Publication, 1997.
2. **Yorem Koren:** Computer Control of Manufacturing Systems, McGraw Hill Book Company.
3. **Zimmer & Groover:** Computer Aided Design and Manufacture, Prentice Hall of India Pvt. Ltd.
4. **Mehta. V. K.:** Principles of Electronics, S.Chand & Company Limited.

Reference Books:

1. **Mikell P.Groover:** Automation, Production Systems and Computer Integrated Manufacturing, Prentice Hall of India Pvt. Ltd.
2. **Ramesh S. Gaonkar:** Microprocessor, Architecture, Programming and Application, Penram International Publshing(India).

AUTOMOBILE ENGINEERING LAB

Subject code : ME1663
L:T:P:C : 0:0:3:1.5
Duration of examination : 3 hours

Objectives: i)Know and understand the various mechanisms that apply to the operation of an Automobile. ii)Appreciate new concepts in Automobile Engineering.iii)Develop ability to come up with innovative ideas

Pre-requisite: ATD I,Basic concept Of Automobile engineering.

Learning Outcome: On successful completion of this course students will:

1. Demonstrate the ability to analyze the operation of various mechanisms and types of Automobile.
2. Appreciate new concepts in Automobile Engineering and develop ability to come up with innovative ideas.

Automotive Tools: Demonstration of automotive tools and their uses.

Automobile parts: Demonstrating the operation of various parts such as-

Clutch: Operation of single plate clutch, multi-plate clutch, centrifugal clutch, wet clutch.

Gearbox: Operation of Sliding mesh gearbox, constant mesh gearbox, synchro-mesh gearbox, epicyclic gearbox, automatic gearbox. Overdrive.

Universal joint and propeller shaft: types of universal joints.

Rear axle: Function, Main parts, Rear axle drives (working principle of Hotchkiss drive and torque tube drive). Differential, Four- wheel drive.

Front axle: Steering geometry (camber, king pin inclination, castor, toe in and toe out). Correct steering angle. Steering mechanisms (Ackerman and Davis steering mechanisms). Under-steer and Over-steer, Power steering.

Suspension systems: Purpose. Types of suspension springs, leaf spring, coil spring, torsion bar. Front suspension and Rear end suspension.

Brakes: Function and Operation. Principle of mechanical and hydraulic brakes, disc brake, air brakes.

Ignition systems: Requirement. Types (Battery ignition system and Magneto ignition system).Ignition timing. Spark plug. Distributor. Principle of Electronic ignition.

Starting systems: Starting motors. Bendix drive. Generator.

Wheels and tyres: Types of wheels. Rims. Types of tyres. Importance of maintaining tyre pressure.

Cooling system: Necessity. Methods of cooling (Direct cooling and Indirect cooling)

The above are the broad area of conduction of experiments. However the specific lists of experiments are the following. Students are required to perform minimum 12 experiments during the Lab in a semester.

List of experiments:-

1. Automotive Tools overview.
2. Automobile Chassis, Frame and Body.
3. Study the classification, construction details and different parts of Internal Combustion (IC) engine.
4. Study the working principle and constructional details of four stroke petrol and diesel engines.
5. Study the working principle and construction details of two stroke petrol and diesel engines.
6. Study the valve timing diagram of S.I. and C.I engines.
7. Study the working principle and construction of fuel supply system in petrol and diesel engines.
8. Study the working principle, operation and constructional details of Synchromesh and sliding mesh type gear boxes.
9. Study the construction and working principle of differential gear.
10. Study the working and operation of simple and compound gear trains.

11. Study the working principles, constructional details and operation of the Automotive Clutches.
12. Study the constructional details working principles and operation of the Automotive Steering Systems.
13. Study the constructional details, working principles and operation of the Automotive Brake systems.
14. Study the constructional details, working principles and operation of the Automotive Suspension systems.
15. Study the working and construction of Automotive Cooling and Lubrication systems.
16. Study the working principle and construction of Electrical systems (Engine start system) of an automobile.
17. Study the working and constructional details of Automotive Drive lines.
18. Study the working and construction of automotive wheels and tyres-tubes.
19. Study the working and construction of Computerized Wheel Aligner.

Reference books:

4. **Kirpal Singh:** Automobile engineering (volume I & II), Standard publishers distributors
5. **Dr. N. K. Giri:** Automobile Mechanics, Khanna publishers.
6. **V.Ganeshan:** I. C. Engines, TMH publishers

COMPUTATIONAL LAB II

Subject code : ME1662
L:T:P:C : 0:0:3:1.5
Duration of examination : 3 hours

Objectives: i) To know the basic concepts problem solving.ii) To understand the basic concepts of C. iii)To develop the programming skills of students in C.

Pre-requisite: Engineering Mathematics III,C programming.

Program Outcomes: On successful completion of this course students will:

1. Students will become familiar with fundamentals of various science and technology subjects and thus acquire the capability to applying them.
2. Students will become equipped with the knowledge and skills necessary for entry-level placement in Mechanical, Mechatronics and Electrical Engineering as well as IT companies.

Interpolation: Newtonian polynomial interpolation formulae (Forward and Backward interpolation), Newton's divided difference, Lagrange's interpolation formula,

Numerical Integration: Trapezoidal rule, Simpson's one third and three eighth rule.

Solution of Transcendental Equation: Numerical solution of algebraic and transcendental equations using method of ordinary iteration. Regula Falsi and Newton Rapson's method.

Solution of systems of linear equation: i) Direct Method: Gauss Elimination and LU decomposition method, Iterative Method: Jacobi, Gauss –Seidal method. Method for Matrix Inversion.

Solution of Differential Equation: Numerical solution of initial value problems in ordinary differential equations by Euler's method, Runge Kutta fourth order method. Finite difference method for the solution of boundary value problems in linear ordinary differential equations using central differences.

The above are the broad area of conduction of experiments. However the specific list of experiments are the following. Students are required to perform minimum 12 experiments during the Lab in a semester.

List of experiments:-

1. To write a C program on Bisection Method.
2. To write a C program on Regula Falsi Method.
3. To write a C program on Newton Rapson's Method.
4. To write a C program on Trapezoidal rule Method.
5. To write a C program on Simpson's one third Method.
6. To write a C program on Simpson's three eighth Method.
7. To write a C program on Gauss Elimination Method.
8. To write a C program on Iterative : Jacobi Method.
9. To write a C program on Iterative: Gauss –Seidal method Method.
10. To write a C program on Forward interpolation Method.
11. To write a C program on Backward interpolation Method.
12. To write a C program on Runge Kutta fourth order Method.

TextBooks

1. **S. Arumugam, A. Thangapandi Issac, A. Somasundaram:** Namerical Methods, Scitech
2. **E Balagurusamy:** NUMERICAL METHODS,Mcgraw Higher Ed

Reference Books

1. **B. S. Grewal**:Numerical Methods in Engineering and Science with Programs in C, Khanna Publishers.

MINI PROJECT

Subject Code : ME1671
L:T:P:C : 0:0:3:0
Objective: To motivate the students for practical application of knowledge gain.
Pre-requisite: Knowledge of Mechanical engineering subjects taught.
Learning Outcome: On successful completion of course students will:

1. Utilize the theoretical knowledge on actual application.
2. Visualize the practical application of mechanical equipments.
3. Able to develop new concept for various applications.

Mini project should be done by the students in seventh semester for which a teacher is assigned to the student(s) under whom he/she/they will work. Minimum contact hour per week is 3 hrs.

MECHANICAL VIBRATIONS

Subject Code **: ME1701**
L: T: P: C **: 3: 1: 0: 4**
Questions to be set **: 4 from each unit**
Questions to be answered **: 5 full questions selecting at least 2 from each unit**

Objectives:i) To formulate the mathematical models of problems in vibrations using Newton's second law or energy principles.ii) To determine a complete solution of mechanical vibration problems sing various mathematical or numerical techniques.iii) To determine physical and design interpretations from the results, iv) To apply skills and understanding, and be able to solve standard vibration problems that occur in mechanical engineering applications.

Pre-requisite: Knowledge of Strength Of Materials, Engineering Mechanics, Theory of Machine, Engineering Mathematics.

Learning Outcome: On successful completion of this course students will:

1. Be able to solve for the motion and the natural frequency of freely vibrating SDOF undamped and damped systems.
2. Be able to decompose any periodic function into a series of simple harmonic motions using Fourier series analysis.
3. Be able to obtain the complete solution for the motion of a SDOF vibratory system that is subjected to forcing functions.
4. Be able to solve vibration problems that contain multiple degrees of freedom

UNIT I

Introduction: Importance and scope, definition and terminology, simple harmonic motion.

Undamped free vibration of SDOF systems: Equations of motion, Newton's law, D'Alembert's Principle and Energy method; expressions for natural frequency of various spring-mass, torsional and other systems with different types of restoring forces.

Damped free vibration of SDOF systems: Viscous damping; response of overdamped, critically damped and underdamped systems – logarithmic decrement; response of systems with Coulomb damping.

Forced vibration of SDOF systems: Steady state forced vibration due to external harmonic force, rotating and reciprocating unbalance, base excitation; vibration isolation and transmissibility; determination of equivalent viscous damping from frequency response curve. (18 L)

UNIT II

Vibration measuring instruments: Seismic type; Displacement measuring instrument -vibrometer, velocity pick-up, and accelerometers.

Free vibration of two DOF systems: Equations of motion for different undamped systems; natural frequency and normal modes of vibration.

Forced vibration of two DOF systems: Undamped forced vibration with harmonic excitation; undamped dynamic vibration absorber.

Vibration of multi DOF systems: Equations of motion in matrix form, influence coefficients, mass, flexibility and stiffness matrices; determination of natural frequency by Dunkerley's and Rayleigh's methods; determination of natural frequency and mode shape by Holzer method and matrix iteration method.

Whirling of shaft: Critical speed of a light shaft having a single disc – without damping and with damping. (18L)

Text books:

1. **G.K. Grover:** Mechanical Vibrations, Nem Chand & Bros., Roorkee
2. **W.T. Thomson:** Theory of Vibration with Applications, CBS Publishaers, New Delhi

Reference books:

1. **S.S. Rao:** Mechanical Vibrations, Pearson Education, Delhi
2**. Tse, Morse and Hinkle:** Mechanical Vibrations, CBS Publishaers, New Delhi.
3**. Timoshenko:** Vibration Problems in Engineering,

OPERATIONS RESEARCH

Subject Code : ME1710
L:T:P:C : 2:1:0:3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objectives:i)Understand the managerial skill.ii)Understand the concept of Project evaluation and review technique.iii)Understand the concept of Optimization.

Pre-requisite: Concept of Principal Of Management and Industrial Engineering.

Learning Outcome: On successful completion of this course students will:

1. Be able to understand the characteristics of different types of decision-making environments and the appropriate decision making approaches and tools to be used in each type.
2. Be able to build and solve Transportation Models and Assignment Models.

UNIT-I

Linear Programming: Definition, phases, application of O.R., assumptions in L.P.P., Graphical solution, The Simplex method (technique and algorithm), Duality, Dual Simplex method.

Transportation model: Algorithm for Transportation problems, NWC, Least cost, VAM, MODI method. **Assignment model:** Definition, solution algorithm for assignment models (Hungarian method).

Game Theory: Theory of Games, Rules of game theory, Two person zero sum game, Methods for solving two person zero sum game.

(18 hrs)

UNIT-II

Networks: CPM and PERT analysis. General Explanation, Calculation of event times, activity times, total float, free float, independent float.

Queuing models: Queuing systems and structures, Notation parameter, Single server and multi-server models, Poisson input, Exponential service, Constant rate service, Infinite population problem

Goal Programming

Inventory Models: Inventory models, Economic order quantity models, stochastic inventory models, multi product models, Inventory control models in practice.

(18 hrs)

Text Books:

1. **Hamdy A.Taha**: Operations Research, PHI.
2. **Prem Kr Gupta&D.S Hira**: Operations Research
3. **N. D. Vohra**: Operation Research,TMH

Reference Books:

1. **S.D.Sharma**: Operations Research, Kedar Nath and Ram Nath &Co.
2. **P.C. Tulsian and V. Pandey**: Quatitative Techniques- Theory and Problems, Pearson Education
3. **Lovin and Krit Patrick**: Quantitative approach to Management, TMH.

PERSONNEL MANAGEMENT AND INDUSTRIAL RELATIONS

Subject Code	**: ME1721**
Number of Lecture Hrs per week	**: 03 Hrs.**
L: T: P: C	**: 4: 0: 0: 4**
No. of questions to be set	**: 2 each from Unit I and Unit II.**
No. of questions to be answered	**: 5 full questions selecting at least 2 from each unit**

Objectives: This course covers the basics of working of personnel department, the detailed process of recruitment and appraisal phenomena in an organization. This course also emphasizes on handling the industrial relations, disputes and the importance of trade unions.

Pre-requisite: Management study

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

1. Detailed process of recruitment.
2. Develop the importance of appraisal.
3. Thorough experience of handling ergonomics related problems.
4. Develop the importance of trade unions.
5. Idea of grievance handling and disputes settlement

UNIT I

Personnel management: Objectives, Functions of Personnel Management, Process of Human Resource Planning

Recruitment: Steps in recruitment process, Sources of recruitment, methods of recruitment. Promotions, Demotions, Transfers, Separation, Absenteeism and Turn over, Wage and Salary administration

Appraisal: Performance Appraisal, Methods of Performance evaluation.

(24L)

UNIT II

Industrial Relations: Functional Requirements, Employees participation in management. Grievances and Grievance Handling, Act of Indiscipline/ Misconduct, Principles for maintenance of discipline.

Industrial Disputes, Procedure for the Settlement of Disputes, Government and Industrial Relations, Organs of Industrial Peace.

Trade Unions: Objectives and Functions, Growth of Trade Union Movement, Factors Affecting Growth of Trade Unions, Essentials of a Successful Trade Union.

(24L)

Text books:

1. **Mamoria C B and Gankar S V**- ersonnel Management, (23e), Himalaya Publishing House,
2. **Megginson L C**, Personnel and Human Resources Administration, (3e), R. D. Irwin

Reference books:

1. **Beach D S-** Personnel: The Management of the People at Work, (3e), Macmillan, 1975.
2. **Yoder D-** Handbook of Personnel Management and Labor Relations, Volume 1, McGraw Hill

FINITE ELEMENT METHOD

Subject Code : ME1722
Number of Lecture Hrs per week : 03
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objective: The course outlines the following objective:

1. To learn basic principles of finite element analysis procedure .
2. To learn the theory and characteristics of finite elements that represent engineering structures.
3. To learn and apply finite element solutions to structural, thermal, dynamic problem to develop the knowledge and skills needed to effectively evaluate finite element analyses performed by others.
4. Learn to model complex geometry problems and solution techniques.

Pre-requisites: Students should have mathematical, graphing skills, and CAD-CAM with a good technical understanding of products, processes, and measuring devices in their work environment.

Learning Outcomes: After successfully completing the course, students should be able to do the following:

1. Present some basic theory of FEA
2. Introduce the general procedures that are necessary to carry out an analysis
3. Present basic information that is necessary for the safe use of FEA.

UNIT I

Introduction, historical background, applications, advantages, finite element softwares. Theory of elasticity - stress and equilibrium, stress-strain relationship, strain-displacement, relationship, plane stress, plane strain and axi-symmetric approximation.

Potential energy and equilibrium, Principle of minimum potential energy. Discrete and Continuous systems, Rayleigh-Ritz method, Galerkin method. Solution of Algebraic equations, Banded and skyline solutions. Global, Local and Natural coordinates in 1, 2 and 3 dimensions - Area coordinates.

(18L)

UNIT II

One dimensional elasticity problems - discretisation of domain into elements – generalized coordinates approach - derivation of elements equations - assembly of element equations - transformation matrices - global equations, load vector, properties of stiffness matrices, imposition of Boundary conditions - penalty and elimination approach, multi-point constraints. Finite element formulation of plane trusses, beams and beams on elastic supports.

Finite element formulation of 2D problems using constant strain triangle element and isoparametric quadrilateral element. Axi-symmetric solids subjected to axi-symmetric loading. Features of 3D problems in stress analysis.

(18L)

Text books:

1. Reddy: An Introduction to Finite Element Method: McGraw-Hill, 3/e
2. Hutton: Fundamentals of Finite Element Analysis: McGraw-Hill, 1/e
3. Krishnamoorthy: Finite Element Analysis: Theory and Programming: McGraw-Hill, 2/e

Reference books:

1. T. K. Chandrupatla and A. D. Belegundu: Introduction to Finite Elements In Engineering: Prentice Hall of India Pvt. Ltd., New Delhi
2. S. Rajasekaran: Finite Element Analysis in Engineering Design: Wheeler Publishing,
3. K. S. Bathe & E. L. Wilson: Finite Element Method: Prentice Hall of India
4. R. D. Cook: Concepts and Applications of Finite Element Analysis

POWER PLANT ENGINEERING

Subject Code : **ME1731**
L: T: P: C : **3: 0: 0: 3**
Questions to be set : **4 from each unit**
Questions to be answered : **5 full questions selecting at least 2 from each unit**

Objectives:i) To develop a basic concept of power plant(coal based), ii) To follow the details of hydraulics turbines, iii) To able to implement their theoretical knowledge in their practical life(various power plants) iv) To develop ability to come up with innovative ideas.

Pre-requisite: Knowledge of Applied Thermodynamics, Fluid Mechanics and Hydraulic Machines.

Learning Outcome: On successful completion of this course students will:

1. Be able to demonstrate the working of thermal, hydro electric and Gas turbine plant.
2. Be able to find the various parameters involve in power plants.
3. Be able to get new concepts related to powerplants.

UNIT I

Thermal PowerPlant: Selection of site, Fuel used-Coal, Classification of coal, Analysis of coal, Coal handling system,Ash handling system, Equipments used for preparation & burning of Pulverized coal, Plant layout.

Boiler & Auxiliaries: Boiler drum, circulation ratio, slips ratio, void fraction, blow down, steam separator, Fluidized bed boilers.

Turbine & Auxiliaries: Turbine components-Casing, Rotor, Blades; Condensate system, Regenerative Feed heating.

Steam Condensers and Cooling Tower: Jet Condenser, Surface condenser, Air leakage & its effect on performance of condensers, Vacuum efficiency, Condenser efficiency, Daltons Law of partial pressure, Air extraction pump, Thermodynamic analysis of condenser, Cooling towers, Design criteria of cooling towers.

(18L)

UNIT II

Gas Turbine Power Plant*:* Fuel used, Plant layout, Components of gas turbine plant (compressor, combustion chamber, and turbine),Methods to improve the efficiency of the gas turbine plant, Combined cycle power plant.

Hydro-electric Power Plant: Selection of site, Plant layout, Hydrology, Essential Equipments-Surge tank, Penstock, Spillways, Gates and Valves, Power house, Draft tube.

Nuclear Power Plant: Selection of site, Principle of release of nuclear energy, Fission & Fusion reaction, Fuels used, Main parts of a reactor & their function, Coolant cycle, Plant layout. Emissions from power plants and their controls.

(18L)

Text Books:

1.**P. K. Nag**: Power Plant Engineering, TMH
2.**Domkundawar, A. Domkundawar:** Power Plant Engineering, Dhanpat Rai & Sons.

Reference Books:

1. **A. Chakrabarty, M. L. Soni, P. V. Gupta, U. S. Bhatnagar**: Power System Engineering, Dhanpat Rai & Sons.
2. **R. K. Rajput:** A Textbook of Power Plant Engineering, Laxmi Publication
3. **R. K. Hegde**: Power Plant Engineering, Pearson Education

REFRIGERATION & AIR-CONDITIONING

Subject Code : ME1732
L: T: P: C : 3: 0: 0: 3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objectives: i)Students will learn the basic concepts and principles of air conditioning and refrigeration. ii)Students will learn the fundamental analysis methodology of air conditioning and refrigeration. iii)Students will learn the basic process and systems of air conditioning and refrigeration.

Pre-requisite: Knowledge of Thermodynamics, Fluid Mechanics

Learning Outcome: Upon successful completion of this course the students will be able :

1. To demonstrate an ability to analysis psychrometric processes and cycles of air conditioning systems.
2. To demonstrate an ability to estimate the energy requirements of cooling and heat equipment for simple air conditioning applications.
3. To demonstrate an ability to estimate energy requirements for simple air conditioning processes.

UNIT I

Gas Cycle Refrigeration: Reversed Brayton Cycle, Application in Air –Craft Refrigeration-Simple system, Bootstrap system, Regenerative system, Reduced Ambient system.

Vapour Compression Refrigeration (VCR): VCR; Multi-stage or compound system-Flash gas removal, flash inter-cooling, complete multi-stage compression system; Multi-evaporator system; Cascade system.

Vapour Absorption System: Simple VAR system, Modification of simple VAR system, Maximum co-efficient system, Electrolux system.

Compressors: Reciprocating & Centrifugal compressors.

Evaporators: Flooded and Dry evaporators, extended surface evaporators.

(18L)

UNIT II

Expansion Device: Capillary tube, Automatic Expansion Valve, Thermo-static expansion valve.

Condensers: Air cooled condenser, water cooled condenser, Evaporative condenser, cold storage.

Psycrometries: Properties of moist air, mixing process, By- pass factor, Sensible heat factor, Basic processes in Air- conditioning, Air-washer, Psychrometric chart.

Load Calculation: Internal heat gain, System heat gain, Effective sensible heat factor, Cooling & heating load estimation.

(18L)

Text books:

1. C.P. Arora: Refrigeration & Air Conditioning, Tata McGraw Hills Publishing Company.
2. C. P. Arora & S. Domkundwar : Refrigeration and Airconditioning , Danpatrai & Sons

Reference books:

1. Jordon and Prister: Refrigeration and Air-Conditioning, PHEM Ltd, 1985.
2. S. Singh: Refrigeration and Air-Conditioning, Khanna Book Publishing

ENERGY MANAGEMENT

Subject Code : ME1733
L: T: P: C : 3: 0: 0: 3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objectives: (i) To prepare the students for successful career in the energy industry; energy regulation and management agencies; and in the academic and R&D institutions. (ii)To produce graduates strong in energy resources, technologies and management fundamentals, and capable in addressing the present and potential future energy problems. (iii)To produce energy professionals, who are sensitive to, and well aware of, the energy issues and concerns, and who can apply their specialized knowledge for the sustainable energy management.

Pre-requisite: (i) Basic concept of thermodynamics, (ii) Heat Transfer

Learning Outcomes : Upon successful completion of this course the students will:

1. Understand and acquire fundamental knowledge on the science of energy and on both the conventional and non-conventional energy technologies
2. Acquire the expertise and skills needed for the energy monitoring, auditing and management, and for the development, implementation, maintenance and auditing of Energy Management Systems
3. Capable of analysis and design of energy conversion systems
4. Acquire skills in the scientific and technological communications, and in the preparation, planning and implementation of energy projects

UNIT I

Introduction: Energy demand and supply scene of the country, Need of energy management, **Energy audit:** Definition, need, and types of energy audit; Energy management (audit) approach: Understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements; Fuel & energy substitution; Energy audit instruments; Energy Conservation Act; Duties and responsibilities of energy managers and auditors.

Thermal energy management: Energy conservation in boilers, steam turbines and industrial heating systems; Application of FBC; Cogeneration and waste heat recovery; Thermal insulation; Heat exchangers and heat pumps; Building Energy Management.

(18 L)

UNIT II

Energy action planning: Assessing the Organization, Description and use of Energy Management Matrix, Establishing Organizational Profile, Assessing the Human Element and Technical situation. Strategic approach of organizing the action - Gain Control, Invest, Maintain Control, Understanding Organizational Change. Key elements; Force field analysis; Energy policy purpose, perspective, contents, formulation, ratification; Organizing the management: location of energy management, top management support, managerial function, roles and responsibilities of energy manager, accountability; Motivation of employees: Information system-designing barriers, strategies; Marketing and communicating: Training and planning.

Financial analysis of energy efficiency projects: Principles of Financial Analysis: Inflation, Interest (The time value of Money), Discount Rate, Depreciation, Life Cycle, Salvage Value, Project Costs, Project Benefits, Taxes, Net Cash Flow, Financial Analysis Techniques: Simple Payback Period (SPP), Life-cycle Cost and Annualized Life-cycle Cost, Net Present Value (NPV), Internal Rate of Return (IRR).

(18 L)

Text books:

1. **CB Smith,** Energy Management Principles, Pergamon Press, New York, 1981
2. **Hamies,** Energy Auditing and Conservation; Methods, Measurements, Management & Case study, Hemisphere, Washington, 1980
3. **Witte, Larry C,** Industrial Energy Management & Utilization, Hemisphere Publishers, Washington, 1988

4. **Bureau of Energy Efficiency** Study material for Energy Managers and Auditors

Reference books:

1. **D Patrick and S W Fardo,** Energy Management and Conservation, Prentice Hall Inc.
2. **J.Krieder and A. Rabi (1994):** Heating and Cooling of Buildings: Design for Efficiency, McGraw-Hill.
3. **Archie, W Culp**. Principles of Energy Conservation, McGraw Hill, 1991.
4. **P. O'Callaghan:** Energy Management, McGraw - Hill Book Company, 1993.
5. **C.W. Gellings and J.H. Chamberlin (1993):** Demand-Side Management Planning,
6. Fairmont Press.
7. **Thuman A and Mehta D Paul,** Handbook of Energy Engineering, The Fairmount Press.
8. **Kennedy, Turner and Capehart,** Guide to Energy Management, The Fairmount Press
9. **Wayne C Turner,** Energy Management Handbook, The Fairmount Press
10. **Frank Kreith, Ronald E West,** CRC Handbook of Energy Efficiency, CRC Press
11. **Kao Chen,** Energy Management in Illumination System, CRC Press
12. **Gellingn, Chamberli,** Demand Side Management: Concepts and methods, Penwell
13. **John Elting Treat,** Energy Futures: Trading Opportunities, Penwell
14. **Charles M Cotlschalk,** Industrial Energy Conservation, John Wiley & Sons
15. **Amit Kumar Tyagi**, Handbook on Energy Audits and Management, TERI

ROBOTICS AND AUTOMATION

Subject Code : ME1737
L: T: P: C : 3: 0: 0: 3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting atleast 2 from each unit

Objectives: i) To demonstrate and understand how to program robots and computers, ii) To control manufacturing automation, with an emphasis on the team approach to problem solving in a work environment. Iii) To utilize state of the art equipment like the Tetrix Robotic System, Scorbot ER-4 Manipulator, and peripherals that include conveyers, sliders, and turntables.

Pre-requisites: Basic of electronics and Programming background.

Learning Outcome: On successful completion of this course the student will be able to:

1. Describe in detail how industrial robot systems are used, structured and operate,
2. Describe in detail the structure and operation of robotic tooling, including actuators, mechanics and sensors,
3. Describe other parts of automated manufacturing systems, including process control, component flows, machine safety and personal safety,
4. Describe computer-aided production tools and data communication within an industrial robotics network,
5. Identify fundamental issues within sustainable industrial development from an automation perspective and be able to exemplify the consequences of these,
6. Implement and present a basic automation task with an industrial robot, including pilot study, online and offline programming and evaluation of the results, based on a given specification.

UNIT I

Fundamental Concepts of robotic: History, present status & future trends-Robotics & automation-Laws of Robotics-Robot definitions- Robotics systems & robot anatomy-Specification of Robots-resolution, Repeatability & accuracy of a manipulator.

R**obot drives & power transmission systems & control**: Robot drive mechanisms, hydraulic-electric-pneumatic drives, mechanical transmission method-Rotary-to /rotary motion conversion, rotary –to linear motion conversion-End effectors.

Sensors & Intelligent Robots:Sensory devices-Non optical-position sensors-optical position sensors-Velocity sensors-Proximity sensors-contact & non-contact type-touch &slip sensors-Force & torque sensors-Al & Robotics.Computer Vision for Robotics Systems.

(18L)

UNIT II

Robot Cell Design & Control: Specification of commercial robots-Robots design & process specification-Motor selection in the design of a robotic joint-Robot cell layouts-Economic & social aspect of robotics.

Application of Robots: Capabilities of Robots-Robotics applications-Obstacle avoidance-Robotics in India-The future of robotics Factor Automation-Hierarchical computer control.

(18L)

Text Books:

1. **Richard D.Klafter, Thomas A.Chmielewski Michael Negin,** Robotics Engg-An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P.Ltd.1989.
2. **Ghosh,** Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998
3. **Shiman Y.Nof**,"Handbook of Industrial Robotics. "John Willey & Sons, New York, 1985.

4. **Mikell P. Weiss G.M., Nagel R.N., Odraj N.G.,** Industrial Robotics, McGraw-Hill Singapore, 1996.

Reference Books:

1. **Fu.K.S.Gomalez, R.C.Lee, C.S.G,"Robotics:** Control, Sensing, Vision& Intelligence", MGH book co.1987.
2. **MikellP.Grooveret.al,"**Industrial Robots-Technology, Programming & application", MGH,New York, 1980.
3. **Deb.S.R,** Robotics technology and flexible Automation, John Wiley, USA 1992.
4. **Asfahl C.R.,** Robots and manufacturing Automation, John Wiley, USA 1992

INTERNAL COMBUSTION ENGINE

Subject Code : ME 1740
L: T: P: C : 3: 0: 0: 3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting atleast 2 from each unit

Objective: i) To study the thermodynamics, combustion, heat transfer, friction and other factors affecting engine power, efficiency and emissions, ii) To introduce students to the environmental and fuel economy challenges facing the internal combustion engine, iii) To introduce students to future internal combustion engine technology and market trends.

Pre-requisite: Knowledge of Thermal Engineering, Basic of chemical Engineering.

Learning Outcome: Upon successful completion of course, the students will be able:

1. To analyse the working of IC engine.
2. To differentiate the working of 4 & 2-stroke engine.
3. To recognize and understand reasons for differences among operating characteristics of different engine types and designs
4. To give an engine design specification, predict performance and fuel economy trends with good accuracy
5. To analyse the combustion process, predict concentrations of primary exhaust pollutants.
6. To set-up and run engines in controlled laboratory environments
7. To develop skills to run engine dynamometer experiments.

UNIT I

I.C. Engine:

Air Standard cycles & their analysis (Otto and Diesel cycles); Fuel air cycles and their analysis, Actual cycles and their analysis, Valve timing diagrams for 4-stroke S.I. and C.I. engines, Combustion S.I.Engines - Introduction, Ignition Limits, Stages of combustion in S,I,Engines, Effect of engine variables on ignition lag and flame propagation, Factors influencing the flame speed, Rate of pressure rise, Cycle variations, Abnormal Combustion, Detonation or knocking, Effect of engine variables on knock or detonation, Control of detonation, Abnormal combustion knock- surface ignition, S,I, Engine combustion chamber design principles.

Two Stroke & 4-Stroke Engine

Type of two stroke S.I.Engines – Crankcase scavenged and Loop Scavenged engines, Scavenging systems, Scavenging pumps, Scavenging parameters – delivery ratio, charging efficiency, trapping efficiency, scavenging efficiency, relative charge. Type of 4- stroke Engines. Construction details of 4-stroke petrol engine. Working principle, Otto cycle, and actual indicator diagram. Advantages & disadvantages of two stroke and four stroke engines, Comparison of two Stoke S.I. & C.I. Engines, Valve timing diagrams for two stroke engines.

(18L)

UNIT II

Combustion in C.I.Engines:

Stages of combustion in C.I. Engines, Air fuel ratio in C.I. Engines, Delay period, Variables affecting delay period, Diesel knock, Methods of controlling Diesel knock, Comparision of Knock in S.I.and C.I. Engine.

Testing and Performances: Performance parameters, Basic Measurements, Measurements of speed, fuel consumption, air consumption, exhaust smoke, exhaust emission, brake power (Prony brake, rope brake) indicated power, friction power (Morse test, Willian's Line Method), Indicated Mean effective pressure, Brake mean effective pressure, Engine efficiencies – Air standards efficiency, Indicated and Brake thermal efficiencies, Mechanical efficiency.

(18L)

Text books:

1. **Heinz Heisler**; Advanced Engine Technology, SAE International Publications, USA, 1998.
2. **M.L. & Sharma, R.P. Mathur;** I.C. Engines; Dhanpat Rai & Sons.

Reference books:

1. **V. Ganeshan;** I.C. Engines, Tata McGraw-Hill
2. **John B Heywood**; Internal Combustion Engine Fundamentals, Tata McGraw-Hill 1988.

TOOL ENGINEERING AND DESIGN

Subject Code : ME1735
L: T: P: C : 3: 0: 0: 3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objectives: To familiarize the student with tool nomenclature and cutting forces and give knowledge about the tool geometry .To impart knowledge on tool materials, tool life and tool wear. To educate students on failure analysis of cutting tools. To impart the knowledge about the mechanism of chip formation, heat distribution and thermal aspects of machining.

Pre-requisites: Basics knowledge of tool geometry, tool signature, functions of various angles in single point and multi point cutting tool. Knowledge of Trigonometry.

Learning Outcomes:On successful completion of this course, students will be able:

1. To design a high production cutting tool.
3. To reduce the cost of machinery.
4. To prevent failures of cutting tool

UNIT I

Tool Geometry: Introduction, basic shape of cutting tools, tool point reference system and tool axis reference, machine reference system, geometry of single point cutting turning tools: location of cutting edges, orientation of face and flank surfaces, interrelationship between different systems of rake angle nomenclature, method of slope for rake angles, method of master line for rake angles, method of circle diagram for rake angle conversion, geometry of twist drills , working system rake and clearance angles,

Cutting Tool Materials: Introduction of cutting tool materials, properties, tool life, performance and condition of use of HSS, cemented carbides and ceramics.

(18L)

UNIT II

Design of Single Point Cutting Tool: Design of tool shanks for strength and rigidity, design of tool-tips, optimization of tool shape: clearance angle, rake angle, inclination angle, principal cutting edge angle(PCEA), Auxiliary cutting edge angle (ACEA), nose radius, Design of chip breakers : geometry of chip- breaking action , chip breaker types.

Design of High Production Cutting Tools: Introduction, features of high production cutting tools: use of negative rake for edge strengthening principles of restricted contact, compounding of cuts, typical high production cutting tools, Kolesov tool, modified Kolesov tool with retraced cutting edge, improved designs of milling cutters ,Schmidt's double radial rake cutter, chip breaking grooves in cutters.

(18L)

Text books:

1. **A. Bhattacharyya**; Metal Cutting Theory and Practice, New Central Book Agency (P) Ltd.
2. **Edward M. Trent & Paul K. Wright**; Metal Cutting, Butterworth & Heinemann

Reference books:

1. **Cyril Donaldson, George H LeCain, VC Goold**; Tool Design, Tata McGraw Hill
2. **BL Juneja, GS Sekhon**; Fundamentals of Metal Cutting and Machine Tools, New Age International (P) Ltd.

TOTAL QUALITY MANAGEMENT

Subject Code : ME1736
Number of Lecture Hrs per week : 03 Hrs.
L: T: P: C : 3: 0: 0: 3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objectives:i)Understand the process and planning of the desire product.ii)Work in a team and respect the idea of all team members.iii)become a leader or manager of any industry and take responsibility. iv)Develop ability to come up with innovative ideas.v) Understand the ISO 9000, and help the organization to get ISO Certification.vi) Take knowledge of TQM and covert their theoretical knowledge into the practical one and fulfill the customer requirement.

Pre-requisites: Quality concepts

Learning Outcome: On successful completion of this course students will:

1. Develop an understanding on quality management philosophies and frameworks
2. Develop in-depth knowledge on various tools and techniques of quality management
3. Learn the applications of quality tools and techniques in both manufacturing and service industry
4. Develop analytical skills for investigating and analysing quality management issues in the industry and suggest implement able solutions.

UNIT I

Introduction

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs – Analysis, Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

TQM principle

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

(18L)

UNIT II

Statistical Process Control(SPC) The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

TQM tools

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

Quality Systems

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits.

(18L)

Text books:

1. **Dale H.Besterfield, et at:** Total Quality Management, Pearson Education Asia, 2005.
2. **Dale H.Besterfield, et at.:** Total Quality Management, Prentice – Hall of India Private Limited, 2006.
3. **Subburaj Ramasamy:** Total Quality Management, Tata McGraw- Hill, 2006

Reference books:

1. **James R.Evans & William M.Lidsay:** The Management and Control of Quality, South-Western (Thomson)
2. **Feigenbaum.A.V.:** "Total Quality Management, McGraw-Hill, 1991.
3. **Oakland.J.S.:** "Total Quality Management Butterworth – Hcinemann Ltd., Oxford. 1989.
4. **Narayana V. and Sreenivasan:** N.S. Quality Management – Concepts and Tasks, New Age International 1996.
5. **Zeiri.:** "Total Quality Management for Engineers Wood Head Publishers, 1991.
6. **Ullman D.G:** The Mechanical Design Process, Mc Graw Hill, International Editions 1997.

COMPUTER INTEGRATED MANUFACTURING

Subject Code : ME1738
L: T: P: C : 3: 0: 0: 3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objective:(i) To describe the fundamental concepts of CIM, (ii) To explain enterprisewide integration of CIM and concept of CIM wheel, (iii) differentiate between CAM, CAD/CAM, and CIM, (iv) To know the scope of CIM, (v) To discuss operations flow within CAD/CAM, and (vi) To know the different approaches for integration of CAD/CAM

Pre-requisites: Basic concept of CAD/CAM

Learning Outcome: On successful completion of this course students will:

1. Identify the main elements in computer integrated manufacturing systems;
2. Apply knowledge of computer aided process planning, feature and group technology, and data exchange in manufacturing processes.
3. Apply the concepts/components of computer integrated manufacturing and integrate them in a coordinated fashion
4. Process product models with CAM tools and CNC machines.

UNIT I

Introduction

Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction toCAD/CAM – Concurrent Engineering-CIM concepts – Computerised elements of CIM system – Typesof production - Manufacturing models and Metrics – Simple problems – Manufacturing Control – Levels of Automation – Lean Production and Just-In-Time Production.

Production planning and control and computerisedprocess planning

Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer AidedProcess Planning – Aggregate Production Planning and the Master Production Schedule – MaterialRequirement planning – **Capacity Planning- Control Systems-Shop Floor Control-Inventory Control** – (18 L)

UNIT II

Cellular manufacturing

Group Technology(GT), Part Families – Parts Classification and coding – Simple Problems in OpitzPart Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept –Machine cell design and layout –- Arranging Machines in a GT cell – Hollier Method – Simple Problems.

Flexible manufacturing system (fms) and automated guided vehicle system (agvs)

Automated Guided Vehicle System(AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.

Industrial robotics

Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – EndEffectors – Sensors in Robotics – Robot Accuracy and Repeatability - Industrial Robot Applications –

(18 L)

Text Books:

1. **Mikell.P.Groover "**Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.
2. **Radhakrishnan P, SubramanyanS.and Raju V.,** "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.

Reference Books:

1. **Kant Vajpayee S,** "Principles of Computer Integrated Manufacturing", Prentice Hall India, 2003.
2. **Gideon Halevi and Roland Weill,** "Principles of Process Planning – A Logical Approach" Chapman & Hall, London, 1995.
3. **P Rao, N Tewari&T.K. Kundra,** "Computer Aided Manufacturing", Tata McGraw Hill Publishing Company, 2000.

PRODUCTION AND OPERATION MANAGEMENT

Subject Code : ME1739
L:T:P:C : 3:0:0:3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objectives: This course aims at teaching the students to look at the production planning and inventory control systems through a managerial perspective; obtaining a fair understanding of how operations managers allocate the resources using long term capacity planning, aggregate production planning, and inventory analysis; recognizing the relationships among the strategic, tactical and operational levels of planning in production systems; and gaining expertise in production and inventory control tools

Pre-requisite: Mathematical and Statistical Background

Learning Outcome: On successful completion of this course students will:

1. Have a basic understanding of the operation and control of production systems.
2. Be able to use quantitative models to analyze and optimize such system and understand the limits of these models and how they can be used in practice

UNIT I

Introduction to Operations Management: Basic Concept and Historical Development of Operations Management; Current Trends and Issues in Operations Management.

Forecasting: Demand Management; Types of Forecasting – Long and Short-term demand forecasting methods; Components of Demand; Time Series Analysis – Simple Moving Average, Weighted Moving Average, Exponential Smoothing, Forecast Errors, Sources of Error, Measurement of Error, Linear Regression Analysis, and Decomposition of a Time Series.

Aggregate Production Planning and Resource Planning: Productivity Definitions, Scope and measurement; Productivity improvement methods for organizations in India; Framework of Aggregate Production Planning; Basic Strategies – Level Strategy, Chase Strategy, and Mixed Strategy; Master Production Scheduling; Resource Planning – Multiple Levels in Product, Product Structure, Bill of Materials (BOM); Material Requirement Planning (MRP); Capacity Requirements Planning (CRP); Manufacturing Resource Planning (MRP-II).

Scheduling of Operations: Loading of Machines – Assignment Rule (Hungarian Method); Priority Rules and Techniques for Job Shop and Flow Shop Scheduling, Shortest Processing Time (SPT), Longest Processing Time (LPT), Earliest Due Date (EDD),Critical Ratio (CR); Johnson's Rule and Gantt Chart – Scheduling of 'n' Jobs on Two Machines, 'n' Jobs on Three Machines, 'n' Jobs on 'k' Machines, and 2 Jobs on 'k' Machines.

Production Planning and Control.

(18L)

UNIT II

Plant Location and Plant Layout: Importance of Plant Location; Factors Affecting Plant Location; Quantitative Methods for Plant Location – Centre of Gravity Method, Load-Distance Method, and Transportation Model; Definition of Plant Layout; Objectives and Importance of Plant Layout; Muther's Principle of Plant Layout; Types of Plant Layouts – Product, Process, Combination, and Fixed Position Layouts; Quantitative Techniques for Planning Layouts – Flow Process Charts, Activity Relationship Charts, Travel Chart, Load-Distance Matrix Method, Line Balancing – Basic concept, Line Balancing Methods (Kilbridge Method and Rank Positional Weight Method), and Concepts of Balance Delay and Balance Efficiency.

Material Handling: Definition, objectives and principles of Material Handling; Advantages of Scientific Material handling; Safety in Material Handling; Factors to be Considered for Selection of Material Handling Equipment; Classification of Material Handling Equipment.

(18L)

Text books:

2. **Richar B Chase, F Robert Jacobs, Nicholas J Aquilano, and Nitin K Agarwal:** Operations

Management for Competitive Advantage, McGraw-Hill
3. **N. D. Vohra;** Quantitative Techniques in Management, McGraw Hill Education

Reference books:

1. **J Krajewski and Larry P Ritzman:** Operations Management – Strategy and Analysis**,** Prentice Hall
2. **Sang M Lee and Marc J Schniederjans**;Operations Management, oughton Mifflin College Div

ADVANCED MANUFACTURING TECHNIQUES

Subject code	**: ME1741**
L: T: P: C	**: 3: 0: 0: 3**
Questions to be set	**: 4 from each unit**
Questions to be answered	**: 5 full questions selecting at least 2 from each unit**

Objectives: i) To inculcate specialized knowledge and skill in advanced manufacturing processes using the principles and methods of engineering analysis and design. ii) To cultivate the ability to develop and implement new improved manufacturing processes resulting in creation and distribution of value in engineering applications. iii) To impart knowledge about the significance of controlling process parameters for the optimal performance for newly developed engineering materials used in industries and research organizations.

Pre-requisite: Manufacturing process

Learning Outcomes:On successful completion of this course students will :

1. Have the knowledge and understanding of Theories, principles and practice in advanced manufacturing technology.
2. Have the knowledge and understanding of design, prototyping, materials and manufacturing processes.
3. Have the knowledge and understanding of methods for manufacturing system design and optimization.

UNIT I

Non-Conventional Machining process: Introduction, Needs for Unconventional machining processes, classification of unconventional machining process. Water Jet Machining (WJM): Process, working principle, process characteristics, process performance, and applications. **Abrasive Water Jet Machining (AWJM):** Process, working principle, application, AWJM system, mixing, suspension jet, and catcher, mechanism of material removal, environmental issues and future.

Chemical Milling (CM): process, principle of operation, equipment, applications.

Electro-Chemical Machining (ECM): process, working principle, equipment, material removal rate, applications.

Electro-Discharge Machining (EDM): process, operating principles, EDM process parameters, characteristics of EDM, dielectric, electrode material, material removal rate and product quality, equipment, RC type relaxation EDM generator, Wire-cut EDM, process, various features of wire-cut EDM process.

(18 L)

UNIT II

Electron Beam Machining (EBM): introduction, process technology, gun construction, current control, control of spot diameter, control of focal distance of magnetic lens, current pulsing, application.

Plasma Arc Machining (PAM): principle of operation, plasma arc torches; indirect arc plasma torches and direct arc plasma torches, parameters affecting cutting, advantages of plasma arc cutting.

Iron Beam Machining (IBM): introduction, beam source; electrode characteristics, discharge mechanism, cathode electron emission, cathode sputtering, regulating and control electrodes, ion guns, ion beam set-up, unit, sputtering rate (MRR), applications, advantages & disadvantages.

High Energy Rate Forming Processes: Explosive Forming, Standoff Technique, Contact Technique. , Electro Magnetic Forming: Applications. Electro Hydraulic Forming, Advantages, Accuracy of parts produced, Materials formed

Advanced Welding Processes: Friction Welding Process, advantages and limitations, applications,

friction stir welding: advantages, limitations and applications.

(18 L)

Text Books:

1. **V.K. Jain:** Advanced machining process, Allied Publishers Pvt. Ltd.
2. **O.P. Khanna:** A Text Book of Production Technology, Dhanpat Rai Publications
3. **P. K. Misra :** Nonconventional Machining, Narosa Publishing House,India
4. **P. C. Pandey & H. S. Shan :** Modern Manufacturing Processes, TMH

Reference Books:

1. **Campbell:** Principles of Manufacturing Materials and Processes, TMH
2. **Lindberg:** Processes and Materials of Manufacture-PHI
3. **E.J. Weller:** Non-Traditional Machining Process, Sosiety of Manufacturing Engineers Publishers,Michingan
4. **Gary F. Benedict:** Non-Traditional Manufacturing Process, Marcel Dekkar Inc. New York.

COMPUTER AIDED DESIGN & MANUFACTURING (CAD/CAM)

Subject Code : ME1742
L:T:P:C : 2:1:0:3
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Objective:i)To gain a good working understanding of Geometric Dimensioning and Tolerancing.ii)To gain an understanding and appreciation of modern industrial design.iii)To understand modern CAD/CAM operations.iv)To gain a working knowledge of concurrent engineering.v)To be able to use a modern CAM system.vi)To understand CNC machine tool capabilities.vii)To understand rapid prototyping.

Pre-requisite: Concept of Mechatronics, Degree Of Freedom & Manufacturing

Learning Outcome: On successful completion of this course students will:

1. Be able to design parts in a modern parametric CAD system for manufacture on a rapid prototyping machine and/or a CNC machining system.
2. Be able to use geometric dimensioning and tolerancing based on the ASME standard in design and to generate proper engineering drawings.
3. Understand function, capabilities, and limitations of modern CNC machining centers.

UNIT I

Numerical Control: Need for N/C machine tools,Basic Components of N/C system, Design Consideration of N/C Machine tools, N/C motion control system, N/C coordinate systems, Preparatory Functions and Miscellaneous Functions, Examples of part programming with CNC Lathe and Milling Machine.

Fundamentals of CAD/CAM:
Definitions of CAD/CAM tools, product cycle and CAD/CAM, industrial utilization of CAD/CAM systems, design process and applications of computer for design, creating the manufacturing database, benefits of CAD.

CAD/CAM Hardware:
Types of CAD/CAM systems, system considerations, input output devices.

CAD/CAM software:
Introduction to CAD/CAM software, functions of a graphics package, geometry construction, transformations.

Geometric modeling:
Wire frame, surface and solid modeling, mathematical representation of curves, parametric design of various curves, mathematical representation of surfaces, and parametric design of surfaces.

(18L)

UNIT II

Basic Mechatronics: Basic concept and elements of Microprocessor, Microcomputer and Assembly Languages.

Drives: Concept of Hydraulic System, Stepping Motor. Computer–Process Interfacing : Manufacturing process data, System Interface hardware devices-Transducer, Sensors.

Robotics: Introduction to robotics, robot physical configurations, basic robot motions, robot programming methods, robot programming languages, end effectors, work cell control and interlocks, various applications of robots.

Finite Element Analysis: Introduction-Definition, utility and application, Revision of matrix algebra. One Dimensional Problem-Finite element modeling, co-ordinate and shape functions, potential energy approach and Galerkin approach, Global stiffness matrix and boundary conditions, Quadratic shape function

(18L)

Text books:

1.**Zimmer & Groover:** CAD/CAM Computer Aided Design and Manufacture, Prentice Hall

of India Pvt. Ltd., New Delhi..
2.**Ibrahim Zeid:** CAD/CAM, Theory & Practice, TMH.
3.**Yorem Koren:** Computer Control of Manufacturing Systems, McGraw Hill Book Company.
4.**T.R.Chandrupatla & A.D. Belegundu:** Introduction to Finite Elements in Engineering, PHI

Reference books:

1.**Mikell P. Groover:** Automation, Production Systems and Computer Integrated Manufacturing, Prentice Hall of India Pvt. Ltd.
2.**Radhakrishnan, Subramanyun & Raju:** CAD/CAM/CIM, New age international.
3.**Robert J Schilling:** Fundamentals of Robotics-Analysis & Control, PHI
4.**Tsemeo Yoshikawa:** Fundamentals of Robotics -Analysis & Control, PHI
5.**Klaus-Surgen Bathe:**Finite Element Procedures, PHI
6.**Steven M. Lepi:** Practical Guide to Finite Element, Marcel Dekker Inc.

MACHINE DYNAMICS LAB

Subject Code : ME1761
L: T: P: C : 0: 0: 3: 1.5
Duration of examination : 3 hours

Objective:i)Apply skills and understanding, and be able to solve standard vibration problems that occur in mechanical engineering applications.ii)Appreciate the concept of machine Dynamics iii)Come up with innovative ideas.

Pre-requisites: TOM I,TOM II,MD II,& Basic Concept of Machine Vibration.

Learning Outcome: On successful completion of this course students will:

1. Students will able to find the various parameters related to dynamics of machines.
2. Appreciate the concepts of dynamics and statics.

Governors-Performance testing of Porter, Hartnell and Hartung governors- controlling force, stability, sensitiveness isochronism, capacity and coefficient of insensitiveness, effort and power of governors.

Gyroscopic effects- Study of Gyroscopic effects of a rotating disc.

Balancing of rotating masses-static and dynamic balancing of several masses rotating in the same plane and balancing of several masses rotating in different planes.

Undamped free vibration: Natural frequency of various spring-mass, torsional and other systems with different types of restoring forces.

Damped free vibration: Viscous damping; response of overdamped, critically damped and underdamped systems

Forced vibration of SDOF systems: Steady state forced vibration due to external harmonic force.

Whirling of shaft: Critical speed of a light shaft having a single disc – without damping and with damping

Cam and Follower: Generation of cam profile with knife edge follower.

Gear Train: Power transition using epicyclic gear train- gear ratio, torque, efficiency.

Bearing: Operation of journal bearing**.**

Coriollis acceleration: Determination of coriollis component of acceleration of a rotating as well as translating body.

The broad areas for conduct of experiments are lenlisted above. However, the specific lists of experiments are as follows. Students are required to perform minimum 12 experiments during the Lab in a semester.

List of experiments:-

1. To perform experimental studyon free torsional vibration- single rotor and Double Rotor.
2. To study the damped torsional oscillations for determining the damping coefficient.
3. To determine the radius of gyration of a given bar by using bi-filler suspension.
4. To study free and forced vibration of equivalent spring mass system with and without damping.
5. Determination of gyroscopic effect of a rotating disc and calculation of gyroscopic couple in a motorized gyroscopic set-up.
6. To study the longitudinal vibration of helical spring and to determine the theoretical and actual frequencies of oscillation .
7. To study Static and dynamic balancing of masses.
8. (a) Determination and comparison of experimental periodic time with theoretical periodic time for a simple pendulum.
   (b) To determine the radius of gyration of a compound pendulum and to verify its expression of time-period.
9. Plotting of follower displacement Vs. angle of cam rotation curves in a Cam-analysis machine.
10. Determination of various characteristic curves in a Universal Governor apparatus.
23. Determination of epicyclic gear-ratio and verification of torque equation in an epicyclic gear-Train apparatus.
24. Determination of Coriollis component of acceleration.
25. Determination of frequency and mode of Whirling of shaft
26. Study of pressure profile on journal bearing apparatus.

References books:

1. **V. Ramamurti**: Mechanical Vibrations practice with basic theory, Narosa
2. **S.S.Rattan**: Theory of Machines, TMH

CAD/CAM LAB

Subject Code : ME1762
L: T: P: C : 0: 0: 3: 1.5
Duration of examination : 3 hours

Objective:i)To gain a good working understanding of Geometric Dimensioning and Tolerancing.ii)To gain an understanding and appreciation of modern industrial design.iii)To understand modern CAD/CAM operations.iv)To gain a working knowledge of concurrent engineering.v)To be able to use a modern CAM system.vi)To understand CNC machine tool capabilities.vii)To understand rapid prototyping.

Pre-requisite: Concept of Mechatronics, Basic Knowledge of CAD/CAM operating Languages

Learning Outcome: On successful completion of this course students will:

1. Be able to design parts in a modern parametric CAD system for manufacture on a rapid prototyping machine and/or a CNC machining system.
2. Be able to use geometric dimensioning and tolerancing based on the ASME standard in design and to generate proper engineering drawings.
3. Understand function, capabilities, and limitations of modern CNC machining centers. Programming of CNC machines.Turning Centre: Simple exercises on programming and simulation of machining involving various turning processes. Machining Centre: Simple exercises on programmin and simulation of machining involving Drilling, Contour machining processes. Demonstration of working on Turning centre.

CAD/CAM Hardware:

Types of CAD/CAM systems, system considerations, input output devices.

CAD/CAM software:

Introduction to CAD/CAM software, functions of a graphics package, geometry construction, transformations.

CREO PARAMETRIC: Overview on setting working directory and saving the work, Various tolls, orthographic projection, part drawing, 3-D modeling, assembly.

ANSYS: Introduction of ANSYS**,** node deflection, von misses stress for beam.

The broad areas for conduct of experiments are lenlisted above. However, the specific lists of experiments are as follows. Students are required to perform minimum 12 experiments during the Lab in a semester.

List of Experiments

1. Modelling of isometric block-1- Modelling by using tools like extrude, pocket, etc.
2. Modelling of isometric block-2- Modelling by using tools like extrude, pocket, etc.
3. Modelling of isometric jug/ container-Modelling by using tools like revolve, shell, etc.
4. Modelling of piston along with piston pin and circlips-Individual modelling and assembly of each by considering suitable constraints.
5. Modelling of universal joint-Individual modelling and assembly of each by considering suitable constraints.
6. Wireframe modelling of cigar-pipe-Wireframe and surface modelling by using tools like variable/ multi-section, etc. and addition of thickness.
7. Surface modelling of water bottle-Surface modelling by using tools like variable/ multi-section, diabolo/ impression of different figs., etc. and addition of thickness.
8. Assembly of part design-1. Assembly of more than two part design using different assembly tools.
9. Assembly of part design-2. Assembly of more than two part design using different assembly tools.

10. Conversion of 3D models into 2D drawings and universal file convertors-Selected models to be converted into 2D drawing for manufacturing along with are converted for CNC machining by using to .dxf, .iges and .step.
11. Application of FEA of different examples by considering node, mesh, etc.
12. Analysis of a simply supported beam-Application of different boundary conditions.
13. Comparative study of different analysis of a cantilever beam by considering different metals-Comparative study of FEA analyses of a same part when metals are different.

Reference books:

1. **Zimmer & Broover :** CAD/CAM Computer Aided Design and Manufacture, Prentice Hall of India Pvt/ Ltd., New Delhi.
2. **Ibrahim Zeid**: CAD/CAM, Theory & Practice, TMH.

INDUSTRIAL TRAINING II

Subject Code : ME1782
Objective: i) To familiarize the students with the actual operation in industry.
Pre-requisite: Knowledge of basics of Mechanical engineering
Learning Outcome: On successful completion of course students will:

1. Visualize the practical application of mechanical equipments.
2. Able to relate the theoretical knowledge with practical use.
3. Able to develop new concept of operations.

After completion of VIth semester, students do their Industraial Training II of four weeks during summer vacation at different industries/establishments. Report and PPT to be evaluated by the department in 7th semester examination.

MAJOR PROJECT

Subject Code : ME1875
Duration : 16 weeks
Objective: To familiarize the students with Industrial technical problems.
Pre-requisite: Knowledge of Mechanical engineering
Learning Outcome: On successful completion of course students will:

1. Able to Identify and resolve the actual industrial problems
2. Come up with innovative ideas.
3. Visualize the practical application of mechanical equipments.
4. Able to relate the theoretical knowledge with practical use.
5. Able to develop the interpersonal and managerial skills.

VIIIth semester student(s) will have to undergo minimum of 16 weeks major project work on live industrial problems preferably in the industries. However the student(s) can do major project work in any R & D lab /organization/institution of good repute. The project work will be evaluated at the place of work/organization by the industry project guide out of 100. Further the college will also assign a project guide. The project work will be evaluated at two stages in the department, namely (i) Internal evaluation (out of 100) and (ii) external evaluation (out of 100). For external evaluation an external examiner is required from outside the college.