DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS

BACHELOR OF TECHNOLOGY

[2016-17]

SIKKIM MANIPAL UNIVERSITY

Date of Revision: 17-June-2016

Applicable for academic batch 2016-17 from 1st semester

Applicable for academic batch 2015-16 from 3rd semester

B.TECH 1ST SEMESTER (GROUP – A)							
SL.No.	**Sub. Code**	**Subject Name**	**Teaching Dept.**	**Contact hours per week**			**Credits**
				L	P	T	
1	MA 1101	Engineering Mathematics I	MATHS	4	0	1	4
2	CE 1102	Mechanics of Solids	CE	4	0	1	4
3	PH 1103	Engineering Physics	PHY	4	0	1	4
4	ME 1104	Elements of Mechanical Engineering	ME	4	0	1	4
5	ME 1105	Engineering Graphics	ME	1	1	0	3
6	BA 1106	Communication Skills	MGT	4	0	1	3
7	BA 1115	Universal Human Values & Professional Ethics - I	MGT				2
8	ME 1161	Workshop Practice I	ME	0	1	0	1.5
9	PH 1162	Engineering Physics Lab	PHY	0	1	0	1.5
Total Credit for the semester : 27							
B.TECH 1ST SEMESTER (GROUP – B)							
1	MA 1101	Engineering Mathematics I	MATHS	4	0	1	4
2	EC 1107	Basic Electronics	ECE	4	0	1	4
3	CH 1108	Engineering Chemistry	CHEM	4	0	1	4
4	EE 1109	Elements of Electrical Engineering	EE	4	0	1	4
5	CS 1110	Computer Programming using C	CSE	4	0	1	4
6	CH 1111	Environmental Science	CHEM	4	0	1	2
7	BA 1115	Universal Human Values & Professional Ethics - I	MGT				2
8	CH 1163	Engineering Chemistry Lab	CHEM	0	1	0	1.5
9	CS 1164	Computer Programming Lab	CSE	0	1	0	1.5
Total Credit for the semester : 27							
Total credit for the semesters I & II :54							

B.TECH II[nd] SEMESTER (GROUP – A)							
SL. No.	**Sub. Code**	**Subject Name**	**Teaching Dept.**	**Contact hours per week**			**Credits**
				L	**P**	**T**	
1	MA 1201	Engineering Mathematics II	MATHS	4	0	1	4
2	EC 1107	Basic Electronics	ECE	4	0	1	4
3	CH 1108	Engineering Chemistry	CHEM	4	0	1	4
4	EE 1109	Elements of Electrical Engineering	EE	4	0	1	4
5	CS 1110	Computer Programming using C	CSE	4	0	1	4
6	CH 1111	Environmental Science	CHEM	4	0	1	2
7	BA 1215	Universal Human Values & Professional Ethics - II	MGT				2
8	CH 1163	Engineering Chemistry Lab	CHEM	0	1	0	1.5
9	CS 1164	Computer Programming Lab	CSE	0	1	0	1.5
Total Credit for the semester : 27							
B.TECH II[ND] SEMESTER (GROUP – B)							
1	MA1201	Engineering Mathematics II	MATHS	4	0	1	4
2	CE 1102	Mechanics of Solids	CE	4	0	1	4
3	PH 1103	Engineering Physics	PHY	4	0	1	4
4	ME 1104	Elements of Mechanical Engineering	ME	4	0	1	4
5	ME 1105	Engineering Graphics	ME	1	3	0	3
6	BA 1106	Communication Skills	MGT	4	0	1	3
7	BA 1215	Universal Human Values & Professional Ethics - II	MGT				2
8	ME 1161	Workshop Practice I	ME	0	1	0	1.5
9	PH 1162	Engineering Physics Lab	PHY	0	1	0	1.5
Total Credit for the semester :27							
Total credit for the semesters I & II :54							
Minimum credits to be earned for promotion from 1st year to 2nd year : 30/50							

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

(CGPA SCHEME)

IIIRD SEMESTER – MECHANICAL ENGINEERING

SL. NO	SUBJECT CODE	SUBJECT	TEACHING DEPTT.	NO OF HOURS/WEEK		DURATION OF EXAMS (HRS)	TOTAL CREDITS
				LECTURE	PRACTICAL		
1	MA1305	Engg. Mathematics III	Maths	4	-	3	4
2	ME1307	Engg. Thermodynamics	ME	4	-	3	4
3	ME1303	Manufacturing Process I	ME	4	-	3	4
4	ME1309	Strength of Materials	ME	4	-	3	4
5	EE1307	Electro Technology	E & E	4	-	3	4
6	ME1305	Mechanical Drawing	ME	1	3	3	4
7	ME1361	Strength of Material Lab	ME	-	3	3	1.5
8	EE1364	Electro Technology Lab	E & E	-	3	3	1.5
9	ME1362	Computational Lab I	ME	-	3	3	1.5
			TOTAL	**21**	**12**		**28.5**

IVTH SEMESTER - MECHANICAL ENGINEERING

SL. NO	SUBJECT CODE	SUBJECT	TEACHING DEPTT.	NO OF HOURS/WEEK		DURATION OF EXAMS (HRS)	TOTAL CREDITS
				LECTURE	PRACTICAL		
1	MA1405	Numerical Methods	MATHS	4	-	3	4
2	ME1407	Thermal Engg. – I	ME	4	-	3	4
3	ME1403	Fluid Mechanics	ME	4	-	3	4
4	ME1409	Theory of Machines I	ME	4	-	3	4
5	ME1405	Material Science	ME	4	-	3	4
6	ME1406	Manufacturing Process II	ME	4	-	3	4
7	ME1461	Workshop Practice II	ME	-	3	3	1.5
8	ME1462	Computer Graphics Lab	ME	-	3	3	1.5
9	ME1463	Thermal Engineering Lab I	ME	-	3	3	1.5
			TOTAL	**24**	**9**		**28.5**

VTH SEMESTER - MECHANICAL ENGINEERING

SL. NO	SUBJECT CODE	SUBJECT	TEACHING DEPTT.	NO OF HOURS/WEEK		DURATION OF EXAM (HRS)	TOTAL CREDITS
				LECTURE	PRACTICAL		
1	ME1501	Industrial Engineering and Management	HUM	4	-	3	4
2	ME1502	Heat Transfer	ME	4	-	3	4
3	ME1508	Fluid & Hydraulic Machines	ME	4	-	3	4
4	ME1509	Machine Design I	ME	4	-	3	4
5	ME1505	Metrology	ME	4	-	3	4
6	ME1511	Mechanics of Solids I	ME	4	-	3	4
7	ME1561	Workshop Practice III	ME	-	3	3	1.5
8	ME1562	Fluid Mechanics Lab	ME	-	3	3	1.5
9	ME1563	Metrology Lab	ME	-	3	3	1.5
			TOTAL	**24**	**9**		**28.5**

VITH SEMESTER - MECHANICAL ENGINEERING

SL. NO.	SUBJECT CODE	SUBJECT	TEACHING DEPTT.	NO. OF HOURS/WEEK		DURATION OF EXAM (HRS)	TOTAL CREDITS
				LECTURE	PRACTICAL		
1	ME1609	Theory of Machines II	ME	4	-	3	4
2	ME1607	Thermal Engg. – II	ME	4	-	3	4
3	ME1603	Machine Design II	ME	4	-	3	4
4	ME1604	Automobile Engineering	ME	4	-	3	4
5	ME1605	Mechatronics	ME	4	-	3	4
6	ME1610	Non Traditional Machining Processes	ME	4	-	3	4
7	ME1661	Thermal Engineering Lab II	ME	-	3	3	1.5
8	ME1662	Computational Lab II	ME	-	3	3	1.5
9	ME1663	Automobile Engg. Lab	ME	-	3	3	1.5
			TOTAL	**24**	**9**		**28.5**

VIITH SEMESTER - MECHANICAL ENGINEERING

SL No	SUBJECT CODE	SUBJECT	TEACHING DEPTT.	NO OF HOURS/WEEK		DURATION OF EXAMS (HRS)	TOTAL CREDITS
				LECTURE	PRACTICAL		
1	ME1701	Mechanical Vibrations	ME	4	-	3	4
2	ME1710	Operations Research	ME	4	-	3	4
3	ME1703	Computer-aided Design and Manufacturing	ME	4	-	3	4
4	ME1707	Internal Combustion Engine	ME	4	-	3	4
5	ME17**	Elective I	ME	4	-	3	4
6	ME17**	Elective II	ME	4	-	3	4
7	ME1761	Machine Dynamics Lab	ME	-	3	3	1.5
8	ME1762	CAD/ CAM Lab	ME	-	3	3	1.5
9	ME1771	Mini Project	ME	-	-	-	2
10	ME1781	*Industrial Training and Seminar	ME	-	-	-	1
			TOTAL	**24**	**6**		**30**

NOTE: *Industrial training is conducted during summer vacation after VI semester. However, Seminar is conducted at the end of VII semester.

LIST OF ELECTIVES

ELI (ELECTIVE I)

1731 POWER PLANT ENGG
1732 REFRIGERATION AND AIR-CONDITIONING
1733 ENERGY MANAGEMENT
1737 ROBOTICS AND AUTOMATION

ELII (ELECTIVE II)

1739 PRODUCTION AND OPERATION MANAGEMENT
1735 TOOL ENGINEERING AND DESIGN
1736 TOTAL QUALITY MANAGEMENT
1738 COMPUTER INTEGRATED MANUFACTURING

VIIITH SEMESTER - MECHANICAL ENGINEERING

SL. NO	SUBJECT CODE	SUBJECT	TEACHING DEPTT.	NO OF HOURS/WEEK		DURATION OF EXAMS (HRS)	TOTAL CREDITS
				THEORY	PRACTICAL		
1	ME1875	Major Project	ME/ Industry	-	-	-	16

ELEMENTS OF MECHANICAL ENGINEERING

Subject Code	**: ME1104**
Number of Lecture Hrs per week	**: 04**
Questions to be set	**: 4 from each unit**
Questions to be answered	**: 5 full questions selecting at least 2 from each unit**

UNIT I

Thermodynamics: Introduction, systems and surroundings, property, state and process; reversible and irreversible process, cyclic process; heat, work and energy.

First law of thermodynamics: energy equations for non-flow and steady flow processes, limitations of first law.

Second law of thermodynamics: statements, equivalence of second law.

Thermodynamic processes: Relationship between P, V, T, expressions for work done, heat transferred and change in internal energy and enthalpy for - constant volume process, constant pressure process, constant temperature process, isentropic process, and polytropic process – simple calculations.

Air compressor: Introduction – uses of compressed air, classification, working principle of Reciprocating and Centrifugal Compressor. Ideal single acting reciprocating compressor- Expression of work done per kg. of air delivered- Without clearance and with clearance (Polytropic process), Simple calculations relating to reciprocating compressors.

Internal Combustion Engines: Introduction, classification, engine details, Otto and Diesel cycles (no derivation), expression of efficiency, spark ignition and compression Ignition engines, working principles of 4-stroke and 2-stroke cycle engines. (24L)

UNIT II

Fluid Mechanics: Introduction- definition of fluid, fluid properties (Density, Sp. weight, Sp. volume, Sp. gravity), Viscosity- dynamic and kinematic, Newton's law of viscosity, different types of fluid. Definitions of compressible and incompressible fluid. Fluid statics- Statement of Pascal's law, Hydrostatic law (no derivations), different types of pressure and their relationships

Transmission of Motion and Power: Introduction, modes of transmission; belt drive – types of belts used, open and crossed belt drive, velocity ratio – slip in belt drive, simple calculations; Gear drive – types of gears, spur gear nomenclature, simple and compound gear trains – simple calculations.

Welding: Introduction, classification, welding rods and fluxes, principles of gas, resistance and electric arc welding processes (no other specific welding processes).

Lathe: Classification, description and function of lathe parts (details of function not necessary), list of operations performed on a lathe, cutting speed, feed and depth of cut.

Drilling Machine: Classification, operations on drilling machine. (24L)

Text books:

1. **Roy, Hazra Choudhury & Hazra Choudhury**- Elements of Mechanical Engineering; Media Promoters and Publishers Pvt. Ltd.
2. **Mathur & Domkundwar** - Elements of Mechanical Engineering; Dhanpat Rai & Co.

Reference books:

1. **Hazra Choudhury & Hazra Choudhury** – Elements of Workshop Technology vol. I & II – Media Promoters and Publishers Pvt. Ltd.
2. **Gupta –** Basic Mechanical Engineering – Dhanpat Rai & Co.
3. **Gopalakrishna –** Mechanical Engineering Science – Subhash Publications.
4. **R. K. Bansal**- A Txt Book of Fluid Mechanics and Hydraulic Machine; Laxmi Publications.

ENGINEERING GRAPHICS

Subject Code	**: ME1105**
No. of Lecture Hrs per week	**: 01**
No. of Practice Hrs per week	**: 03**
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**

UNIT I

Lettering, conventions and dimensioning.
Scales: Representative fraction, construction of plain and diagonal scales.
Principles of orthographic projections following 1st angle projection:
Projection of points: Projection of points in all quadrants.
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 Vol. I & II**, by Gopalakrishna
2. **Engineering drawing** by N.D.Bhatt

Reference books:
1. **Machine drawing** by N.D.Bhatt

WORKSHOP PRACTICE I

Subject Code : ME1161
No. of Practice hours/ week : 3 hours
Duration of examination : 3 hours

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 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 workshop in a semester.

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 and sawing operation on the given wooden piece for making Tee-Dovetail joint
3. To prepare a Tee-dovetail carpentry joint
4. To prepare a Tee-bridle carpentry joint
5. To perform external threading on G.I./PVC pipe
6. To perform tapping (internal threading) on M.S/ 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

ENGINEERING MATHEMATICS III

Subject Code : **MA1303**

Number of Lecture Hrs per week : **04**
Questions to be set : **4 from each unit**
Questions to be answered : **5 full questions selecting at least 2 from each unit**

UNIT I

Fourier analysis: Periodic functions, Trigonometric Series, Fourier series, Fourier series of odd and even functions, functions with arbitrary period, half range expansion, Fourier integrals, Fourier transforms, Fourier sine and cosine transforms, Convolution theorem(statement only).

Application of Fourier series to forced vibration problems, Application of Fourier integral and Fourier transform to solve heat equation.

Partial differential equations: Definition, degree, order of a PDE. Formation of PDE. Linear and nonlinear PDE. Solution of first order linear PDE, Lagrange's method. Solution of first order Nonlinear PDE, Charpit's method. Solution of higher order PDE by direct integration. Solution of higher order linear PDE with constant coefficients, homogeneous and nonhomogeneous.

Derivations of one dimensional wave equation (vibrating string) and its solutions by using method of separation of variables. Simple problems. D ' Alembart's solution of' wave equation. Derivation of one dimensional heat equation and its solution by using method of separation of variables. Solution of 2D-Laplace's equation.

(24L)

UNIT II

Vector calculus: Vector-calculus-gradient, divergence and curl, their physical meaning and identities. Line, surface and volume integrals. Simple .problems- Green's theorem - statements of divergence and Stoke's theorems - Simple applications. Curvilinear Co-ordinates.

Numerical Analysis 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 ruleSolution of systems of linear equation: Jacobi, Gauss- Seidal and relaxation methods. Solution of tridiagonal systems. Eigen values and eigen vectors of matrices and elementary properties, computation of largest eigen value by power method. Numerical evaluation of Fourier coefficient, difference equations with constant coefficient and their solution.

(24L)

Text books:

1. **C. E. Weatherburn :** Vector Analysis
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

Number of Lecture Hrs. per week : 04
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

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, statement of the law and its application to 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, introduction to unsteady flow problems.
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 thermodynamic temperature scales, 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.

(24 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.
Real Gases: Vander wall's equation of state, principles of corresponding states, compressibility factor, virtual equation of state.

(24 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
Number of Lecture Hrs per week : 04 Hrs.
Questions to be set : 4 from each unit.
Questions to be answered : 5 full questions selecting at least 2 from each unit

UNIT I

Introduction to 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.
Melting: Types of furnaces and applications, brief description of working of electric arc furnace, induction furnace and cupola.
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.

(24L)

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.
Presses: Types, working of mechanical and hydraulic presses, safety devices.
Non destructive Testing: Visual, Magnetic, liquid penetrant, ultrasonic radiography, eddy current, acoustic emission monitoring.

(24L)

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. **Campbell:** Principles of Manufacturing Materials and Processes, TMH
2. **Lindberg:** Processes and Materials of Manufacture-PHI
3. **O.P.Khanna :** Foundry Technology
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
Number of Lecture Hrs per week : 04 Hrs.
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting atleast 2 from each unit

UNIT I

Introduction: Concept of mechanics of deformable solids; concept of stress developed against external force/pressure; brief review of normal and shearing stress and strain; 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.
Torsion: Torsion formula for circular cross-sections, Maximum normal and shear stresses, Angle of twist, combined bending & torsion of solid & hollow shafts, torsion of thin walled tubes
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, laminated springs.

UNIT II

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.
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.

TEXTBOOKS:

1.**Beer, Johnston and Dewolf**–Mechanics of materials-TataMcgrawhill
2.**Timoshenko & Young -** Elements of Strength of Materials - East west press.
3.**Ramamrutham& S 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:

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

MECHANICAL DRAWING

Subject Code	**: ME1305**
Number of Lecture Hrs per week	**: 01**
No of Practice Hours	**: 03**
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**

UNIT I

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

UNIT II

Assembly Drawing (Given the working drawing only two views to be asked in the examination)

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

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

EE 1364

ELECTRO TECHNOLOGY

Subject Code	**: EE1307**
Number of Lecture Hrs per week	**: 04 Hrs.**
Questions to be set	**: 4 from each unit**
Questions to be answered	**: 5 selecting at least 2 from each unit**

UNIT I

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

Basic operation amplifier, block diagram of typical op amp, 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: Two transistor analogy of SCR, V – I characteristics of SCR, triggering methods, SCR ratings, turn on and turn off mechanisms,

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

(24L)

UNIT II

Mathematical Models of physical systems: differential equations of physical systems, transfer function analysis, mechanical, translational and rotational systems, electrical systems, hydraulic systems, pneumatic systems, thermal systems and electromagnetic 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.

Proportional, PI and PID controllers.

Concepts of stability in frequency domain: Necessary conditions of stability, relative stability, Root locus technique, Polar Plots, Bode Plots, gain and phase margins, Nyquist stability criterion.

(24L)

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
Number of Practical Hrs per week : 03 Hrs.

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

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 workshop in a semester.

List of Experiments:-

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

COMPUTATIONAL LAB I

Lab Subject Code : ME1362
Number of Practice Hrs per week : 03 Hrs

Object oriented paradigm:an 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

1. If statement
2. If-else statement
3. Nested if-else statement
4. For loop
5. While loop
6. Do,, while loop
7. Break statement
8. Switch statement
9. Continue statement
10. Go to statement

Arrays and strings

Programming with functions

Pointers and runtime bindings

Operator overloading

1. Unary operator overloading
2. Binary operator overloading

Inheritance

1. Constructors in derived classes
2. Destructions in derived classes
3. Abstract classes
4. Multilevel, Multiple, Hierarchical, Multipath & Hybrid inheritance

Virtual Functions

Poly Morphism

Generic programming with templates

1. Function template
2. Overloaded function template
3. Class templates

Input/output files

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 workshop in a semester.

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. Mastering C++ by **K.R. Venugopal, Rajkumar, T. Ravishankar,** TMH ISSBN 0-07-463454-2

Reference book:

1. Object oriented programming in C++ by **Robert Lafore,** Pearson ISBN 978-81-317-2282-4

ELECTRO TECHNOLOGY LAB

Subject Code : EE 1364
Number of contact Hrs. per week : 03 Hrs.

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. No load speed characteristics 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 amplifications
6. V-I characteristics of SCR
7. V-I characteristics of Triac
8. Commutation of SCR
9. Motor control with SCR and Triac
10. Study of single phase half controlled converter
11. 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

ENGINEERING MATHEMATICS IV

Subject Code	**: MA1405**
Number of Lecture Hrs per week	**: 04**
Questions to be set	**: 4 from each unit**
Questions to be answered	**: 5 full questions selecting at least 2 from each unit**

UNIT I

Probability Theory: Introduction to Probability : Finite sample space, conditional probability and independency, Baye's theorem, one dimensional random variable, mean, variance and expectation, Chebyschev's inequality, Two and higher dimensional random variables, covariance, correlation coefficients, least squares principle of curve fitting, Distributions : Binomial, Poission, Uniform, Normal, Gamma, Chi square and exponential, simple problems.

Application of Fourier and Z Transform: Parseval's identity of Fourier transforms, Solution of boundary value problems using Fourier transforms, Z transforms, Solution of difference equation using Z transforms.

(24L)

UNIT II

Numerical Analysis II: 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 convergency and multiple roots of polynomial equations. Solution of nonlinear equation by Newton Rapson's method. Simple examples. 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 - Millne's method, Adam Bashforth, Adam Moultan method.

(24L)

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**

Number of Lecture Hrs per week : **04**
Questions to be set : **4 from each unit**
Questions to be answered : **5 full questions selecting at least 2 from each unit**

UNIT-I

Gas Power Cycles: Introduction: Carnot Cycle, Stirling Cycle, Ericsson Cycle, Air Standard Cycles: Otto Cycle, Diesel Cycle, Dual Cycle, Comparison of Otto, Diesel and Dual Cycles, Brayton Cycle, Effects of Irreversibility in Turbine and Compressor.

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, Thermodynamics of coupled cycles, Process heat and by product power – Back pressure turbine and Pass out turbine.

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 for adiabatic and frictionless expansion of steam, Nozzle efficiency, Super saturation in steam turbine nozzles, Equations for supersaturated steam.

(24L)

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, Actual P-V diagrams for single-stage and two stage compressors, Power and efficiencies of a compressor**.**

Rotary Air Compressors: Roots blower, Vane type blower and Screw type.

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, Volumetric efficiency, 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.

(24L)

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. **K Gupta and Rajendra Prasad**: Thermodynamics for Engineers
4. **C P Arora:** Thermodynamics, Tata McGraw Hill
5. **C P Arora:** Refrigeration and Air conditioning, Tata McGraw Hill

FLUID MECHANICS

Subject Code	**: ME1403**
Number of Lecture Hrs per week	**: 04 Hrs.**
Questions to be set	**: 4 from each unit**
Questions to be answered	**: 5 full questions selecting at least 2 from each unit**

UNIT I

Basic Concepts: Properties of fluid; Newton's law of viscosity; variation of viscosity with temperature; classification of fluids; surface tension and capillarity.
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: simple and differential manometers.
Hydrostatic Forces: Total pressure and center of pressure;Forces on plane and curved surfaces; Buoyant force; Center of buoyancy; Metacentre anddetermination of metacentric height; stability and equilibrium of floating and submerged bodies.
Fluid Kinematics: Types of fluid flow; Continuity equation in three dimension; Local and convective acceleration; Rotational and irrotationl flow;Types of flow lines:Stream line, path line and streak line; velocity potential and stream function; Free and forced vortex flow;circulation and vorticity.
Fluid Dynamics: Euler's equation of motion; Bernoulli's equation for real and ideal fluids; Momentum equation ; Kinetic energy correction factor; Momentum correction factor;Practical applications of Bernoulli's equation – venturimeter, orifice meter andpitot-tube.

(24 L)

UNIT II

Orifices and Mouthpieces: Classification of orifices; Flow through an orifice; Hydraulic coefficients; Classification of mouthpieces; Flow through a mouthpiece.
Notches and Weirs: Classification of notches and weirs; Discharge over rectangular, triangular and trapezoidal notches and weirs; Velocity of approach;Discharge over a broad-crested weir.
Laminar flow: Reynolds Experiment; Laminar flow through circular pipe: shear stress and velocity distribution; Hagen Poiseuille formula; Laminar flow between two parallel plates:shear stress and velocity distribution.
Flow through pipes: Losses in pipe flow; Major energy loss and minor energyloss; Loss of head due to sudden enlargement and contraction; Hydraulic gradient and total energy line; Water hammer in pipes; Flow through siphon; Pipes in parallel and series; Branched pipes; Equivalent pipe.

(24 L)

Text books:

1. **Som and Biswas**, Introduction to Fluid mechanics and Machinery, *Tata McGraw Hill.*
2. **K L Kumar**, Fluid Mechanics, *Eurasia Publishing House, New Delhi*
3. **Streeter, Bedford and Wylie**, Fluid mechanics, *McGraw Hill*

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*

THEORY OF MACHINES I

Subject Code : **ME1409**

Number of Lecture Hrs per week : **04**
Questions to be set : **4 from each unit**
Questions to be answered : **5 full questions selecting at least 2 from each unit**

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, single slider crank chain, double slider crank chain and their inversions; mobility of a mechanism – Grashof's law for movability of a Four bar mechanism.
Other mechanisms: Drag link mechanism, Quick return motion mechanisms, Pantograph, Hooke's joint, Ackermann and Davis steering gear mechanisms, Intermittent motion mechanisms, Geneva mechanisms, Toggle 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.

(24L)

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, initial tension, idler and jockey pulleys.
Friction: pivot and collar friction, thrust bearings, single and multi-plate clutches, cone clutches, centrifugal clutches, friction materials.

(24L)

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. **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. **Rattan:** Theory of Machines, Tata McGraw Hill
4. **J.E.Shigley:**Theory of Machines and Mechanisms-Tata McGraw Hill

MATERIAL SCIENCE

Subject Code	**: ME1405**
Number of Lecture Hrs per week	**: 04 Hrs.**
Questions to be set	**: 4 from each unit**
Questions to be answered	**: 5 full questions selecting at least 2 from each unit**

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 and X-ray diffraction – crystal structure identification.

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.

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

(24L)

UNIT II

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, standard designations for steels and cast irons.

Non-ferrous Alloys: Principles of precipitation or age hardening, composition, microstructure, properties and applications of brasses, bronzes, Al-Si, Al-Cu and Al-Zn alloys.

Non-metallic materials: Properties and uses of polymers, ceramics and important composite materials.

(24L)

Text books:

1. **Avner:** 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**
Number of Lecture Hrs per week	**: 04 Hrs.**
Questions to be set	**: 4 from each unit**
Questions to be answered	**: 5 full questions selecting at least 2 from each unit**

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.

Capstan and Turret Lathes: Constructional features, comparison with engine lathes, turret indexing mechanism, tool layout, tool holder and work holding devices.

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

(24L)

UNIT II

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

Planning Machines: Classification, constructional features, tool and work holding devices. driving mechanism, operations.

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.

Broaching Machine: Construction, operations, application, Broaching tool.

(24L)

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

Reference books:

1. **Campbell:** Principles of Manufacturing Materials and Processes, TMH
2. **Lindberg**: Processes and Materials of Manufacture-PHI

WORKSHOP PRACTICE II

Subject Code : ME1461
Number of practical Hrs per week : 03 Hrs.

Shaping: Demonstration of shaping operations, use of single point cutting tool, difference between shaping and planning operation, working over mild steel plate.
Welding: Explanation of resistance welding and its classification, to conduct spot welding over lap joint and butt joint**.** Explanation of gas 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.
Casting: Casting definition, demonstration of a gating system, different casting defects.

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 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.
2. To carry out shaping operation to make a block of rectangular cross-section with grooves on opposite sides of the given mild steel specimen.
3. To carry out spot welding of two metal sheets/plates of a given specimen.
4. To carry out facing operation on the given mild steel rod specimen on a lathe machine to a length of 130 mm.
5. 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.
6. 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.
7. To perform drilling and fitting operations on a rectangular mild steel test specimen.
8. To perform tapping operation on drilled mild steel test specimen.
9. To carry out oxy-acetylene gas welding and brazing on two metal plates/sheets specimen.
10. To prepare a V-block mould by floor molding and sand mould casting processes.
11. Core making for hollow casting.
12. To study casting defects and their recommended remedies.

Reference books:

1. Elements of Workshop Technology by **S. K. Hajra Choudhury & Others.**
2. A Course in Workshop Technology by **B.S. Raghuvanshi**

COMPUTER GRAPHICS LAB

Subject code : ME1462
Number of Practical Hrs per week : 03 Hrs.

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 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 have a overview on setting working directory and saving the work in CADIAN.
2. To learn about the basic drawing tools.
3. To generate orthographic projection of isometric object 1 using basic drawing tools.
4. To generate orthographic projection of isometric object 2 using basic drawing tools.
5. To generate orthographic projection of isometric object 3 using basic drawing tools.
6. To generate orthographic projection of isometric object 4 using basic drawing tools.
7. To generate isometric projection of orthographic object 1 using basic drawing tools.
8. To generate isometric projection orthographic object 2 using basic drawing tools.
9. To generate isometric projection orthographic object 3 using basic drawing tools.
10. To generate isometric projection orthographic object 4 using basic drawing tools.
11. To generate solids 1 using 3D drawing tools.
12. To generate solids 2 using 3D drawing tools.
13. To generate solids 3 using 3D drawing tools.

THERMAL ENGINEERING LAB I

Subject code : ME1463
Number of Practical Hrs per week : 03 Hrs

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 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 of Two-stroke and Four-stroke Engines.
2. To study of C.I and S.I engine.
3. To study of various kinds of boilers and Gas turbine.
4. Performance testing of a single cylinder four stroke diesel engine.
5. Performance testing of a multi cylinder four stroke petrol engine.
6. Performance testing of a multi fuel variable compression 4-stroke engine with petrol.
7. Performance testing of a multi fuel variable compression 4-stroke engine with diesel.
8. Performance testing of two stage reciprocating air compressor.
9. Performance testing of an air conditioner trainer.
10. Performance testing of a refrigeration trainer.
11. To Study of axial fan.
12. To Study of flow through centrifugal blower having forward, backward and radial curved impeller.

INDUSTRIAL ENGINEERING AND MANAGEMENT

Subject code : **ME1501**
Number of Lecture Hrs per week : 04 Hrs.
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

UNIT I

Management: Definition of management, the various approaches to management, Classification of managers {four types} Functions of managers, managerial skills and levels. 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 in the basic control process, Management Control Techniques.

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)

(24hrs)

UNIT II

Plant layout: Factors affecting plant location, Rural vs. Urban plant sites, objectives & principles of a good plant layout. Process, product, combination & fixed layout.
Work Study: Productivity and work study, Introduction and definition of Work-study, Prerequisites of conducting a work study.
Method Study : Introduction, definition, procedure, Recording techniques, Flow Process Charts, Critical examination by questioning technique, 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).
(24 hrs)

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
4. Mr Potty-Industrial Management

REFERENCE BOOKS:
1. Apple- Plant Layout
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.

HEAT TRANSFER

Subject code : ME1502
Number of Lecture Hrs per week : 04 Hrs.
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

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.

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, flow across a cylinder and banks of tubes, 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 inside ducts – laminar and turbulent flow, bulk mean temperature, dimensionless temperature, 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

(24L)

UNIT II

Free convection

Principles of natural 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, laminar film condensation on a vertical plate, condensation on horizontal tubes, effect of superheated vapour and non-condensable gases, boiling heat transfer, regimes of boiling, nucleate and film boiling, correlations of boiling heat transfer

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 between two diffuse gray surfaces – (i) two infinite parallel plates, (ii) two infinitely long concentric cylinders; radiosity and irradiation, radiation network for grey surfaces exchanging energy, radiation shields, radiation from cavities

(24L)

Text books:

1. **J.P. Holman.:** Heat Transfer, McGraw – Hills
2. **M.N. Ozisik:** Heat Transfer- A Basic Approach, Mc- Graw Hills
3. **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**
Number of Lecture Hrs per week	**: 04 Hrs.**
Questions to be set	**: 4 from each unit**
Questions to be answered	**: 5 full questions selecting at least 2 from each unit**

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

(24L)

UNIT II

Hydraulic Turbines: Introduction, Impulse and Reaction turbines, Tangential flow (Pelton type), 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.
Fluid Systems: Introduction, Hydraulic press, Accumulator, Intensifier, Ram, Lift, Crane, Coupling, Torque converter. (24L)

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
3. **Modi & Seth:** Hydraulics and Fluid Mechanics; Standard Book House

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

MACHINE DESIGN I

Subject Code : ME1509
Number of Lecture Hrs per week : 04 Hrs.
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

Use of Design Data Handbook (SI units) is permitted during the University examination (to be supplied by the University)

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, impact loads.

Shafting: Torsion of circular shafts, solid and hollow .ASME and ISI codes equations for design of transmission shafts. Mises Hencky theory for transmission shafting, stress concentration. Design of shafts subjected to bending in two planes, in addition to axial loads.

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

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

(24L)

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: Types of welds, 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, dynamic and impact loading on bolts, 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, pivoted block brake with long shoe, internal expanding brake, band brakes, and thermal considerations.

(24L)

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

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.

METROLOGY

Subject code : ME1505
Number of Lecture Hrs per week : 04 Hrs.
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

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, Pneumatic-Flow type and Back pressure type, Solex pneumatic gauge.
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.

(24L)

UNIT II

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
Strain measurement: factors affecting strain measurements, types of strain gauges, types of electrical resistance strain gauge: unbounded strain gauges, wire gauges, foil gauges, gauge material, gauge factor, Potentiometric circuits, and Wheatstone bridge circuits: quarter bridge, Half bridge: temperature compensation, Measurement of angular velocity: Photoelectric tachometer, Stroboscope and stroboscopic methods,
Measurement of Pressure: Bourdon gauge, Diaphragm selectrical resistance type secondary transducers, piezoelectric pressure transducer, McLeod gauge, thermal conductivity gauges

(24L)

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.BSharp:** PracticalEngineeringMetrology,Pitman,London
3. **M. R. Taher:** Metrology of Measuring Instruments, E.L.B.S.

MECHANICS OF SOLIDS-I

Subject code : ME1511
Number of Lecture Hrs per week : 04 Hrs.
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting atleast 2 from each unit

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.

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.
Unsymmetrical Bending: Properties of beam cross-section, slope of neutral axis, stress and deflection in unsymmetrical bending, determination of shear center and flexural axis (for symmetry about both axis and about one axis) for I-section and channel section.
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.

TEXTBOOKS:

1.**Beer,Johnston,andDewolf**–Mechanics of materials- TataMcgrawhill
2.**Timoshenko & Young -** Elements of Strength of Materials - East west press.
3.**Ramamrutham&SNarayan–**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:

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

WORKSHOP PRACTICE III

Subject code : ME1561
Number of Practical Hrs per week : 03 Hrs.

Welding : Arc welding
Lathe: use of various work-holding devices, operations such as taper turning by different methods, boring, drilling and thread-cutting – single start and multi-start.
Milling: different types of cutters, different milling operations – machining of gears
Shaping and slotting machines: various operations including shaping of flat surfaces and cutting of slots and keyways.
Projects involving above operations with proper control of speed, feed and depth of cut.
Use of instruments like sine bar, vernier depth and height gauges, Bevel protractors etc. in the preparation of these works should be emphasized.

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 workshop in a semester.

List of Experiments:-

1. To perform the facing operation and obtain the length of cylindrical work piece.
2. To perform the straight turning operation and obtain the diameter of cylindrical job as per the drawing on lathe machine
3. To obtain the step turning operation and maintain diameter of cylindrical job as per the drawing on lathe machine.
4. To perform taper turning operation and maintain the dimension of given job as per the drawing on lathe machine.
5. To perform drilling operation and maintain the dimension of given job as per the drawing on lathe machine.
6. To perform knurling operation on lathe machine.
7. To perform grooving operation on lathe machine.
8. To perform plain shaping operation on a metal piece on shaping machine and maintain the given dimension.
9. To perform slot cutting operation on a metal piece on shaping machine and maintain the given dimension.
10. To make a butt joint by arc welding.

FLUID MECHANICS LAB

Subject code : ME1562
Number of practical Hrs per week : 03 Hrs.

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 in 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 the velocity of flow of fluid using pitot tube apparatus.
9. Determination of the force exerted by the jet of water on vanes.
10. Determination of kinematic viscosity by red wood viscometer.
11. Determination of overall efficiency of the 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. Fluid Mechanics and Hydraulic Machines by **R.K.Bansal**
2. Fluid Mechanics and Fluid Power Engineering by **D.S Kumar**
3. Fluid Mechanics and Machinery by **S.K.Agarwal**
4. Introduction to Fluid Mechanics by **S.K.Som, G.Biswas**

METROLOGY LAB

Subject code : ME1563
Number of practical Hrs per week : 03 Hrs.

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, and 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 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. Measurement and Calibration of Vernier Caliper using Slip gauge.
2. Measurement and Calibration of Vernier Height gauge.
3. Measurement and Calibration of Vernier Depth gauge.
4. Measurement by using micrometer.
5. Angular measurement by using Bevel Protractor.
6. Angular measurement by using Sine Bar.
7. Measurement of thread parameter using profile projector.
8. Measurement of Flatness of Surface plate.
9. Measurement of Gear Elements.
10. Measurement by using slip gauge.
11. Measurement of bore diameter by two spheres method.
12. Inspection using ring limit gauges.
13. Checking the squareness of try square using slip gauge.

Reference books:

1. Engineering Metrology by **K.J. Hume**
2. Practical Engineering Metrology by **K. W. B Sharp**
3. Metrology of Measuring Instruments by **M. R. Taher**

THEORY OF MACHINES II

Subject code	**: ME1609**
Number of Lecture Hrs per week	**: 04 Hrs.**
Questions to be set	**: 4 from each unit**
Questions to be answered	**: 5 full questions selecting at least 2 from each unit**

UNIT I

Synthesis of Mechanisms: 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- 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.

(24L)

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 wheel and four wheel 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.

(24L)

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. **Rattan**: Theory of Machines, Tata McGraw Hill

Reference books:

2. **T. Bevan**: Theory of Machines, CBS Publishers
3. **J.E.Shigley:**Theory of Machines and Mechanisms-Tata McGraw Hill
4. **Mr Potty:** Industrial Management

Reference books:

1. **Apple:** Plant Layout
2. **Stephen Robbins:** Organizational Behavior

THERMAL ENGINEERING - II

Subject Code	**: ME1607**
Number of Lecture Hrs per week	**: 04 Hrs.**
Questions to be set	**: 4 from each unit**
Questions to be answered	**: 5 full questions selecting at least 2 from each unit**

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, Throttle governing, Pressure distribution at varying loads with throttle governing, Throttle governing in reaction turbines, Nozzle control governing, Nozzle box pressures with nozzle control governing, By-pass governing – Theory of by-pass governing.

(24L)

UNIT II

Gas Turbine & Jet Propulsion:

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 (24L)

Text books:

1. **Domkunwar, Kothandaraman et al.:** A course in Thermal Engineering; Dhanpat Rai & Sons
2. **Ballaney:** Thermal Engg. Khanna Publishers

Reference books:

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

MACHINE DESIGN II

Subject code : ME1603
Number of Lecture Hrs per week : 04 Hrs.
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

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. (24L)

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, helical torsion springs, leaf springs, ripping 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. (24L)

Text books:
1. **K.Mahadevan and K.Balaveera reddy:**Design Data Handbook (SI Units), KREC, Surathkal
2. **R.S. Khurmi & J.K. Gupta:** Machine Design, S Chand Publications
3. **V B Bhandari:** Design of machine elements, TMH

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)

AUTOMOBILE ENGINEERING

Subject code : ME1604
Number of Lecture Hrs per week : 04 Hrs.
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

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, engine mounting)
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.

(24L)

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. 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)
Lubrication: Function. Types of lubricants – tests and ratings. Engine lubricating system (Full pressure system and Splash system). Oil pumps, Oil pressure relief valve, Oil pressure gauge, Oil level gauge, Oil filters.
Emission control and Vehicle rules: Introduction, emission control systems (Crankcase emission control, Evaporative emission control, Exhaust emission control). Motor Vehicle Act. Registration of motor vehicle. Driving License. Control of traffic. Insurance Risk. Claims for compensation.

(24L)

Text books:

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

MECHATRONICS

Subject code : ME1605
Number of Lecture Hrs per week : 04 Hrs.
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

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, Tool Compensation, Canned Cycle, Subroutines, Macros, Examples of part programming with CNC Lathe and Milling Machine.

(24L)

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, DC motor, Stepping Motor, ACMotor.
Interpolator: DDA Integrator-principle of operation, exponential deceleration, DDA Hardware-Linear Interpolator. **Computer–Process Interfacing** : Manufacturing process data, System Interpretation of process data, Interface hardware devices-Transducer, Sensors, Analog to Digital Converters, Digital to Analog Converters, Digital Input/Output processing.

(24L)

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).

NON TRADITIONAL MACHINING PROCESSES

Subject code : ME1610
Number of Lecture Hrs per week : 04 Hrs.
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

UNIT I

Non-Conventional Machining process: Introduction, Needs for Unconventional machining processes, classification of unconventional machining process. Abrasive Jet Machining (AJM): process, operating principles, equipment, process parameters, machining characteristics, material removal rate, application, limitations. Ultrasonic Machining (USM): process, working principle: magnetostrictive transducers, process parameters and their effects, material removal rate, applications, limitations. Water Jet Machining (AWJM): 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.

(24 L)

UNIT II

Laser Beam Machining (LBM): process, lasing process, lasing materials, processing with lasers, applications 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 Process: Introduction, process principles of High Velocity Forming of Metals (HVF), Explosive fabrication, Electro-hydraulic forming, Magnetic pulse forming.

(24 L)

Text books:

1. **E.P. Degarmo, J. Temple Black and Ronald A. Kohser:** Materials and Processes in Manufacturing, Prentice Hall of India
2. **P.N. Rao:** Manufacturing Technology (Metal Cutting & Machine Tools), TMH
3. **R.K.Jain:** Production Technology, Khanna Publishers
4. **V.K. Jain:** Advanced machining process, Allied
5. **O.P. Khanna:** A Text Book of Production Technology

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.

THERMAL ENGINEERING LAB II

Subject code : ME1661
Number of practical Hrs per week : 03 Hrs.

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.

References books:

1. A course in Thermal Engineering by **S.Domkundwar & Dr.C.P.Kothadarmers**
2. Internal combustion engines by **P.L.Ballaney**

COMPUTATIONAL LAB II

Subject code : ME1662
Number of Practical Hrs per week : 03 Hrs.

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

AUTOMOBILE ENGINEERING LAB

Subject code : ME1663
Number of Practical Hrs per week : 03 Hrs.

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.

MECHANICAL VIBRATIONS

Subject Code	**: ME1701**
Number of Lecture Hrs per week	**: 04 Hrs.**
Questions to be set	**: 4 from each unit**
Questions to be answered	**: 5 full questions selecting at least 2 from each unit**

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

(24 L)

UNIT II

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, centrifugal pendulum 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

(24L)

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
Number of Lecture Hrs per week : 04 Hrs.
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

UNIT-I

Definition, phases, application of O.R., assumptions in L.P.P., Graphical solution, Simplex algorithm (No questions on formulations to be set), Dual Simplex method, Solution , Algorithm for Transportation problems, NWC, Least cost, VAM, MODI method. Solution algorithm for assignment problems (Hungarian method).
Networks: CPM and PERT analysis. General Explanation, Calculation of event times, activity times, total float, free float, independent float.

(24 hrs)

UNIT-II

Queuing models, Queuing systems and structures, Notation parameter, Single server and multi-server models, Poisson input, Exponential service, Constant rate service, Infinite population problem
Decision Theory , Decision making, Steps in decision theory approach, Decision making under certainty, Uncertainty and under condition of risk, Decision Tree, Game Theory, Theory of Games, Two person zero sum game, Methods for solving two person zero sum game. (24 hrs)

TEXT BOOKS
Hamdy A.Taha-Operations Research, PHI.
Prem Kr Gupta&D.S Hira- Operations Research
N. D. Vohra -Operation Research — TMH

REFERENCE BOOKS:
S.D.Sharma-Operations Research, Kedar Nath and Ram Nath &Co.
Lovin and Krit Patrick – Quantitative approach to Management, TMH.

COMPUTER AIDED DESIGN & MANUFACTURING (CAD/CAM)

Subject Code : ME1703
Number of Lecture Hrs per week : 04 Hrs.
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

UNIT I

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.

(24L)

UNIT II

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

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

(24L)

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.

INTERNAL COMBUSTION ENGINE

Subject Code : ME 1707
Number of Lecture Hrs per week : 04 Hrs.
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting atleast 2 from each unit

Unit I

GasPowerCycles: Introduction: Carnot Cycle, Stirling Cycle, Ericsson Cycle, Air Standard Cycles: Otto Cycle, Diesel Cycle, Dual Cycle, Comparison of Otto, Diesel and Dual Cycles,

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.

Unit II

Combustion in C.I.Engines:

Stages of combustion in C.I. Engines, Air fuel ration 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.

Classification of CI Engine combustion chambers and methods of swirl generation used in them - Induction swirl, Compression swirl, and combustion induced swirl

Engine Friction and Losses:

Direct Frictional Losses, Pumping Lossand Power Loss to drive auxiliaries.

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. (24L)

Text books:

1. Heinz Heisler, 'Advanced Engine Technology," SAE International Publications, USA, 1998.
2. **Sharma and Mathur:**I.C. Engines; Dhanpat Rai & Sons.

Reference books:

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

ME1731

POWER PLANT ENGINEERING

Subject Code	**: ME1731**
Number of Lecture Hrs per week	**: 04 Hrs.**
Questions to be set	**: 4 from each unit**
Questions to be answered	**: 5 full questions selecting at least 2 from each unit**

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.

(24L)

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.

NuclearPowerPlant: 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.

(24L)

Text books:

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

Reference books:

1. **AChakrabarty,M.L.Soni,P.V.Gupta,U.S.Bhatnagar**,: Power System Engineering, Dhanpat Rai & Sons.

REFRIGERATION & AIR-CONDITIONING

Subject Code : ME1732
Number of Lecture Hrs per week : 04 Hrs.
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

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.
Refrigerant: Characteristic of Refrigerants, Types & Designations of Refrigerants, Modern refrigerants.
Compressors: Reciprocating & Centrifugal compressors.
Evaporators: Flooded and Dry evaporators, extended surface evaporators.

(24L)

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.
Transmission and Distribution of air: Total, static and velocity pressure, friction losses in ducts, Dynamic losses in Ducts, Air flow through a simple duct system.
Fans: Axial and Centrifugal fans, Fan Characteristic.

(24L)

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

Reference books:
1. Jordon and Prister: Refrigeration and Air-Conditioning, PHEM Ltd, 1985.

ENERGY MANAGEMENT

Subject Code	**: ME1733**
Number of Lecture Hrs per week	**: 04 L Hrs.**
Questions to be set	**: 4 from each unit**
Questions to be answered	**: 5 full questions selecting at least 2 from each unit**

UNIT I

Introduction: Energy demand and supply scene of the country, Need of energy management, Total Energy Management Process.

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.

Material and energy balance: Facility as an energy system; Methods for preparing process flow; material and energy balance diagrams.

Electrical energy management: Supply side: Methods to minimize supply-demand gap, renovation and modernization of power plants, reactive power management, HVDC, and FACTS. Demand side: conservation in motors, pumps and fan systems; energy efficient motors.

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.

(24 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).

Monitoring and targeting: Defining monitoring & targeting; Elements of monitoring & targeting; Data and information analysis; Techniques: energy consumption, production, cumulative sum of differences (CUSUM); Energy Service Companies; Energy management information systems.

The project development cycle: Basic Steps: Project Definition and Scope, Technical Design, Financing, Contracting, Implementation and Monitoring.

(24 L)

Reference 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. **D Patrick and S W Fardo,** Energy Management and Conservation, Prentice Hall Inc.
5. **J.Krieder and A. Rabi (1994):** Heating and Cooling of Buildings: Design for Efficiency, McGraw-Hill.
6. **Archie, W Culp**. Principles of Energy Conservation, McGraw Hill, 1991.
7. **P. O'Callaghan:** Energy Management, McGraw - Hill Book Company, 1993.
8. **C.W. Gellings and J.H. Chamberlin (1993):** Demand-Side Management Planning,
9. Fairmont Press.
10. **Thuman A and Mehta D Paul,** Handbook of Energy Engineering, The Fairmount Press.
11. **Kennedy, Turner and Capehart,** Guide to Energy Management, The Fairmount Press
12. **Wayne C Turner,** Energy Management Handbook, The Fairmount Press
13. **Frank Kreith, Ronald E West,** CRC Handbook of Energy Efficiency, CRC Press

14. **Kao Chen,** Energy Management in Illumination System, CRC Press
15. **Gellingn, Chamberli,** Demand Side Management: Concepts and methods, Penwell
16. **John Elting Treat,** Energy Futures: Trading Opportunities, Penwell
17. **Charles M Cotlschalk,** Industrial Energy Conservation, John Wiley & Sons
18. **Amit Kumar Tyagi**, Handbook on Energy Audits and Management, TERI
19. **Majumder Milli**, Energy Efficient Buildings, TERI
20. **Paul O'Callaghan**, Energy Management, McGraw Hill
21. **Bureau of Energy Efficiency** Study material for Energy Managers and Auditors
22. Examination: Paper I to IV.

PRODUCTION AND OPERATION MANAGEMENT

Subject Code : **ME1739**
Number of Lecture Hrs per week : **04 Hrs.**
Questions to be set : **4 from each unit**
Questions to be answered : **5 full questions selecting at least 2 from each unit**

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

(24L)

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.

(24L)

Text books:

1. Operations Management for Competitive Advantage by **Richar B Chase, F Robert Jacobs, Nicholas J Aquilano, and Nitin K Agarwal.**
2. Quantitative Techniques in Management by **N. D. Vohra.**

Reference books:

1. Operations Management – Strategy and Analysis by **Lee J Krajewski and Larry P Ritzman.**
Operations Management by **Sang M Lee and Marc J Schniederjans**.

TOOL ENGINEERING AND DESIGN

Subject Code : ME1735
Number of Lecture Hrs per week : 04 Hrs.
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

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, interrelationship between clearance and rake angles of turning tools, geometry of twist drills , working system rake and clearance angles, geometry of plain milling cutter, geometry of plain milling tooth.

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

(24L)

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, Klopstock tool, Bykov tool, KBYK tool, Kolesov tool, modified Kolesov tool with retraced cutting edge, features of high –productivity drill shapes, double cone drills, thinned web drills, chip breaker drills, improved designs of milling cutters ,Schmidt's double radial rake cutter, chip breaking grooves in cutters.

(24L)

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	**: 04 L Hrs.**
Questions to be set	**: 4 from each unit**
Questions to be answered	**: 5 full questions selecting at least 2 from each unit**

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.

(24L)

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. Concurrent Engineering – Introduction, Key features.

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.

(24L)

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.

Robotics and Automation

Subject Code	**: ME1737**
Number of Lecture Hrs per week	**: 04**
Questions to be set	**: 4 from each unit**
Questions to be answered	**: 5 full questions selecting atleast 2 from each unit**

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-Types- in piping problem-Remote centered compliance devices-control of actuators in robotics mechanisms.

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. Robot vision systems-Imaging components-image representation-Hardware aspects-Picture coding- Object recognition & categorization-Visual inspection-Software Considerations-Application-Commercial robotic vision systems
(24L)

Unit II

Transformations & Kinematics: Homogenous coordinates-coordinates references frames-Homogenous transformation for the manipulator-The forward & inverse problem of manipulator kinematics-Motion generation-Manipulator dynamics-Jacobian in terms of D-H matrices-Controller architecture.

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.
(24L)

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 Book:

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

Computer integrated manufacturing

Subject Code : ME1738
Number of Lecture Hrs per week : 04 Hrs.
Questions to be set : 4 from each unit
Questions to be answered : 5 full questions selecting at least 2 from each unit

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 – Mathematical models of Production Performance– Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automatedsystem – 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 –Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) -Simple Problems. (24 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 – Quantitative analysis in Cellular Manufacturing – Rank OrderClustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems.

Flexible manufacturing system (fms) and automated guided vehicle system (agvs)
Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning andControl– Quantitative analysis in FMS – Simple Problems. 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 –Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems.

(24 L)

Text books:

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

Reference books:

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

MACHINE DYNAMICS LAB

Subject Code : ME1761
Number of practical Hrs per week : 03 Hrs.

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 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. Experiments on free torsional vibration- single rotor and Double Rotor.
2. To study the damped torsional oscillations and determine the damping coefficient.
3. To determine the radius of gyration of a given bar by using bi-filler suspension.
4. Experiments on 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. Experiments on Static and dynamic balancing of masses.
8. (a) Determination of Experimental periodic time and its comparison with theoretical periodic time its comparison with 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.
1. Determination of epicyclic gear-ratio and verification of torque equation in an epicyclic gear-Train apparatus.
2. Determination of Coriollis component of acceleration.
3. Determination of frequency and mode of Whirling of shaft
4. Study of pressure profile on journal bearing apparatus.

References books:

1. Mechanical Vibrations practice with basic theory by **V.Ramamurti**
2. Theory of Machines by **S.S.Rattan**

CAD/CAM LAB

Subject Code : ME1762
Number of Lab Hrs per week : 03 Hrs

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 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. Introduction to CAD/CAM
2. To have a overview on setting working directory and saving the work in Creo parametric.
3. To have a brief introduction about sketch.
4. To Generate orthographic projection with the help of Sketch tools.
5. To have a brief introduction about part drawing
6. To learn about the different drawing tools that can be made in Part Drawings.
7. To generate 3d drawing using extrude command.
8. To have a clear view about engineering tools in Part drawings of CREO PARAMETRIC.
9. To have a clear view about editing tools in Part drawings of CREO PARAMETRIC.
10. To Set working directory and start a new assembly
11. To assemble two different components in assembly.
12. Lab exercises .
13. Introduction to Ansys.
14. To determine the nodal deflection, and von mises stress for the beam.
15. Lab exercises.

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.

ME1771

MINI PROJECT

Subject Code : ME1771

Number of contact Hrs per week : 03

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.

ME 1781

INDUSTRIAL TRAINING AND SEMINAR

Subject Code : ME1781

After completion of VIth semester, students do their vocational training during summer vacation at different industries/establishments, and they prepare a detailed report of it. Whatever they have learnt during the vocational training is presented by them in front of a departmental team of faculties at the end of VIIth semester in seminar. The duration of industrial training is of 4 weeks minimum.

MAJOR PROJECT

Subject Code : ME1875

Duration : 16 weeks

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.