Appendix - II

B.TECH DEGREE COURSE IN MECHANICAL ENGINEERING

(2015 Admissions)

SCHEME OF EXAMINATIONS & SYLLABUS

III to VIII SEMESTERS

B.TECH DEGREE COURSE

Scheme of Examinations (2015 admissions)

SEMESTER I [Stream A]

Code No.	Subject	L Hrs/Wk	T Hrs/Wk	P/D Hrs/Wk	C	Marks		Total
						CA	ESE	
AS15-1101A	Calculus	3	1	0	3	40	60	100
AS15-1102A	Engineering Physics	3	1	0	3	40	60	100
GE15-1103A	Engineering Mechanics	4	1	0	4	40	60	100
GE15-1104A	Basic Civil Engineering	3	0	0	3	40	60	100
GE15-1105A	Basic Mechanical Engineering	3	0	0	3	40	60	100
HS15-1106A	Technical Communication and Professional Ethics	2	1	0	2	40	60	100
GE15-11L1A	Civil Engineering Workshop	0	0	3	1	25	25	50
GE15-11L2A	Mechanical Engineering Workshop	0	0	3	1	25	25	50
HS15-11L3A	Language Lab	0	0	1	1	25	25	50
HS15-11L4A	NSS/Nature Conservation	0	0	1	1	50	-	50
	TOTAL	**18**	**4**	**8**	**22**			

CA – Continuous Assessment**, ESE –** End Semester Examination

SEMESTER II [Stream A]

Code No.	Subject	L Hrs/Wk	T Hrs/Wk	P/D Hrs/Wk	C	Marks		Total
						CA	ESE	
GE15-1201A	Computer Programming	3	1	0	3	40	60	100
AS15-1202A	Engineering Chemistry	3	1	0	3	40	60	100
GE15-1203A	Engineering Graphics	2	1	3	5	40	60	100
GE15-1204A	Basic Electrical Engineering	3	0	0	3	40	60	100
GE15-1205A	Basic Electronics Engineering	3	0	0	3	40	60	100
AS15-1206A	Environmental Studies	3	1	0	3	40	60	100
GE15-12L1A	Electrical Engineering Workshop	0	0	3	1	25	25	50
GE15-12L2A	Computer Programming Laboratory	0	0	3	1	25	25	50

	TOTAL	**17**	**4**	**9**	**22**			

Stream A: *Civil Engg., Electrical and Electronics Engg., Mechanical Engg. and Safety and Fire Engineering*

B.TECH DEGREE COURSE IN MECHANICAL ENGINEERING

Scheme of Examinations (2015 admissions)

SEMESTER III

Code No.	Subject	L Hrs/Wk	T Hrs/Wk	P/D Hrs/Wk	C	Marks		Total
						CA	ESE	
AS15-1301*	Linear Algebra & Transform Techniques	3	1	0	3	40	60	100
ME15-1302	Electrical Technology	3	1	0	3	40	60	100
ME15-1303	Mechanics of Solids	3	1	0	3	40	60	100
ME15-1304	Fluid Mechanics	3	1	0	3	40	60	100
ME15-1305	Metallurgy & Materials Science	3	1	0	3	40	60	100
ME15-1306	Machine Drawing	3	1	0	3	40	60	100
ME15-13L1	Strength of Materials Lab	0	0	3	2	25	25	50
ME15-13L2	Fluid Mechanics Lab	0	0	3	2	25	25	50
	TOTAL	**18**	**6**	**6**	**22**			

* Common for CE/CS/EC/EE/IT/ME/SE

CA – Continuous Assessment, ESE – End Semester Examination

SEMESTER IV

Code No.	Subject	L Hrs/Wk	T	P/D	C	Marks	Total

			Hrs/Wk	Hrs/Wk		CA	ESE	
AS15-1401*	Complex Variables and Partial Differential Equations	3	1	0	3	40	60	100
ME15-1402	Metrology & Instrumentation	3	1	0	3	40	60	100
ME15-1403	Mechatronics	3	1	0	3	40	60	100
ME15-1404	Applied Thermodynamics	3	1	0	3	40	60	100
ME15-1405	Hydraulic Machinery	3	1	0	3	40	60	100
ME15-1406	Manufacturing Processes	3	1	0	3	40	60	100
ME15-14L1	Metrology Lab	0	0	3	2	25	25	50
ME15-14L2	Hydraulic Machinery Lab	0	0	3	2	25	25	50
	TOTAL	**18**	**6**	**6**	**22**			

* Common for CE/CS/EC/EE/IT/ME/SE

SEMESTER V

Code No.	Subject	L Hrs/Wk	T Hrs/Wk	P/D Hrs/Wk	C	Marks		Total
						CA	ESE	
AS15-1501*	Numerical and Statistical Methods	3	1	0	3	40	60	100
ME15-1502	Mechanics of Machinery	3	1	0	3	40	60	100
ME15-1503	Machine Tools & Machining Science	3	1	0	3	40	60	100
ME15-1504	Thermal Engineering	3	1	0	3	40	60	100
ME15-1505	Industrial Management	3	1	0	3	40	60	100
ME15-1506	Power Plant Engineering	3	1	0	3	40	60	100
ME15-15L1	Computational Methods Lab	0	0	3	2	25	25	50
ME15-15L2	Machine Shop	0	0	3	2	25	25	50
	TOTAL	**18**	**6**	**6**	**22**			

* Common for CE/CS/EC/EE/IT/ME/SE

SEMESTER VI

Code No.	Subject	L Hrs/Wk	T Hrs/Wk	P/D Hrs/Wk	C	Marks		Total
						CA	ESE	
ME15-1601	Dynamics of Machinery	3	1	0	3	40	60	100
ME15-1602	Machine Design – I	3	1	0	3	40	60	100
ME15-1603	Operations Management	3	1	0	3	40	60	100
ME15-1604	Heat & Mass Transfer	3	1	0	3	40	60	100
ME15-1605	CAD/CAM	3	1	0	3	40	60	100
ME15-1606	Elective – I	3	1	0	3	40	60	100
ME15-16L1	CAD/CAM Lab	0	0	3	2	25	25	50
ME15-16L2	Heat and Mass Transfer Lab	0	0	3	2	25	25	50
	TOTAL	**18**	**6**	**6**	**22**			

ME15-1606 ELECTIVE – I

E1: Hydraulic and Pneumatic drives
E2: Advanced Mechanics of Solids
E3: Energy Conservation and Environment Protection
E4: Advanced Engineering Materials
E5: Fundamentals of Combustion & Pollution

SEMESTER VII

Code No.	Subject	L Hrs/Wk	T Hrs/Wk	P/D Hrs/Wk	C	Marks		Total
						CA	ESE	
ME15-1701	Refrigeration & Air-conditioning	3	1	0	3	40	60	100
ME15-1702	Vibration & Noise Control	3	1	0	3	40	60	100
ME15-1703	Machine Design – II	3	1	0	3	40	60	100
ME15-1704	Automobile Engineering	3	1	0	3	40	60	100
ME15-1705	Elective II	3	1	0	3	40	60	100
ME15-17L1	Thermal Engineering Lab	0	0	3	2	25	25	50
ME15-17L2	Automation Lab	0	0	3	2	25	25	50
GE15-17L3	Entrepreneurship Development	0	0	2	1	50	-	50
ME15-17L4	Project Phase I & Industrial Internship‡	0	0	2	2	50	-	50
	TOTAL	**15**	**5**	**10**	**22**			

ME15-1705 ELECTIVE – II

E1: Aerospace Engineering
E2: Finite Element Method
E3: Quality Engineering
E4: Mechanical Behaviour of Materials
E5: Supply Chain Management

‡*Industrial internship of a minimum duration of 2 weeks during May - June vacation before the commencement of 7th Semester classes is desirable*

SEMESTER VIII

Code No.	Subject	L Hrs/Wk	T Hrs/Wk	P/D Hrs/Wk	C	Marks		Total
						CA	ESE	
ME15-1801	Compressible Fluid Flow	3	1	0	3	40	60	100
ME15-1802	Production Technology	3	1	0	3	40	60	100
ME15-1803	Operations Research	3	1	0	3	40	60	100
ME15-1804	Elective III	3	1	0	3	40	60	100
ME15-18L1	Seminar			3	2	50	-	50
ME15-18L2	Project Phase II			11	6	200	-	200
ME15-18L3	Comprehensive Viva Voce			0	2	-	50	50
	TOTAL	**12**	**4**	**14**	**22**			

ME15-1804 ELECTIVE – III

E1: Propulsion Engineering
E2: Materials Management
E3: Computational Fluid Dynamics
E4: Cryogenic Engineering
E5: Theory of Plates and Shells

LIST OF OPTIONAL SUBJECTS

Sl. No:	Subject	L	T	P	No: of Hours/Semester	CA Marks
1	Personality Enrichment	1	2		30	50
2	General Aptitude	1	2		30	50
3	Foreign Language	1	2		30	50
4	Advanced Computer Programming	1		2	30	50
5	Healthy Living	1		2	30	50
6	Theatre Arts	1		2	30	50
7	Imaging Devices	1		2	30	50
8	Disaster Management	1		2	30	50

One or more optional subjects may be offered in any semester outside regular teaching hours and the students may opt to study them if they wish. The course may be conducted by using experts from inside or outside the University on Self Supporting manner. The Fee may be fixed based on the expenses in a non-profit manner with the students of the department given a subsidised rate of fee and those from outside may also be allowed at a higher fee. The regular students may be issued the mark list with the optional subject included in current semester and the outsiders may be issued a certificate separately.

AS15-1301 LINEAR ALGEBRA AND TRANSFORM TECHNIQUES

(Common for all branches)

Course Objectives:

To acquire fundamental knowledge in linear algebra and transform techniques and apply in engineering disciplines

Course Outcomes:

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

1. Solve linear system of equations and to determine Eigen values and vectors of a matrix.
2. Understand the concept of vector space and sub space.
3. Determine Fourier series expansion of functions and transform.
4. Solve linear differential equation and integral equation using Laplace transform.

Module I

Linear Algebra 1: Rank of a matrix, solution of linear system of equations- existence, uniqueness, general form-Eigen values and Eigen vectors- properties of Eigen values - Diagonalization of a matrix - Cayley Hamilton theorem (without proof) Verification-Finding inverse and power of a matrix using it-Quadratic form-orthogonal reduction of quadratic form to Canonical form.

Module II

Linear Algebra 2: Vector space-subspace-Linear dependence and independence-Spanning of a subspace- Basis and Dimension. Inner product- Inner product spaces - Orthogonal and Orthonormal basis –Gram- Schmidt Orthogonalization process. Linear Transformation.

Module III

Fourier Analysis: Periodic function, Fourier series, Functions of arbitrary period, Even and odd functions, Half Range Expansion, Harmonic analysis, Complex Fourier Series, Fourier Integrals, Fourier Cosine and Sine Transform, Fourier Transform.

Module IV

Laplace Transforms: Gamma functions and Beta function-Definition and properties, Laplace transforms. Inverse Laplace Transform, Shifting theorem, Transform of Derivative and Integrals, Solution of differential equation and integral equation using Laplace transform, Convolution, Unit step function, Second Shifting theorem, Laplace transform of periodic function.

References:

1. Erwin Kreyzig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, (2010).
2. Grewal, B. S., Higher Engineering Mathematics, 43rd Edition, Khanna Publishers, (2013).

3. Hsiung,C. Y. and Mao G.Y., Linear Algebra, World Scientific Publishing Co. Inc., (1999).
4. Hoffman K. and Kunze, R., Linear Algebra, Prentice Hall, New Delhi, (1971).
5. Venkataraman M. K., Linear Algebra, The National Publishing Co., (1999).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1302: ELECTRICAL TECHNOLOGY

Course Objectives:
To understand the concept, working and performance of transformers, motors, generators and alternators.

Course Outcomes:
On completion of this course the student will be able:
1. To study the different types, constructional details, operational principles, and performance characteristics of DC motors and DC generators.
2. To understand the construction and working of transformers, transformer losses, current transformer, and potential transformers.
3. To understand the constructional details, operational principles, and performance characteristics of induction motors and alternators.
4. To learn about the generation, transmission, and distribution of electrical energy.

Module I
DC machines: Basic principle of operation of DC Generator, construction, emf equation, types of generators, armature reaction and commutation, characteristics, losses and efficiency .
DC Motor: working principle, Concepts of motoring and generating action, Torque equation, Types of motors, characteristics, starting, speed control, losses and efficiency ,brake test, Swinburne's test, applications.

Module II
Transformers: Working principles and elementary theory of an ideal transformer, Constructional features of single phase transformer, emf equation, turns ratio, vector diagram, equivalent circuit, impedence transformation, transformer losses, flux leakage, efficiency, open circuit and short circuit test, load test. Auto transformer – working principle and saving copper, basic idea of current transformer and potential transformer, distribution and power transformer, applications, standard rating, IS specifications.

Module III
AC Machines: Alternator- rotating field, speed and frequency, effect of distribution of winding, coil span, characteristics, emf equation, losses and efficiency, regulation (emf method only), applications, synchronous motor-principles of operation, over excited and under excited, starting, applications, synchronous capacitor.
Induction Motor: Induction motor, principles of operation, constructional features of squirrel cage and slip ring motors, torque-slip characteristics, starting, speed control, losses and efficiency.

Module IV
Generation, transmission & distribution of electrical energy: Different methods of power generation-thermal, hydro-electric, nuclear, diesel, gas turbine stations(general idea only), electrical equipment in power stations, concept of bus bar, load dispatching, methods of transmission, transmission lines, overhead lines and insulators, corona and skin effect of DC & AC distribution, substation (elementary idea only).

References

1. Hughes, K, Electrical Technology, English Language Book Society, (1996).
2. Cotton, H., Advanced Electrical Technology, CBS Publishers and Distributors, New Delhi, (1984).
3. Nagrath, I. J, Kothari D.P, Electrical Machines, Tata McGraw Hill Publishing Co. Limited, (1997).
4. Bimbra, F. S., Electrical Machines, 7th Edition, Khanna publishers, (2007).
5. Gupta B.R and Vandana Singhal, Fundamentals of Electric machines, D. K Publishers, (2000).
6. Vincent Del Toro, Electrical Machines & Power systems, Prentice Hall, (1998).
7. Chapman, S. J, Electric Machines & Power systems, McGraw Hill, (1999).

Type of Questions for End Semester Exam.

PART - A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.

Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1303: MECHANICS OF SOLIDS

Course Objectives:
To impart the concept of stress and strain, analyze shear force and bending moment and also determine the deflections in beams.

Course Outcomes:
On completion of this course the student will be able:
1. To understand the concept of stresses and strain and their transformations
2. To draw the shear force and bending moment diagrams
3. To find out the normal and shear stresses in Euler-Bernoulli beam
4. To find out the deflection of beams by direct integration, Macaulay's method, and Moment Area Method

Module I
Tension, Compression, and Shear: Normal stress and strain, stress-strain diagrams, elasticity and plasticity, linear elasticity and Hooke's law, shear stress and strain, allowable stresses.
Axially loaded members: Deflections of axially loaded members, statically indeterminate structures, temperature and pre-strain effects, strain energy.
Analysis of stress and strain: Plane stress, plane strain, principal stresses and maximum shear stresses, Mohr's circle for plane stress, spherical & cylindrical pressure vessels.

Module II
Torsion : Torsion of circular bars, pure shear, relation between modulus of elasticity and modulus of rigidity, power transmission, strain energy in torsion.
Shear force and Bending moment: Types of beams, shear force and bending moment, relation ship among load, shear force, and bending moment, shear force and bending moment diagrams.

Module III
Stresses in beams: Normal strains in beams, normal stresses in beams, cross sectional shapes of beams, shear stresses in beams, beams with axial loads, Combined axial, bending, and torsional loads.
Theories of failure: Various theories of failure and their applications to ductile and brittle materials.

Module IV
Deflections of beams: Differential equations of the deflection curve, deflections by integration, Macaulay's method, moment area method, deflections of non prismatic beams, deflections of statically indeterminate beams-propped cantilevers and fixed beams.
Columns: Buckling and stability, Euler's equations for columns with different support conditions.

References:
1. Gere and Timoshenko, Mechanics of Materials, 2nd Edition, CBS Publisher, (2004).
2. Popov, E.P, Introduction to mechanics of solids, Pearson Education, (1998).
3. Beer & Johnston, Mechanics of Solids, 3rd Edition, Mc Graw Hill, (2002).

4. Shames & Pittaresi, Introduction to Solid Mechanics, 3rd Edition, PHI, (2009).
5. Mott, Applied strength of materials, 5th Edition, PHI, (2009).
6. Carl, T.F., Ross, Strength of Materials & Structures, 4th Edition, Elsevier, (1999).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1304: FLUID MECHANICS

Course Objectives:

To impart the concept of continuity, momentum equations, analyse different flows and resolve boundary layers.

Course Outcomes:

On completion of this course the student will be able:

1. To understand the basics of fluid kinematics, manometry, forces on submerged bodies, fluid dynamics, and continuity equations
2. To understand the Bernoulli's equation, Laminar and Turbulent flows, one dimensional flow through pipe
3. To understand the basics of two dimensional flow, vorticity, vortex tube, velocity potential, stream function, Rankine half body, Rankine oval, Doublet, Magnus effect etc.
4. To understand the concepts of boundary layer, Prandtl's boundary layer equations, Blasius solution, Karman's momentum integral equations, skin friction drag.

Module I

Preliminaries, Concept of continuum, Properties of fluids – density – pressure – viscosity - surface tension - capillarity - vapour pressure, Fluid statics, Basic equations of fluid statics, Variation of pressure in a fluid, - Manometry - Forces on surfaces and bodies in fluids, Floatation - stability of bodies in fluid - metacentric height and its measurement, Fluids in rigid body motion, Fluid kinematics -Eulerian and Lagrangian description - local and material rates - deformation of a fluid element -strain rate-velocity relations, Graphical description of flow – streamlines - path lines - streak lines - stream tube, Fluid dynamics - concept of the control volume -Reynolds transport equation and its use to formulate fluid mechanics problems, Integral and differential forms of the continuity - momentum and energy equations, Illustrative examples.

Module II

One dimensional flow through pipes, Non viscous equation for the flow through a stream tube and along a stream line – Euler's equation – Bernoulli's equation, - Energy equation, Applications of the one dimensional equations - velocity and flow measuring devices and quasi steady problems, Laminar and turbulent flow through pipes - Hagen- Poiseuille equation - Darcy-Weisbach equation - pipe friction -Moody's chart - minor losses in pipes.

Module III

Two dimensional incompressible inviscid flows – Vorticity - Vortex tube - Irrotational flow - Velocity potential, Stream function - relation between stream function and potential function in ideal flows -Equation of a streamline - governing equations, Fundamental flow patterns, Combination of basic patterns - Rankine half body - Rankine oval - Doublet and flow over a cylinder, Magnus effect and the calculation of lift on bodies.

Module IV

Plane viscous flow past bodies, The boundary layer - Prandtl's boundary layer equations, Blasius solution for the boundary layer over a flat plate, Karman's

Momentum Integral equations - Solutions using simple profiles for the boundary layer on flat plate - calculation of skin friction drag.

References:

1. Shames, I.H., Mechanics of fluids, Mc Graw Hill Book Co., (1962).
2. Frank M. White, Fluid Mechanics, 7th Edition, Tata Mc Graw Hill, New Delhi, (2008).
3. Cengel Y. A., & Cimbala J. M., Fluid Mechanics-Fundamentals and Applications, Tata McGraw Hill, (2006).
4. Gupta V., & Gupta S. K., Fluid Mechanics and its applications, 1st Edition, New Age International, (1984).
5. Som S. K., and Biswas G., Fluid Mechanics and Fluid Machines, 2nd Edition., Tata McGraw Hill, (2004).
6. Cohen and Kundu, Fluid Mechanics, 6th Edition, Elsevier, (2015).
7. Babu, V., Fundamentals of Incompressible flow, 1st Edition, CRC Press, (2010).
8. Massey, Fluid Mechanics, English Language Book Society, (2006).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1305: METALLURGY AND MATERIAL SCIENCE

Course Objectives:

To improve the awareness of crystal structure, phase diagrams, heat treatment process and failure mechanisms.

Course Outcomes:

On completion of this course the student will be able:

1. To study the crystal structure, crystal systems, crystallographic planes, crystal imperfections, solidification, and diffusion
2. To understand the phase rule, phase diagrams, solid solutions, examples of binary solid solutions
3. To learn about different heat treatment processes for steel and applications of ferrous and nonferrous alloys
4. To understand different failure mechanisms

Module I

Crystallography : crystal structure, space lattice, crystal systems, miller indices of crystal planes and directions, atomic density of crystallographic planes and lines, atomic packing factor, coordination number, inter planar spacing.

Solidification of metals : homogenous and heterogeneous nucleation, crystal growth, grains and grain boundaries, equi-axed and columnar grains, dendritic pattern, polymorphism.

Crystal imperfections : point defect, line defect, edge dislocation, screw dislocation, interaction between dislocation, planar defects, stacking faults, grain boundary, twist and twin boundaries, volume defects.

Diffusion : mechanism of diffusion in crystals, types of diffusion, factors affecting diffusion, Fick's law of diffusion, metallurgical application of diffusion.

Module II

Phase: Equilibrium between phases, Gibb's phase rule, solid solution, interstitial, substitutional, ordered and disordered types, Hume – Rothery rules, equilibrium phase diagrams of binary alloys complete solid solubility, partial solid solubility, no solid solubility,: eutectic, peritectic and eutectoid reactions, Cu- Ni, Cd-Bi, Pb-Sn, Ag-Pt, and Fe-C systems as examples.

Heat treatment of steel: Definition and aims of heat treatment, T T T diagram, isothermal and continuous cooling, annealing, normalizing, hardening, tempering, austempering, martempering, hardenability of steels, jomini test, surface treatments – case hardening, carburising, cyaniding, nitriding, flame hardening, induction hardening, metal coating- hot dipping, electro plating, metal cladding, impregnation, metal spraying.

Module III

Deformation of metals : Elastic, anelastic and visco elastic behaviour, plastic deformation, mechanism of slip, slip planes and slip directions, mechanism of twinning, strengthening mechanisms, work hardening, grain boundary hardening, precipitation hardening, cold working, hot working, recovery, recrystalisation and grain growth.

Failure of metals : creep, mechanism of creep, creep curves, creep resistant materials, fracture, brittle fracture, Griffith's theory, ductile fracture, ductile-brittle transition, protection against fracture, fatigue.

Module IV

Applications of ferrous and non ferrous alloys steel - low, medium, high carbon steels, Stainless steels ferritic, austenitic, martensitic, duplex steels, tool steels cast iron, gray, white, ductile cast irons, copper and its alloys, aluminium and its alloys, magnesium and alloys, titanium and its alloys, refractories - super alloys, ceramics, composite and glasses, shape memory alloys, Nano materials, bio materials, Optical fibers.

References:

1. Van Vlack, L.W., Elements of material science and Engineering, 6th Edition, Prentice Hall, (1989).
2. Reed Hill, Physical metallurgy principles, 2nd Edition, Affiliated East-West Press, New Delhi, (2008).
3. Clark & Varney, Physical metallurgy for engineers, 2nd Edition, Van Nostrand Reinhold Company, (1962).
4. Raghavan, V., Material science and engineering, 5th Edition, Prentice Hall, (2007).
5. Avner, Mechanical metallurgy, 3rd Edition, Tata McGraw Hill, (2013).
6. Narula, Material Science, 1st Edition, Tata McGraw Hill, (2001).
7. Agarwal, B.K., Introduction to engineering materials, 1st Edition, McGraw Hill Education, (2007).
8. Manas Chanda, Science of Engg. Materials Vol I, II and III, Macmillan Co. of India, (1980).
9. Rajan, T. V. & Sharma C.P., Heat Treatment: Principles & Techniques, 2nd Edition, PHI, (2010).
10. Fischer, Materials Science for Engineering Students, 1st Edition, Elsevier, (2008).

Type of Questions for End Semester Exam.

PART - A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.

Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1306: MACHINE DRAWING

Course Objectives:
To impart the concept of orthographical views and generate assembly drawing of machine parts.

Course Outcomes:
On completion of this course the student will be able:
1. To convert a pictorial view in to orthographic view
2. To draw the different views of threaded nuts and bolts
3. To draw the orthographic views of cotter joints, pipe joints, couplings and bearings
4. To draw the assembly drawing of machine parts

Module I
Introduction to Machine Drawing: Conversion of pictorial views to orthographic views.
Screwed fastenings: Screw thread forms, V and Square threads, Conventional representation of threads, Hexagonal headed bolt and nut, Square headed bolt, Nut locking arrangements, Foundation bolts- ray bolt and Lewis foundation bolt.
Cotter and Pin joints: Socket and Spigot joints, Gib and Cotter joint for rectangular rods, Sleeve and Cotter joints, Knuckle joint.

Module II
Pipe joints : Coupler joints, Nipple joints, Union, Socket and Spigot joints, Integral flanged joints and Hydraulic joints.
Couplings: Parallel and Tapered sunk keys, Saddle keys, Feather keys and Pin keys, Muff coupling, Protected type flange coupling, Pin type flexible coupling.
Bearings : Solid journal bearings, Bushed bearings, Plummer block, Foot step bearing, Thrust bearings.

Module III
Assembly of machine parts: Machine Vice, Tail-Stock of Lathe Steam Engine parts: Stuffing box, Cross head.
I.C. engine: Piston and Connecting rod.
Valves: Steam stop valve, Spring loaded safety valve, Lever safety valve, Ramsbottom safety valve.

References:

1. Bhatt, N.D., Elementary engineering drawing, 30th Edition, Charotar publishing house, (1990).
2. Parkinson, First year engineering drawing, Pitman, London, (1958).
3. Gill, P.S., Machine drawing, 18th Edition, Kataria & Sons, (2013).
4. John, K.C., Text Book of Machine Drawing, 1st Edition, PHI, (2009).
5. Basudeb Bhattacharyya, Machine drawing, Oxford University Press, (2011).

Note: Duration of the End Semester exam is 4 hours

Type of Questions for End Semester Exam.

Question Nos. I, II with sub sections (a), (b) if required ---- (15 marks each with options to answer either I or II) from Module I.
Question Nos. III , IV with sub sections (a), (b) if required ---- (20 marks each with options to answer either III or IV) from Module II.
Question Nos. V , VI with sub sections (a), (b) if required ---- (25 marks each with options to answer either V or VI) from Module III.

ME15-13L1: STRENGTH OF MATERIALS LAB

Course Objectives:
To get fundamental knowledge of material properties and use this information for practical applications.

Course Outcomes:
On completion of this course the student will be able:
1. To design the required experiments.
2. To conduct different experiments on the specimens to find out the material properties using the theoretical knowledge
3. To tabulate the data and use necessary theoretical knowledge to find out the results
4. To interpret the results.

Experiments

1. Shear test on M.S.Rod.
2. Vicker's pyramid hardness test.
3. Brinnel Hardness test.
4. Tension test on M.S.Rod.
5. Impact test.
6. Spring test.
7. Bonding test on R.S.J. Beam.
8. Rockwell hardness test.
9. Compression test on concrete cubes and cylinders (300 T machine)
10. Preparation of cubes and cylinders.
11. Testing of cubes and cylinders.
12. Torsion test.

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

ME15-13L2: FLUID MECHANICS LAB

Course Objectives:
To indentify the behaviour of various fluid flows and use these information in practical applications.

Course Outcomes:

On completion of this course the student will be able:

1. To design the required experiments
2. To conduct different fluid flow experiments using the theoretical knowledge.
3. To tabulate the data and use necessary theoretical knowledge to find out the results.
4. To interpret the results.

Experiments

1. Study of pipe fittings and plumbing tools
2. Experiment on notches
3. Pipe friction apparatus
4. Determination of minor losses
5. Metacentric height
6. Venturimeter
7. Orificemeter
8. Flow through orifice
9. Heleshaw experiment
10. Reynolds experiment
11. Free & forced vortex apparatus
12. Verification of Bernoullis equation

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

AS15-1401 COMPLEX VARIABLES AND PARTIAL DIFFERENTIAL EQUATIONS
(Common to all branches)

Course Objectives:

To understand and use complex variables, function integrals, partial differential equation in engineering discipline.

Course Outcomes:

On completion of this course the student will be able to:
1. Transform a region to another region using conformal mapping
2. Evaluate real integrals using residue theorem
3. Form and solve partial differential equation
4. Determine solution of partial differential equation for vibrating string and heat conduction

Module I
Analytic function- Cauchy-Riemann equation (Cartesian and polar)-Harmonic function- construction of analytic function given real or imaginary parts- Conformal mapping of standard elementary function and bilinear transformation.

Module II
Cauchy's integral theorem, Cauchy's integral formula and for derivatives-Taylor's and Laurent's expansion (without proof) - Singularities-Residues-Cauchy's Residues theorem- Contour integration involving unit circle.

Module III
Formation of partial differential equation eliminating arbitrary constants and function—Solution of first order equation-four standard types- Lagrange's equation —Linear homogeneous partial differential equation with constant coefficient.

Module IV
One dimensional wave equation, Alembert's solution and one dimensional heat flow equation—solution by the method of separation of variables- application of Fourier series solution. Solution of Laplace's equation over a rectangular region by the method of separation of variables.

References:
1. Erwin Kreyzig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, (2010).
2. Grewal, B.S., Higher Engineering Mathematics, 43rd Edition, Khanna Publishers, (2013).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.

Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1402: METROLOGY & INSTRUMENTATION

Course Objectives:

To impart the concept of measurements and also the instruments commonly used for measurements.

Course Outcomes:

On completion of this course the student will be able:

1. To understand the concepts of measurements, limits, fits and tolerance.
2. To learn about measurement techniques of angles, tapers, and surface finish
3. To learn about applications of measuring instruments
4. To understand the measurement techniques for strain, force, torque, temperature, air pollution and nuclear radiation.

Module I

General measurements concepts: precision and accuracy, Methods for estimating accuracy and precision, measuring errors.

General principle of measurements: line and end measurements, standards; linear measurements, basic units, and quantities for displacement, mass, time, temperature & optics; Limits, Fits & Tolerance: systems of limits and fits, Hole basis and shaft basis system of representation ; tolerances for linear dimensions, calculation of tolerance grade, representaion.

Gauges*:* classification, types of gauges, gauge maker's tolerances, wear allowance, gauges materials.

Module II

Measurement of angles & tapers: sine bars, angle gauges: auto collimator, clinometer & spirit level; taper gauges, bevel protractors.

Measurement of surface finish: surface structure, integrity, texture, roughens, waviness, lay, RMS & CLA values, roughness values produced by machining processes

Optical measuring instruments: interferometry, optical flats, optimeters, and optical projectors, tool maker's microscope, limitations.

Module III

Applications of measuring instruments-functional elements of an instrument-instrument as transducer-generalized measuring instrument-generalized mathematical model of measuring systems-zero order, first order and second order instruments-classification of instruments- input output configurations-methods of correction for spurious inputs -static calibration and determination of bias systematic error and random error-static and dynamic characteristics, potentiometer transducer as a zero order instrument-analysis of its loading error-mercury in glass thermometer as a first order instrument-step, ramp, frequency response-seismic instrument as a second order instrument.

Module IV

Measurement of strain : strain gauge classification –un bonded and bonded strain gauges-gauge factor-strain rosettes-temperature compensation-calibration. Measurement of force : multiple lever system for weighing- load cells-temperature sensitivity calibration- ballistic weighing- hydraulic and pneumatic load cells. Measurement of Torque: water break-Heenan and Froude hydraulic dynamometer-beam and strain gauge transmission dynamometer. Measurement of Temperature : pressure thermometer-RTDs-compensation for lead resistance thermocouples- five laws of thermocouples and their applications-series and parallel connected

thermocouples-pyrometry-optical pyrometer-infrared pyrometry-total radiation pyrometers.

Air pollution measurements : gas chromatography-ORSAT's apparatus. Nuclear instrumentation: Gieger Muller Counter-ionization chamber-scintillation counter.

Acoustical measurements : basic acoustical parameters-sound pressure-sound pressure levelpower- intensity-power level-microphones-sound.

References:

1. Doebelin E. O., Measurement systems: Application & Design, 3rd Edition, McGraw Hill, (1983).
2. Hume, Engineering Metrology, 2nd Edition, Macdonald London, (1953).
3. Beckwith, Marangoni, & Lienhard, Mechanical Measurements, 6th Edition, Prentice Hall, (2006).
4. Mahajan, M., A textbook of metrology, Dhapat Rai and Co., (2011).
5. Hume, K. J., & Sharp, G. H., Practical Metrology, English Language Book Society, (1958).

Type of Questions for End Semester Exam.

PART - A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.

Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1403: MECHATRONICS

Course Objectives:

To impart the concept of sensors and transducers and also analyse a system for its stability.

Course Outcomes:

On completion of this course the student will be able:

1. To understand the basics of sensors and transducers and different mechatronics systems
2. To model and analyse first and second order systems for their time and frequency domain responses
3. To analyse a system for its stability
4. To design mechatronics system for simple application

Module I

Introduction to Mechatronics – scope -Mechatronics and Engineering Design. Sensors and transducers – classification-thermal, electrical, optical, acoustic, pneumatic, magnetic, and piezo electric sensors. Open loop and closed loop control systems -continuous and discrete processes -servo mechanism – principles -components -error detectors -potentiometers-types. Pneumatic and hydraulic systems -mechanical and electrical systems.

Module II

System modelling -mathematical models -mechanical, electrical, fluid and thermal system building blocks -system models -dynamic response of systems -first and second order systems -modelling dynamic systems - system transfer functions - frequency response.

Closed loop controllers -proportional, derivative and integral controls –PID controller - digital controllers - controller tuning - adaptive control of machine tools.

Module III

Stability analysis: concepts of stability, characteristic equations, stability, analysis, determination of stability by Routh-Hurwitz criterion, Root locus, frequency response using Bode plot, and stability from Bode plot, Nyquivist criteria.

Mechatronics system components: DC and AC servo motors, tacho generators, synchros and stepper motors.

Module IV

Stages in designing mechatronic systems - traditional and mechatronic design -possible design solutions, robot position and proximity sensing -tactile sensing. Man-machine interface. Micro controllers and microprocessors - digital logic circuits -micro controller architecture and programming -programmable logic controllers. Automatic control and real time systems - case studies of mechatronic systems -pick and place robot -automatic car park system -engine management system.

References:

1. Rolf Isermann, Mechatronic Systems: Fundamentals, Springer, (2005).
2. Bolton, W., Mechatronics, Pearson Education Limited, (2015).
3. Singh & Joshi, Mechatronics, PHI, (2006).
4. David G. Alciatore, Michael B. Histand, Introduction to Mechatronics and Measurement System, Tata McGraw Hill, (2003).
5. Onwubolu, Mechatronics: Principles and Applications, 1st Edition, Elsevier, (2006).
6. Dorf & Bishop, Modern Control Systems, 11th Edition, Pearson Education, (2008).

7. Ogata K, Modern Control Engineering, 4th Edition, Prentice Hall Inc., (2002).
8. Kuo, B.C., Automatic Control Systems, 8th Edition, Wiley, (2002).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1404: APPLIED THERMODYNAMICS

Course Objectives:

To impart the concept of laws of thermodynamics, performance of nozzles and steam generators, and also calculate the mole and mass fraction of various mixtures.

Course Outcomes:

On completion of this course the student will be able:

1. To learn first and second law of thermodynamics and the application of these laws for various thermodynamic processes..
2. To analyse the performance of steam generators with additional accessories used for enhancing the performance.
3. To understand the various types of nozzles and its performance at various back pressure conditions and also for different flow conditions.
4. To calculate the mole and mass fractions of various mixtures and also various specific properties of the mixtures.

Module I

First and second law of thermodynamics, Carnot theorem, Thermodynamic temperature scale, Internal Energy and entropy, Claussius inequality, entropy charge in various thermodynamic processes of ideal gases, Application of first and second law of thermodynamics for steady flow processes, reversibility, irreversibility & Availability, Tds equations, (Helmoholtz, Gibbs function & Maxwell relations) Claussius clapeyron equations.

Module II

Pure substance – PV, PT and TS systems – PVT surface – Properties of steam – steam table and Mollier diagram – Analysis of vapour process – thermodynamic analysis of steam power cycles – Rankine, reheat, and regenerative – binary vapour cycles – modern steam generators – performance calculations of boilers.

Module III

Steam nozzles – mass flow rate – throat pressure for maximum discharge – throat area – effect of friction – super saturated flow – effect of back pressure.

Steam turbines – types and classification– velocity diagram – force on blades, W.D. by blades, blade or diagram efficiency- effect of friction on blades.

Module IV

Ideal, perfect and real gases, Properties of Mixtures of Gases and Gas and vapours: Dalton’s law of Partial Pressure, Amagat’s law of Partial volume, Volumetric and Gravimetric analysis of Gas mixtures, Gibb’s Dalton Law, Mean value of Gas constant, Equivalent Molecular weight, Density, Specific volume, specific heat and Molar heat capacity of gas mixture, Advanced Problem on Adiabatic mixing.

References:

1. Spalding D.B. & Cole, E.H., Engineering Thermodynamics, Edward Arnold, London, (1967).
2. Holman, J. P., Thermodynamics, 4th Edition, McGraw Hill Inc., (1987).
3. Nag, P. K., Engineering Thermodynamics, 4th Edition, Tata McGraw Hill, (2008).
4. Bacon, Engineering Thermodynamics, Newnes- Butterworth, (1972).
5. Van Wylen, G. J., Borgnakke, C., & Sonntag R. E., Fundamentals of Thermodynamics, 6th Edition, John Wiley & Sons, (2003).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1405: HYDRAULIC MACHINERY

Course Objectives:

To impart the concept of dimensional analysis, performance of pumps and turbines, and also working of hydraulic devices.

Course Outcomes:

On completion of this course the student will be able:

1. To understand dimensional analysis and principles of similitude
2. To learn the working of various hydraulic turbines and their performance characteristics
3. To understand the working of roto-dynamic pumps and positive displacement pumps
4. To study the principle of working of hydraulic devices

Module I

Dimensional Analysis & Similitude : Rayleigh's method, Buckingham's Pi theorem, nondimensional parameters in fluid mechanics and machinery – principles of similitude – geometric, kinematic and dynamic similarities – model studies. Physical meaning of important dimensional groups of fluid mechanics and their practical use.

Dynamic action of fluid : Momentum equation applied to a control volume, impact of jets, flow of an incompressible fluid over fixed and moving vanes, work done and efficiency.

Module II

Hydraulic turbines: Impulse and Reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine, their constructional features, Velocity triangles, Performance characteristics – non dimensional parameters for comparative study of turbine study of turbine performance, Specific speed, Unit speed, Unit power, theory of draft tubes, speed regulation of turbines, Cavitation, Selection of type and speed of turbines.

Module III

Pumping machinery: general features of positive displacement and rotodynamic pumps, centrifugal pumps, classification, principle of working, velocity diagrams, work done, efficiency, minimum speed, specific speed, losses in pumps, circulatory flow, multistage pumps, propeller pumps, priming, Cavitation and its significance.

Reciprocating pumps: Working, single acting and double acting pumps, Slip, Acceleration head, effect of friction, use of air vessels, Indicator diagrams, efficiencies, pump characteristics.

Module IV

Hydraulic Press, Hydraulic Ram, Hydraulic Intensifier, Hydraulic lift, Hydraulic Accumulator, Hydraulic Crane, Hydraulic Coupling, Hydraulic Torque Converter, Surge tank, Vane pump, gear pump, Working principles of axial and radial pumps, Application to hydraulic devices, Fluid transients, Free and Forced vortex apparatus.

References:

1. Shepherd, D.G., Principles of turbo machinery, MacMillan & Co. Ltd., (1957).
2. Agarwal, Fluid mechanics & Machinery, Tata McGraw Hill, (2001).
3. Douglas, Gasiorek, and Swaffield, Fluid mechanics, Pitman Publishing, (1979).

4. Daugherty & Franzini, Fluid mechanics with Engg. Applications, McGraw Hill, (1989).
5. Vallentine, Applied hydrodynamics, Newnes- Butterworths, London, (1969).
6. Herbert Addison, A treatise on applied hydraulics, 5th Edition, Chapman & Hall, (1972).
7. Stepanof, A. J., Centrifugal and axial flow pumps, Wiley, New York, (1957).
8. Som & Biswas, Introduction to fluid mechanics & fluid machines, 3rd Edition, McGraw Hill, (2011).
9. Shaughnessy, Introduction to Fluid Mechanics, 1st Edition, Oxford University Press, (2005).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1406: MANUFACTURING PROCESSES

Course Objectives:
To acquire information on casting processes and defects, metal forming and fabrication processes.

Course Outcomes:
On completion of this course the student will be able:
1. To learn about the sand casting process.
2. To understand the special casting process and casting defects.
3. To learn about different Metal forming processes.
4. To understand the different Metal fabrication processes and their characteristics.

Module I
Metal casting process: Introduction-advantages and limitations-applications-casting terms. Patterns: Pattern allowance-pattern materials-types of patterns- colour codes.
Moulding materials: Moulding sand composition-testing sand properties-sand preparation-moulding sand properties-types of sand moulds-moulding machines.
Cores: Core sand, types of cores, core prints, chaplets, forces acting on the moulding flasks.
Gating system: Elements of gating system, gates, pouring time, sprue, gating ratio, slag trap system, risering design-caine's method, modulus method, chills-feeding aids.

Module II
Product design for sand casting: designing for economical moulding –designing for eliminating defects-features to aid handling, Casting cleaning and casting defects – fettling - defects in casting.
Special casting process: Shell moulding –precision investment casting –permanent mould casting –die casting – centrifugal casting-continuous casting, Casting metallurgy.

Module III
Metal forming process: nature of plastic deformation-hot working and cold working.
Rolling: principle, rolling stand arrangement, rolling load, roll passes.
Forging: operations, smith forging, drop forging, press forging, machine forging, forging defects, forging design Extrusion-hot and cold extrusion, tube extrusion, wire drawing, swaging.
Sheet metal operation- shearing operation, drawing, spinning, bending, stretch forming, embossing and coining.

Module IV
Metal fabrication process: introduction to fabrication process, gas welding and cutting. Electric arc welding-principle of arc, arc welding equipment, electrodes, carbon arc welding, TIG GMAW, SAW, arc cutting.
Resistance welding: principle –spot, seam, projection, upset, flash welding.
Other welding process: Thermit welding, electro slag welding, EBW, laser beam welding, forge welding, friction welding, diffusion welding, explosion welding.
Welding design: heat input, heat flow, distortion, metallurgy of welding, defects in welding, brazing, braze welding and soldering.

References:

1. Campbell J. S., Principles of Manufacturing materials and Processes, McGraw Hill, (1961).
2. Cox, L. L., Beginner's Guide to Pattern Making, Newnes, London, (1967).
3. Heine R. W., Loper C. R. and Rosenthal, P. C., Principles of Metal Castings , McGraw Hill, (1967).
4. Chvorinov N., Theory of solidification of castings, Die Geisserei, (1940).
5. Tselikov, AI and VV Smirnov, Rolling Mills, Pergamon Press, Oxford, (1965).
6. Rowe G. W., Elements of metal working theory , Edward Arnold, London, (1979).
7. Pearson C. E., and R. N. Parkins , The extrusion of metals, Chapman & Hall Ltd. London, (1960).
8. Hinman C. W., Prss Working of Metals, McGraw Hill, New York, (1950).
9. Little R. L., Welding and welding technology, Tata McGraw Hill , (1996).
10. Patte H. E., Technological Advances in welding and other joining processes, Battelle Press, (1982).
11. Kaushik, Manufacturing Processes, PHI, (2010).
12. Rao, P.N., Manufacturing Technology, 3rd Edition, Tata McGraw Hill, (2008).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-14L1: METROLOGY LAB

Course Objectives:
To impart experience in using different instruments for accurate measurements.

Course Outcomes:
On completion of this course the student will be able:
1. To design the required experiments
2. To conduct different measurement techniques with the available theoretical knowledge
3. To tabulate the data and use necessary theoretical knowledge to find out the results
4. To interpret the results

Experiments

1. Use of vernier caliper, micrometer, depth gauge and height gauge – source of error in measurement ideas on range, precision and accuracy
2. Slip gauges and their use in linear measurements.
3. Ideas on tolerance allowance, limits, fits.
4. Dial gauges – their use in the measurement of small linear displacements, parallelism and concentricity.
5. Measurements using tool maker's microscope – tool angles and tool wear.
6. Measurement of surface roughness – surface roughness parameters – surface finish evaluation using perth-O-meter/ Talysurf
7. Standards for screw threads – Screw thread measurements using Universal Measuring
8. Microscope/Measuring Projector.
9. Use of measuring Projector to evaluate form error.
10. Microstructure studies using Metallurgical Microscope.
11. Lathe tool dynamometer – study and use of measurement of cutting forces in turning.
12. Milling forces – Milling parameters – measurement of milling forces in slab milling operations.
13. Measurement of drilling thrust and torque using drill toll dynamometer.
14. Study of grinding wheel and grinding parameters – experiments in grinding.
15. Non-destructive tests.

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass

ME15-14L2: HYDRAULIC MACHINERY LAB

Course Objectives:

To impart the concept of the performance of hydraulic machinery commonly used and later apply these information in practical situations.

Course Outcomes:

On completion of this course the student will be able:

1.To design the required experiments.

2. To conduct different performance tests on hydraullic machinery using the theoretical knowledge 3. To tabulate the data and use necessary theoretical knowledge to find out the results

4. To interpret the results.

Experiments

1. Pelton Wheel
2. Francis Turbine
3. Kaplan Turbine
4. Centrifugal Pump
5. Variable Speed Centrifugal Pump
6. Reciprocating Pump
7. Plunger Pump
8. Gear Pump
9. Impact of Jets
10. Hydraulic Ram
11. Subsonic Wind Tunnel
12. Study of cut models of pumps and turbines

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

AS15 -1501 NUMERICAL AND STATISTICAL METHODS

(Common to all branches)

Course Objectives:

To understand the concept of probability, statistics and numerical methods which arise in engineering application.

Course Outcomes:

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

1. Solve algebraic and transcendental equations by numerical methods
2. Perform numerical differentiation and integration
3. Find the mean and variance of a probability distribution including the binomial distribution.
4. Use statistical tests in testing hypotheses on data

Module1

Numerical solution of algebraic and transcendental equation by - Regula-Falsi method, Newton Raphson's method. Gauss Seidal iteration method to solve a system of equations and convergence (without proof) Newton's forward and backward interpolation formula. Lagrange interpolation, Newton's divided difference and central differences.

Module II

Numerical differentiation at the tabulated points with forward, backward and central diffrences. Numerical integration with trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule. Taylor series method. Euler method, Modified Euler method, Runge–Kutta method of second and fourth order for solving 1st order ordinary differential equation.

Module III

Random variable (discrete and continuous) Expectation-mean and variance of probability distribution. Binomial, Poisson and Normal distribution and Fitting of this Distribution to the given data. Curve fitting-fitting of straight line, parabola, exponential.

Module IV

Population and Sample-Sampling Distribution (of mean and variance) Testing of Hypothesis-level of significance, Z-test statistic, Chi square test for variance, for goodness of fit and F-test.

References:

1. Erwin Kreyzig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, (2010).
2. Grewal, B.S., Higher Engineering Mathematics, 43rd Edition, Khanna Publishers, (2013).
3. Kandaswamy, P., Thilagavathy, K., & Gunavathy, K., Numerical methods, S. Chand & Co., (2007).
4. Richard A. Johnson, Irwin Miller & Freund, J. E., Probabilty and statistics for Engineers, 8th Edition, Pearson, (2010).

Type of Questions for End Semester Exam.

PART - A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1502: MECHANICS OF MACHINERY

Course Objectives:

To analyze velocity and acceleration in mechanisms such as gears, cams etc. and also synthesize mechanisms.

Course Outcomes:

On completion of this course the student will be able:

1. To understand different mechanisms and inversions and analyze the velocity and acceleration of mechanisms.
2. To study the principle of working of different gears and gear trains.
3. To understand the working of different types of cams and followers, screw jacks and thrust bearings.
4. To synthesize mechanisms and also study the working of clutches and dynamometers.

Module I

Introduction : Machines and mechanisms, lower and higher pairs, kinematic chains, kinematic inversions of four bar, slider crank and double slider crank chains, equivalent linkages, Lower pairs - Pantograph, Paucellier mechanism, Thomson indicator mechanism, Watt mechanism, Geneva mechanism, Steering mechanism, Hooke's joint.

Kinematic analysis of plane mechanisms: General case of plane motion, Arnold Kennedy’s theorem, velocity analysis using instantaneous center method, velocity and acceleration diagrams, Coriolis component of acceleration

Module II

Spur gear: gear terminology, conjugate gears, involute arc of motion, generation of gear teeth profiles, interference, cycloidal and involute gear characteristics, law of gearing, length of path of contact, length of arc of contact, contact ratio, interchangeable gears, standard and non-standard tooth profiles, description of various types of gears like helical, bevel, worm.

Gear Trains: Analysis of simple, compound, reverted and epicyclic gears, solution of epicyclic gear train problems, gear train in differentials.

Module III

Cams: Classification of cams and followers, geometry of radial cams, displacement diagrams, follower motion, uniform velocity, simple harmonic, uniform acceleration and retardation, cycloidal, parabolic, graphical layout of cam profiles, displacement, velocity, acceleration and jerk relations, pressure angle, analysis of tangent cam, convex sided cams with roller follower and flat faced followers.

Friction: Laws of friction, Limiting angle of friction, Flat pivot bearing, Flat collar bearing, Conical pivot bearing, Efficiency of inclined plane, Screw friction, Screw Jack, Torque required to lift and lower the load by screw jack, Efficiency of a screw jack.

Module IV

Friction clutches – Single disc clutch, Multiple disc clutch, Cone clutch, Centrifugal clutch.

Dynamometer – Types of dynamometer, Prony brake dynamometer, Rope brake dynamometer, Belt transmission dynamometer, Torsion dynamometer

Introduction to synthesis: synthesis of slider crank mechanism, crank and rocker mechanism. Optimum transmission angle, synthesis of four bar links, three and four position synthesis. Overlay method, Coupler curve synthesis, Freudenstein’s equations for Four bar and Slider crank mechanism.

References:

1. Rattan, Theory of Machines, 3rd Edition, Tata McGraw Hill, (2009).
2. Ghosh & Mallick, Theory of Machanisms and Mechines, Affiliated East- West Press, (1988).
3. Myszka, Machines & Mechanisms, 4th Edition, Pearson Education, (2012).
4. Thomas Bevan, Theory of Machines, Pearson Education, (1944).
5. Uicker, Pennock & Shigley, Theory of Machines and Mechanisms, 4th Ed., Oxford University Press, (2010).
6. Ashok G. Ambekar, Mechanism & Machine Theory, PHI, (2007).
7. Norton, Kinematics & Dynamics of Machinery, McGraw Hill, (2008).
8. Waldron & Kinzel, Kinematics, Dynamics and Design of Machinery, Wiley, (2004).

Type of Questions for End Semester Exam.

PART - A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.

Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1503: MACHINE TOOLS & MACHINING SCIENCE

Course Objectives:

To acquire the fundamental knowledge on the working, specification and operation of lathe, drilling, shaping and grinding machines and also the geometry of the tools used.

Course Outcomes: On completion of this course the student will be able:

1. To understand the principle of working, specification, different types, and different operations performed in lathe, drilling machine, and shaping machines.
2. To learn the principle of working, specification, different types, and different operations performed in milling and grinding machines.
3. To study the geometry of single point & multipoint cutting tools and mechanics of chip formation.
4. To get the concept of the mechanics of metal cutting.

Module I

Engine lathe,Principle of working, specification of lathe, types of lathes, work holders, tool holders, Box tools, Taper turning, thread turning, for Lathes and attachments.

Turret and capstan lathes, collet chucks, other work holders,tool holding devices.

Principal features of automatic lathes – classification – Single spindle and multi-spindle automatic lathes. Shaping slotting and planing machines, Principles of working, Principal parts, Specification classification, Operations performed. Kinematic scheme of the shaping slotting and planning machines, machining time calculations. Drilling and Boring Machines, Principles of working, Specifications, types, Operations performed, Tool holding devices, Twist drill, Boring machines, Fine boring and Jig boring machines.

Module II

Milling Machine, Principles of working, Specifications, Classifications of milling machines, Principal features of horizontal, vertical and universal milling machines, Machining operations, Types of milling cutters, Methods of indexing, Accessories to milling machines, Grinding machine, Fundamentals, Theory of grinding , Classification of grinding machine, Ccylindrical and surface grinding machine, Tool and cutter grinding machine, Special types of grinding machines, Different types of abrasives – bonds specification of a grinding wheel and selection of a grinding wheel, Lapping, honing and broaching machines , Comparison to grinding .

Jigs &Fixtures: Types and their application for turning, milling, drilling and boring, Principles of location and clamping, tool guidance.

Module III

Introduction to Machining: Basic Mechanism involved, Plastic deformation, Mechanism of Plastic Deformation, Chip formation, Typical lathe tools; Orthogonal cutting; oblique cutting; Types of chips, Mechanism of built-up-edge formation, Tool geometry, Reference planes; Tools specification, Selection of tools angles; Multi-point cutting tools-geometry of peripheral milling cutters and twist drills, Thermal aspects of machining, Regions of heat generation, Distribution of heat generated, Equations of flow due to conduction, transportation, heat absorbed and heat generated; Average shear plane temperature; Average chip-tool interface temperature;

Module IV

Mechanics of metal cutting, Merchant's circle diagram, Determination of cutting and thrust forces, Coefficient of friction, Measurement of shear angle, Direct and indirect methods; Mohr's circle diagram, Lee and Shaffer's relationship, Friction in Metal

cutting, Mechanics of oblique cutting, Concept of rake angle measured in different planes, Shear angle; Velocity and force relationship. Tool wear and tool life, Mechanism of wear, Progressive tool wear, Flank wear, Crater wear, Model of diffusion wear; Tool life : Variables affecting tool life-Cutting conditions, Tool geometry; Tool materials; work materials; Work materials; Cutting fluids; Determination of tool life equation; Machinability, Economics of machining

References:

1. Jain R. K., & Gupta, S. C., Production Technology, 16th Edition, Khanna Publishers, (2001).
2. Pandey, P. C., & Shan, H. S., Modern Machining Processes, Tata McGraw Hill, (1980).
3. Ghosh & Mallick, Manufacturing Science, Affiliated East- West Press, (1985).
4. Richard R. Kibbe, Roland O. Meyer, Machine tool practices, 9th Edition, Prentice Hall, (2009).
5. Rao, P. N., Manufacturing Technology, Volume: 2, Tata Mc Graw Hill, (1992).
6. ASTME, Fundamentals of Tool Design, Prentice Hall, (1987).
7. H.M.T, Production Technology – Hand book, Tata McGraw Hill, (2000).
8. Donaldson, Lecain, & Goold, Tool Design, Tata Mc Graw Hill, (1987).

Type of Questions for End Semester Exam.

PART - A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.

Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1504: THERMAL ENGINEERING

Course Objectives:

To impart the concept of combustion, thermodynamic cycles in engines and the performance parameters.

Course Outcomes:

On completion of this course the student will be able:

1. To understand fuels, calorimetry, and basics of combustion and apply thermodynamic laws to combustion.
2. To study the air standard cycles used in various thermal equipments, its thermodynamic analysis, actual working of Internal Combustion Engines and its performance analysis.
3. To understand various systems in Internal Combustion Engines components and alternate potential engines and their working.
4. To study combustion in Internal Combustion Engines. Dealing with abnormal combustion in Internal Combustion Engines

Module I

Fuels and combustion – Solid, liquid and gaseous fuels – calorific value – calorimeter – combustion equation – Air – Fuel ratio gravimetric & volumetric analysis – excess air Enthalpy and Internal Energy of Combustion – application of first law of thermodynamics to chemical reaction (combustion), adiabatic flame temperature – application of second law of thermodynamics to chemical reaction.

Module II

Air standard cycles, Otto, Diesel, Dual, Brayton, Stirling cycles. Actual cycles of four stroke and two stroke IC Engines, valve timing diagram – Engine testing – Performance and characteristics of constant speed and variable speed engines – heat balance test – Morse test – retardation test – effect of dissociation – variable specific heads and heat losses – scavenging – objectives – effects and methods – Efficiencies (thermal, mechanical and volumetric efficiencies)

Module III

Systems and components of IC Engines – fuel systems – Ignition systems – Cooling – starting – lubrication – governing of IC engines – super charging of SI and CI Engines – turbo charging – exhaust emissions of IC engines – alternate Potential Engines – free piston engines – Wankel Engine and Stratified charged engine automotive transmission system and its components.

Module IV

Combustion in IC engines – flame propagation normal and abnormal combustion detonation – Pre ignition – after burning – HUCR – fuel rating – additives in petrol – combustion chambers of SI engines – combustion in CI engines

– phase of normal combustion diesel knock – effect of engine variables on diesel knock – cetane number – additives in diesel – combustion chambers of CI engines.

References:

1. Cengel and Boles, Thermodynamics: An Engineering Approach, 7th Edition, McGraw Hill, (2010).
2. Maleev, V. L., Internal Combustion Engines, 2nd Edition, McGraw Hill, (1945).
3. Bacon, Engineering Thermodynamics, Butterworth & Co., (1989).
4. Rogowsky, Elements of Internal Combustion Engine, McGraw Hill, (1953).
5. Gill, Smith & Ziurys, Fundamentals of Internal Combustion Engines, Oxford, (1959).

6. Judge, Modern Petrol Engine, Chapman & Hall, (1955).
7. Eastop, T. D., Mcconkey A., Applied Thermodynamics for Engineering Technologists, Prentice Hall, (1996).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1505: INDUSTRIAL MANAGEMENT

Course Objectives:
To get an overview about an organisational set up and its basic functions.

Course Outcomes:
On completion of this course the student will be able:
1. To understand the concept of management, organization, personnel management and apply these concepts in an industrial environment.
2. To get the concept of industrial relations and use it in real life.
3. To understand the concept of financial management and costing to use in an industry.
4. To study the concept of marketing management and entrepreneurship.

Module I
Definitions of management-history of management- Functions and objectives- Scientific management - Contributions of Gilbreth and Gantt, Management by Objective (MBO)- concept and process.
The organization-organization levels and structures, the quality organization, organizational change, managing change, Management obligations, social and professional responsibilities, Forms of business organizations.

Module II
Human resource management - manpower planning and staffing , recruitment, selection and training. Performance appraisal- absenteeism and labour turnover, Industrial safety, Accidents -reasons and prevention.
Industrial relations- objectives, causes and settlement of industrial disputes, workers participation in management, collective bargaining, trade unions, Factories act.
Job evaluation and Merit rating, Wages and Incentives-definitions and importance, payment plans- merits and demerits of various plans.

Module III
Financial management: understanding of financial accounts, inflation, profitability, budgets and controls, Sources of finance.
Control through costing: Cost accounting, valuation of stocks, allocation of overheads, standard costing, marginal costing.
Investment decisions: Feasibility studies, ranking process, payback period, average rate of return, discounted cash flow.

Module IV
Marketing and sales management: Differentiation between Marketing and Sales management, Sales promotion- definition and methods, market segmentation, consumer and industrial markets.
Product management, pricing, marketing communications, sales, Channels of distribution.
Entrepreneurship – concept Entrepreneurship development, factors affecting Entrepreneurship, Project report- preparation and assessment.

References:

1. Bethel L. L., & Atwater, F. S., Industrial Organisation and Management, 5th Edn., McGraw Hill, (1971).
2. Koontz & Donnel, Principles of Industrial Management, (1959).
3. Prasanna Chandra, Financial Management, 8th Edition, TMH, (2011).

4. Pandey, I. M., Financial Management, 11th Edition, Vikas Publishing House, (2015).
5. Reddin & Ryan, Hand Book of MBO, Tata McGraw Hill, (1988).
6. Chandan, J. S., Management: Concept and Strategies, Vikas Publishing House, (1997).
7. Fabrycky W. J., Operation Management, Tata McGraw Hill, (1987).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1506: POWER PLANT ENGINEERING

Course Objectives:

1. To make student conversant with the different quantitative aspects of power generation, power supply and the cost of energy.
2. To differentiate with the concepts of power and energy in the parlance of electricity supply.

Course Outcomes:

On completion of this course the student will be able:

1. To have a general understanding of the scale and scope of hydroelectric power stations and also grasp the basics of diesel engine and gas turbine power plants.
2. To comprehend the complexity of the steam power plant after getting to know about the working of its different components and elements.
3. To understand the basic principle of the working of nuclear power plant and the various types of nuclear reactors with its safety aspects, especially with respect to the current scenario of national and international debates on the same.
4. To be equipped with the knowledge of the basics of various non-conventional energy producing methods.

Module I

Power plant economics – base load and peak load power plants -estimation of load – load curve – load factor – diversity factor – capacity factor – use factor – selection of units – number and size – scheduling operation – cost of energy – depreciation and replacement – economics of plant selection. Hydroelectric power plants – general layout – types of dams – penstock, draft tubes, surge tanks - power house equipments – site selection

Module II

Diesel engine power plant – Layout – Components of a diesel power plant – starting methods – Gas turbine – open and closed cycles – thermodynamics cycles – regeneration – reheating – intercooling – efficiency and performance of gas turbines. combustion chambers of gas turbines – cylindrical – annular and industrial type combustion chamber design– combustion efficiency –advantages and disadvantages Gas Turbine power plants – classification – elements of a Gas Turbine power plant

Module III

Steam power plants - General layout – fuel handling systems – types of furnaces – stokers – burning systems – types of firing : stokers, pulverized coal burners and fluidized bed combustion - power plant boilers, mountings and accessories - dust and ash handling systems – draft and chimney calculations – condensers – cooling systems - Environmental aspects of thermal power systems Nuclear power plants - Fundamentals of nuclear fission – nuclear power plants – reactors – classification – components layout of simple plant – nuclear power safety and waste disposal.

Module IV

Non conventional energy sources – solar radiation and its measurement – Solar energy collectors – Applications of solar energy - Wind energy conversion – site selection – wind energy collectors – Energy from biomass - ocean energy possibilities and future scope – Ocean Thermal electric conversion (OTEC) – Tidal energy - geothermal energy- Magneto Hydro Dynamic (MHD) power – Fuel cells - thermo electric power - thermionic generation.

Reference

1. Wakil, E. I., Power Plant Technology, McGraw Hill, (1985).
2. Nag, P. K., Power Plant Engineering, 3rd Edition, Tata McGraw Hill, (2007).
3. Morse, Power Plant Engineering, Van Nostrand Co., (1953).
4. Lee J. F., Power Station Engineering and Economy, Tata McGraw Hill, (1960).
5. Robert L. Loftness, Nuclear Power Plants, Van Nostrand, (1964).
6. Verma Mahesh, Power Plant Engineering, Metropolitan Book Co., (1976).
7. Rai G. D., Non Conventional Energy Sources, Khanna Publishers, (2004).
8. Cohen & Rogers, Gas Turbine Theory, 6th Edition, Prentice Hall, (2008).

Type of Questions for End Semester Exam.

PART - A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.

Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-15L1: COMPUTATIONAL METHODS LAB

Course Objectives:

To impart knowledge on computational methods for solving equations and apply these skills in the development of softwares.

Course Outcomes:

On completion of this course the student will be able:

1. To identify the required computational method
2. To write different programs using the theoretical knowledge
3. To obtain the results by running the program
4. To interpret the results.

Review of fundamentals of C programming, Pointers-pointer declaration-pointers and one dimensional arrays-pointers and functions, Data files- opening and closing a data file-creating a data file- processing a data file. C-graphics- drawing lines, rectangles, circles and ellipse

Numerical Techniques: Preparation of computer programs for solution of polynomial and transcendental equations: bisection method, regula falsi method, successive iteration- Newton Raphson method. Solution of system linear algebraic equations : Gauss elimination- matrix inversion, Gauss Jordan method, Gauss-Seidel method.

Numerical integration : trapezoidal rule- Simpson's 1/3 rule- Gauss quadrature formulae

Numerical solution of ordinary differential equations : Taylor series method- Runge-kutta method Numerical solution of boundary value problems.

References:

1. Chapra and Canale, Numerical methods for engineers, 6th Edition, McGraw Hill, (2012).
2. Froberg, Introduction to numerical analysis, 2nd Edition, Addison- Wesley, (1969).
3. Kandaswamy, Numerical Methods, S Chand & Co., (2006).
4. Hildebrand, Introduction to Numerical Analysis, Tata McGraw Hill, (1982).

Note: 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

ME15-15L2: MACHINE SHOP

Course Objectives:

To get exposure to different machines such as lathe, milling, slotting, shaping and grinding machines and also select proper tools for different operations.

Course Outcomes:

On completion of this course the student will be able:

1. To design the required experiments.
2. To prepare the required specimen to perform the experiments.
3. To perform different machining operations using the theoretical knowledge.
4. To measure the dimensions.

Introduction to Machine Tools : Types of Machine tools, Spindle drive – work holding devices tool holders – tool movement – selection of speeds. Feed and depth of cut – use of cutting coolants – principle of thread cutting – V-thread and Square thread – thread standards – cutting tool types – grinding of tools – selection of cutting speeds.

Practical : Exercises on Lathe: cylindrical turning, Taper Turning, Facing, Shoulder turning and curve turning – thread cutting, internal thread

Exercises on Milling Machine: Face milling, End Milling, Gear cutting Exercises on Drilling and Boring Machines

Exercises on Shaping and Slotting Machines Exercises on Grinding Machines

References:

1. HMT, Production technology, Tata Mc Graw Hill, (2001).
2. Wilson F. W., ASTME, Tool Engineer's hand book, Mc Graw Hill, (1959).
3. Boguslavsky, B. L., Automatic and semi- automatic lathes, Peace publications, (1963).
4. ASTME, Fundamentals of tool design, Prentice Hall, (1987).
5. Axelrod Burghard, Machine tool operation, Mc Graw Hill, (1959).

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and 45% minimum in the end semester examination for a pass.

ME15-1601: DYNAMICS OF MACHINERY

Course Objectives:

To analyse static and dynamics forces, balance rotating and reciprocating engines and also get exposed to belt, rope and chain drives.

Course Outcomes:

On completion of this course the student will be able:

1. To perform the static and dynamic force analysis of a mechanism.
2. To study about the flywheels, gyroscopes and brakes.
3. To understand the principles of balancing of rotating and reciprocating masses.
4. To study about the belt, rope, and chain drives and the governors.

Module I

Force analysis of plane motion mechanism: Static force analysis, analysis of four bar chain, slider crank mechanism, static force analysis with friction. Dynamic force analysis: D'Alembert's principle, inertia forces, dynamic force analysis of four bar and slider crank mechanism, Shaking forces, gear force analysis of spur, helical and bevel gears, Dynamics of reciprocating engines, equivalent masses, inertia force in single engine, bearing loads in single cylinder engine.

Module II

Flywheels: Inertia torque-turning moment diagrams for multi-cylinder engines, steam engines, coefficient of fluctuation of speed and energy, flywheel mass calculation.

Gyroscopes: motion of a rigid body in 3 dimension, Gyrodynamics, gyroscope and gyroscopic couple, Gyroscopic effects on ships, aircrafts and automobiles.

Brakes – Types of brakes, Block brake, Band brake, Band and Block brake, Internal expanding brake, Condition of self locking, Power transmitted and Heat generated.

Module III

Balancing: Static and dynamic balancing, balancing of several masses in a plane, balancing of rotating masses in several planes, balancing of several masses in several planes. Condition of complete balancing of an engine, reciprocating and rotating parts, locomotive balancing, hammer blow, variation in tractive effort, swaying couple, Multi-cylinder inline engines, Radial and V-engines, Balancing machines and principles of working.

Module IV

Belt, Rope and Chain drives: Types of belt drives, Velocity ratio, Slip, Creep, Length of belt, Power transmitted, Ratio of tensions, Angle of contact, Centrifugal tension, Maximum tension, Initial tension, V belt drive, Ratio of Tensions in V belt and Rope drives, Kinematics of chain drive, Classifications of chains, Chain length.

Governors – Watt governor, Porter governor, Proell governor, Hartnell governor, Sensitiveness, Hunting, Isochronism, Effort of governor, Controlling force.

References:

1. Rattan, S. S., Theory of Machines, Tata McGraw Hill, (2009).
2. Ghosh & Mallick, Theory of Machines and Mechanisms, Prentice Hall India, (2004).

3. David H. Myszka, Machines & Mechanisms: Applied Kinematic Analysis, 4th Ed., Pearson Education, (2012).
4. Thomas Bevan, Theory of Machines, 3rd Edition, Pearson Education, (2009).
5. Sharma & Purohit, Theory of Mechanism & Machines, PHI, (2006).
6. Uicker, Pennock, & Shigley, Theory of Machines and Mechanics, Oxford University Press, (2006).
7. Ashok G. Ambekar, Mechanism & Machine Theory, PHI Learning, (2009).
8. Norton, Kinematics and Dynamics of Machinery, McGraw Hill, (2009).
9. Waldron & Kinzel, Kinematics, Dynamics and Design of Machinery, 3rd Ed., Wiley, (2007).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1602: MACHINE DESIGN - I

Course Objectives:

To design detachabe joints, revited and welded joints, springs and shafts for different types of loading.

Course Outcomes:

On completion of this course the student will be able:

1. To understand the practical considerations and the steps in design process
2. To design detachable joints
3. To design riveted and welded joints
4. To design springs and power shafts

Module I

Introduction to design: Steps in design process, design factors, practical considerations in design, selection of materials, strength of mechanical elements, theories of failure, impact load, shock load, fatigue loading, effects of surface, size, temperature and stress concentration, consideration of creep and thermal stress in design.

Module II

Detachable joints: design of screws, standards, thread stresses, preloading of bolts, fatigue and shock load, eccentric loading. Power screws, mechanism of power screws, thread stresses, efficiency of power screws, types of keys, stresses in keys, design of socket and spigot joint, Gib and cotter, knuckle joints, design of rigid couplings and flexible couplings.

Module III

Riveted joint: Stresses in riveted joint, design of riveted joints with central and eccentric loads, boiler and tank joints, structural joints.

Springs: stresses in helical springs, deflection of helical compression and tension springs, springs subjected to fatigue loading, concentric and helical torsion spring, critical frequency of springs, leaf springs, design of automotive leaf springs.

Module IV

Welded joints: types of welded joints, stresses, design of welded joints subjected to axial, torsional and bending loads, welds subjected to fluctuating loads.

Power shafts: stresses in shafts, design of static loads, combined stresses, reversed bending and steady loads, design of shafts based on deflection and strength, critical speed of shafts.

Data Book

1. Mahadevan K. and Balaveera Reddy, Design data hand book, 4th Edn., CBS Publishers, (2013).
2. P.S.G. TECH, Design Data Hand Book, DPV Printers, (1993).
3. Linghaigh K., & Narayana Iyengar, B. R., Design Data Book, Vol. I & II, McGraw Hill, (1994).
4. Bhandari, V. B., Machine Design Data Book, Tata Mc Graw Hill, (2014).

References:

1. Joseph Edward Shigley, Mechanical engineering design, Tata Mc Graw Hill, (2004).

2. Bhandari, Design of machine elements, 3rd edition, Tata Mc Graw Hill, (2010).
3. Spotts, M. F., Design of machine elements, eighth edition, Prentice Hall, (2003).
4. Sadhu Singh, Mechanical Machine Design-I , S.K.Kataria & Sons, (2011).
5. Pandya & Shah, Machine Design, 17th edition, Charotar Publishing House Pvt. Limited, (2009).
6. Jain, R. K ., Machine Design, Khanna Publishers, (1978).
7. Robert C., Juvinall, Kurt M. Marshek, Machine component design, 5th Ed., Wiley India, (2013).
8. Jusdal, U. C., Design of machine elements, Pearson, (2010).
9. Sharma & Purehit, Design of machine elements, PHI, (2002).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1603: OPERATIONS MANAGEMENT

Course Objectives:

To understand the basic operations involved in an Industrial organisation.

Course Outcomes:

On completion of this course the student will be able:

1. To understand different network techniques and forecasting methods
2. To learn production planning and control as well as inventory control techniques.
3. To study the concepts of aggregate planning and scheduling
4. To get the basic knowledge of plant location and lay out and material handling

Module I

Operations Management-Charecteristics and functions, Production process-nature and importance of production function, relationship with other business activities.

Network techniques: Basic concept of network construction, information requirement, critical path, various slacks and floats, CPM-crashing, PERT- multi-time estimate.

Forecasting: Importanace in operations management, methods of forecasting - time series, moving average, exponential smoothening.

Module II

Production planning and control: Scopes, objectives and functions of production planning and control.

Product Design- Process and Functions, guiding principles, consumption cycle, product life cycle, factors affecting product design, simplification, standardization, specialisation, inter-changeability.

Inventory control: Structure of inventory problems, relevant cost, basic EOQ models, stores ledger, materials requisition sheet, materials return note, material transfer note, bin cards, just in time and lean management.

Module III

Aggregate Planning: Role and need of aggregate planning, graphical and reaction rate methods of aggregate planning.

Scheduling: Definition and scheduling decisions, Gantt charts, indexing methods, critical ratio method of loading & scheduling.

Sequencing : Basic concepts and importance of sequencing, one machine n jobs, 2 machine n jobs, m machine n jobs problems.

Module IV

Plant Location: Factors influencing location,significance of sites in urban,semi-urban and rural areas. Plant Layout: Types, need for layout, layout design process- factors, determination of equipment and employee requirement, production rate determination, space determination, block plan, systematic layout planning.

Material handling: The principles of materials handling, classification of equipments and its selection factors.

Maintenance & replacement: Different types of maintenance,merits and demerits, operational and economic aspects. Replacement of equipments, reasons and basic methods, concept of depreciation.

References:

1. James L. Riggs, Economic decision models for engineers and managers, 4th Ed., McGraw Hill, (1996).
2. Hiller & Liberman, Introduction to Operations Research, 4th edition, Holden Day Inc., (1986).
3. Wiest & Levy, A management guide to PERT and CPM, 2nd edition, Prentice Hall, (1977).
4. Starr & Miller, Inventory control: Theory & Practice, Prentice Hall India, (1962).
5. Sammuel Eilon, Production planning and control, Universal book corporation, Bombay, (1991).
6. Biegel, Production control, Prentice Hall, (1971).
7. Francis & White, Facility layout and location, 2nd edition, Prentice hall Inc., (1992).
8. Moore, Plant layout and Design, The Macmillan Company, New York, (1962).
9. Barnes, R. M., Time and motion study, first edition, Asia publication, (1960).
10. Miller & Blood, Modern maintenance management, American Management Association, (1963).
11. Lewis, B. T., and Marron J. P., Facilities and Plant Engg. hand book, McGraw Hill, (1973).
12. Kanishka Bedi, Production & Operations Management, Oxford University Press, (2004).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1604: HEAT AND MASS TRANSFER

Course Objectives:

To get the concept of different modes of heat transfer and performance/design aspects of heat exchangers.

Course Outcomes:

On completion of this course the student will be able:

1. To understand the basic modes of heat transfer
2. To get an insight on conduction, convection and radiation heat transfers
3. To get a concept on multiphase flow, diffusion and convective mass trnasfer
4. To attain information of parallel and counterflow heat exchangers and their design aspects

Module I

Introduction to heat transfer – basic modes of heat transfer – conduction heat transfer –Fourier law of heat conduction– temperature dependence of thermal conductivity- general heat conduction equation in cartesian, cylindrical and spherical coordinates – boundary conditions – one-dimensional steady state conduction- critical insulation thickness -one-dimensional steady state conduction with heat generation -extended surface – two dimensional steady state heat conduction – conduction shape factor – unsteady state heat conduction in one dimension – lumped heat capacity system – semi-infinite solids with sudden change in surface temperature – Introduction to numerical methods in conduction.

Module II

Convective heat transfer – Newton's law of cooling – Prandtl number – laminar forced convection heat transfer from flat plates – fully developed laminar flow in pipes – turbulent forced convection – Reynolds' analogy – natural convection – natural convection heat transfer from vertical plates and horizontal tubes – condensation and boiling – film and drop wise condensation – film boiling and pool boiling – introduction to multiphase flow and heat transfer. Diffusion and convective mass transfer-Ficks law of diffusion.

Module III

Radiative transfer – electromagnetic radiation spectrum – thermal radiation – radiation properties- black body, gray body – monochromatic and total emissive power – Planck's law – Stefan-Boltzman law – Wien's displacement law – Kirchhoffs identity – shape factor- reciprocity relation – heat exchange between non black bodies; surface and shape resistances- electrical network analogy-heat transfer between parallel surafces – radiation shields.

Module IV

Heat Exchangers: Type of heat exchangers- overall heat transfer coefficient -fouling factors -Logarithmic mean temperature difference (LMTD)- derivation of LMTD for parallel flow and counter flow heat exchangers-LMTD correction factor-effectiveness, NTU method of heat exchanger analysis- effectiveness derivation for parallel flow and counter flow heat exchangers. Design of parallel flow-counterflow-shell and tube multipass heat exchangers-condensers.

References:

1. Cengel, Heat Transfer, 3rd edition, Tata Mc Graw Hill, (2007).

2. Holman J. P., Heat Transfer, 10th edition, McGraw Hill International Students Edition, (2009).
3. Incorpera F. P. & De Witt, D. P., Fundamentals of Heat and Mass Transfer, 7th Ed., Wiley, (2011).
4. Kreith F., Heat Transfer, International Text Book Company, (1958).
5. Gebhart B., Heat Transfer, 2nd edition, McGraw Hill, (1971).
6. Rajput, R. K., Heat and Mass Transfer, S Chand, (2007).
7. Venkanna, Fundamentals of HMT, Prentice Hall, (2011).

Data Book:

1. C. P. Kothandaraman, Heat & Mass Transfer Data Book, 8th edition, New Age International, (2014).
2. Domkundwar, Heat & Mass Transfer Data Book, 3rd edition, Dhanpat Rai, (2006).

Approved data book is to be specified in the question paper.

Type of Questions for End Semester Exam.

PART - A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.

Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1605: CAD/CAM

Course Objectives:

To impart the concept of robotics and design features of CNC machines.

Course Outcomes:

On completion of this course the student will be able:

1. To understand the basics of modelling and automation
2. To study the basics of computer numerical control
3. To study the design features of CNC machines
4. To understand the basic concepts of robotics

Module I

Fundamentals of CAD: Role of computers in design, geometric modelling-wireframe and solid, modelling, engineering analysis-FEM, design review and evaluation, automated drafting, design data base, softwares used in CAD, data exchange between CAD and CAM. Fundamentals of CAM: Definition of automation, levels of automation, high volume discrete parts production, Detroit type of automation, transfer machines, analysis of automated flow lines, assembly machines, flow line balancing, line balancing.

Module II

Computer Numerical Control: basic theory of numerical control, advantages of NC, open and closed loop system, information flow and control theory, classification of CNC machine tools, position control and continuous path control, principles of displacement measurement, digital linear and rotary displacement transducer, analog displacement measuring system. CNC part programming: Manual programming, work piece modelling and computer aided part programming, G and M function, canned cycles, CAPP languages, structure and use of major CAPP languages, programming in APT.

Module III

Design features of CNC machines: Special design features to match machine tools to numerical control system CNC tooling: ATC, APC, features of CNC systems for lathes and machining centre. Testing of NC machine tools, static and dynamic errors.

Module IV

Basic concepts of Robotics: Introduction, basic structure of Robots, resolution, accuracy, and repeatability. Classification and structure of Robotic systems: PTP and CP systems, control loops of robotic systems, types of robots Drives and Control systems: hydraulic systems, DC servo motors, control approaches of Robots. Applications of Robots: handling, loading and unloading, welding, spray painting, assembly, machining. Programming: manual teaching, lead – through teaching, programming languages. Sensors and Intelligent Robots: introduction to Robotic sensors, vision systems, range detectors, force and torque sensors. Advanced concepts in automation: direct numerical control, CAE, CIM, FMS, computer integrated manufacturing – basic concepts of AI and expert systems for manufacturing automation.

References:

1. Groover & Zimmers, CAD/CAM, 5th edition, PHI, (2008).
2. Radhakrishnan, P., Subramanyam, S., CAD/CAM/CIM, New Age International, (2009).

3. Mikell P. Groover, Automation, Production Systems and Computer Aided Manufacturing, Prentice Hall, (2008).
4. HMT, Mechatronics, Tata Mc Graw-Hill Education, (2000).
5. Kundra T. K., Rao P. N. and Tiwari N. K., CNC Machine Tools and Computer aided Manufacturing, Tata McGraw- Hill Education, (1988).
6. SME, Manufacturing Engineering Hand Books, (1984).
7. Zeid, CAD/CAM theory & Practice, Tata McGraw-Hill Education, (2009).
8. Jha, B. K., CNC Programming made easy, Vikas Publishing House, (2003).
9. James G Keramas, Robot Technology Fundamental, Vikas Thomson Learning, (1998).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1606 E1: HYDRAULIC AND PNEUMATIC DRIVES

Course Objectives:
To impart the concept of hydraulic and pneumatic systems and the components of these circuits.

Course Outcomes:
On completion of this course the student will be able:
1. To understand the advantages and limitations of oil hydraulics and pneumatics
2. To learn about the working of hydraulic actuators and control elements
3. To understand electro hydraulic servomechanisms and analysis of hydraulic circuits
4. To study pneumatic systems and circuits.

Module I
Introduction to oil hydraulics and pneumatics, their advantages and limitations, ISO symbols and standards in Oil Hydraulics and pneumatics, Recent developments, applications, Basic types and constructions of Hydraulic pumps and motors, Ideal pump and motor analysis, Practical pump and motor analysis, Performance curves and parameters.

Module II
Hydraulic Actuators, Hydraulic control elements – direction, pressure and flow control valves. Valve configurations, General valve analysis, valve lap, flow forces and lateral forces on spool valves, Series and parallel pressure compensation flow control valves, Flapper valve Analysis and Design, Analysis of valve controlled and pump controlled motor, Electro-hydraulic servo valves-specifications, selection and use of servo valves.

Module III
Electro hydraulic servomechanisms – Electro hydraulic position control servos and velocity control servos, Nonlinearities in control systems (backlash, hysteresis, dead band and friction nonlinearities). Basic configurations of hydraulic power supplies – Bypass Regulated and Stroke Regulated Hydraulic Power Supplies, Heat generation and dissipation in hydraulic systems: Design and analysis of typical hydraulic circuits, Use of Displacement – Time and Travels-Step diagrams: Synchronization circuits and accumulator sizing. Meter - in, Meter - out and Bleed-off circuits: Fail Safe and Counter balancing circuits.

Module IV
Components of pneumatic systems: Direction, flow and pressure control valves in pneumatic systems, Development of single and multiple actuator circuits, Valves for logic functions: Time delay valve, Exhaust and supply air throttling, Examples of typical circuits using Displacement – Time and Travel-Step diagrams, Will-dependent control, Travel-dependent control and Time dependent control, combined control, Program Control, Electro-pneumatic control and air hydraulic control, Applications in Assembly, Feeding, Metalworking, materials handling and plastics working.

References:

1. Joji P., Pneumatic controls, Wiley India Pvt. Ltd., (2008).
2. Anthony Esposito, Fluid Power with applications, 7th Edition, Prentice Hall, (2009).

3. Ernst W., Oil Hydraulic Power and its Industrial Applications, 2nd Ed., McGraw Hill, (1960).
4. Lewis E. E. and Stern H., Design of Hydraulic Control Systems, McGraw Hill, (1962).
5. Morse A. C., Electrohydraulic servomechanisms, McGraw Hill, (1963).
6. Pippenger J. J. and Koff, R. M., Fluid Power Control systems, McGraw Hill, (1959).
7. Fitch Jr. E. C., Fluid Power Control Systems, McGraw Hill, (1966).
8. Khaimovitch, Hydraulic and Pneumatic Control of Machine Tools, Pergamon Press, (1965).
9. John Watton., Fluid Power Systems: modeling, simulation and microcomputer control, Prentice Hall, (1989).
10. Herbert, E., Merritt, Hydraulic control systems, John Wilely and Sons Inc., (1991).
11. Thoma Jean U., Hydrostatic Power Transmission, Trade and Technical Press, England, (1964).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1606 E2: ADVANCED MECHANICS OF SOLIDS

Course Objectives:
To analyse pure bending, non circular bars and thin tubes and also application of energy methods.

Course Outcomes:
On completion of this course the student will be able:
1. To understand the components of stress and starin and the differential equations of equilibrium.
2. To learn about the pure bending about curved bars.
3. To analyse stress and strain in 3D by using energy methods.
4. To learn about the torsion of non circular straight bars and thin tubes.

Module I
2D problems in Cartesian co-ordinates:
stress & strain at a point, components of stress & strain, Hooks law plane stress & plane strain, measurement of surface strains, construction of Mohr circle for stress & strain , strain rosettes, differential equations of equilibrium, boundary conditions, compatibility equations, stress function. Solution by polynomials, St.Venant's principle, bending of a cantilever loaded at the end.

Module II
2D problems in polar co-ordinates
General equations in polar co-ordinates. Stress distribution symmetrical about an axis pure bending of curved bars. Strain components in polar coordinates, displacement for symmetrical stress distribution, rotating disks, thick cylinders, pure bending of curved bars.

Module III
Analysis of stress & strain in 3D
Principal stresses, stress ellipsoid, stress invariants, maximum shearing stress, homogenous deformation. Strain at a point, rotation, differential equations of equilibrium, compatibility. Equations of equilibrium in terms of displacements Stretching of a prismatic bar by its own weight
Energy methods: principle of virtual work, reciprocal theorems, strain energy methods, Castigliano's theorems.

Module IV
Unsymmetric bending, shear flow, shear centre.
Torsion of noncircular straight bars, elliptic cross sections. Membrane analogy. Torsion of thin tubes, open and closed sections.

References :

1. Timoshenko & Goedier, Theory of Elasticity, 3rd Edition, McGraw Hill, (1970).
2. Solecki & Conant, Advanced Mechanics of Materials, Oxford University Press, (2003).
3. Srinath, L.S., Advanced Mechanics of Solids, Tata McGraw Hill, (2009).
4. Kazimi, S. M. A., Solid Mechanics, Tata McGraw Hill, (2001).
5. Boresi & Schmidt, Advanced mechanics of materials, 6th Edition, Wiley, (2002).
6. Bhaskar K. & Varadan, T. K., Theory of Isotropic/Orthotropic elasticity: An introductory primer, Ane Books, (2009).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1606 E3: ENERGY CONSERVATION & ENVIRONMENT PROTECTION

Course Objectives:
To impart information on energy management and auditing, renewable energy sources and environmental impacts of energy use.

Course Outcomes:
On completion of this course the student will be able:
1. To understand the overview of World Energy Scenario and energy economics
2. To study the Importance of energy management and energy auditing
3. To learn about the renewable energy sources
4. To understand the Environmental Impacts of energy use

Module I
Overview of World Energy Scenario. Fossil Fuel Reserves - Estimates, Country Energy Balance Construction - Examples Trends in energy use patterns, Energy Economics - Simple Payback Period, IRR, NPV, Life Cycle Costing.

Module II
Importance of energy management. Energy auditing: methodology, analysis of past trends plant data), Steam Systems: Boiler -efficiency testing, excess air control, Steam distribution & use - steam traps , condensate recovery , flash steam utilisation. Thermal Insulation. Energy conservation in Pumps, Fans (flow control), Compressed Air Systems, Refrigeration & air conditioning systems. Waste heat recovery.

Module III
Cogeneration - concept, options (steam/gas turbines/diesel engine based), selection criteria. Heat exchanger networking- concept of pinch, target setting, composite curves. Renewable energy sources- overview of solar, wind, tidal, geothermal , nuclear energy sources.

Module IV
Environmental Impacts of energy use - Air Pollution - SOx, NOx, CO, particulates Solid and Water Pollution, Formation of pollutants, sources of emissions. Exhaust emission test, procedures, standards and legislation; environmental audits; Emission factors and Global Warming, CO2 Emissions, Impacts. Water pollution

References:

1. Nebojsa Nakicenovic, Arnulf Grubler and Alan McDonald, Global energy perspectives, Cambridge University Press, (1998).
2. Fowler, J. M., Energy and the environment,. 2nd Ed., McGraw Hill, New York, (1984).
3. Witte, L. C., Schmidt P. S. and Brown, D. R., Industrial Energy Management and Utilisation, Hemisphere Publ, Washington, (1988).
4. Industrial Energy Conservation Manuals, MIT Press, Mass, (1982).
5. Stoecker, W.F., Design of Thermal Systems McGraw-Hill , (1989)
6. Kenney, W .F., Energy Conservation in the Process Industries Academic Press, (1984).
7. Sukhatme, S. P., Nayak, J. K., SolarEnergy: Principles of Thermal Collection and Storage,Third Edition, Tata Mc Graw Hill, (2008).
8. Arcadio P. Sincero & Gregoria A. Sincero, Environmental Engineering: A Design Approach, Prentice Hall, (1995).

9. Shenoy, U. V., Heat Exchanger Network Synthesis: Process Optimization by Energy and Resource Analysis, Gulf Publishing Company, Houston, (1995).
10. UNDP, Energy and the Challenge of Sustainability, World energy assessment, New York, (2000).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1606 E4: ADVANCED ENGINEERING MATERIALS

Course Objectives:

To analyse orthotropic lamina and laminated composites.

Course Outcomes:

On completion of this course the student will be able:

1. To understand characteristics of polymer matrix and metal matrix composites.
2. To study manufacturing and testing methods of composites.
3. To analyse orthotropic lamina using stress strain relationship.
4. To analyse laminated composites and determination of stresses and strains.

Module I

Introduction - classification and characteristics of polymer matrix and metal matrix composites - mechanical behaviour of UD composites - longitudinal strength and stiffness - transverse strength and stiffness - failure modes - short fibre composites

Module II

Manufacturing and testing methods - production of various fibres - matrix materials and surface treatments - fabrication of composites - fabrication of thermosetting resin matrix composites - fabrication of thermoplastic-resin matrix composites/short fibre composites - fabrication of metal matrix composites - fabrication of ceramic matrix composites - carbon-carbon composites - machining aspects of composites - experimental characterisation of composites - uniaxial tension - compression and shear tests - determination of interlaminar and fracture toughness - damage identification through non-destructive evaluation techniques - ultrasonic, acoustic emission and X-radiography

Module III

Analysis of orthotropic lamina - Hooke's law for orthotropic materials - stress-strain relations and engineering constants - specially orthotropic lamina - relation between engineering constants and elements of stiffness and compliance matrices - restrictions on elastic constants - stress-strain relationships for generally orthotropic lamina - transformation of engineering constants - strengths of orthotropic lamina - typical design application examples

Module IV

Analysis of laminated composites - strain and stress variation in a laminate - synthesis of stiffness matrix construction and properties of special laminates - symmetric laminates - unidirectional, cross-ply and angle-ply laminates - quasi-isotropic laminates - determination of laminate stresses and strains - laminate analysis through computers - typical design application examples

References:

1. Agarwal B. D. & Broutman L. J., Analysis and Performance of Fiber Composites, John Wiley, (1990).
2. Gibson R. F., Principle of Composite Material Mechanics, McGraw Hill, (1986).
3. Schwartz M. M., Composite Materials Handbook, McGraw Hill, (1984).
4. Jones R. M., Mechanics of Composite Materials, 2nd Edition, CRC Press, (2015).
5. Chawla K. K., Ceramic Matrix Composites, Chapman & Hall, (1993).

6. Tsai S. W., Introduction to Composite Materials, Technomic Publishing Company, (1980).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1606 E5: FUNDAMENTALS OF COMBUSTION AND POLLUTION

Course Objectives:
To impart the concept of reaction kinetics, premixed and diffusion flmaes and also the instrumentation to measure pollutants.

Course Outcomes:
On completion of this course the student will be able:
1. To study the conservation equations
2. To understand the reaction kinetics and laws of transport phenomenon
3. To get exposure to premixed and diffusion flames
4. To learn about the constituents of emission and instrumentation to measure pollutants.

Module I
Introductory concepts: Review of thermodynamics, Thermodynamics of combustion, Stoichiometry of combustion, heats of reaction and formation, Mass transfer definitions: Fick's law. Equations of conservation of species mass, momentum, and energy; multi-component diffusion equation adiabatic flame temperature.

Module II
Chemistry of Combustion: Basic Reaction Kinetics, Elementary reactions, Chain reactions, Multistep reactions, simplification of reaction mechanism, Global kinetics.
Physics of Combustion: Fundamental laws of transport phenomena, Conservations Equations, Transport in Turbulent Flow.

Module III
Premixed Flames: One dimensional combustion wave, Laminar premixed flame, Burning velocity measurement methods, Effects of chemical and physical variables on Burning velocity, Flame extinction, Ignition, Flame stabilizations, Turbulent Premixed flame.
Diffusion Flames: Gaseous Jet diffusion flame, Liquid fuel combustion, fuel atomization, Characteristics of spray Combustion, Solid fuel combustion.

Module IV
Combustion generated pollutants: Constituents and types of emission, mechanisms of hydrocarbon and particulate emissions, and theories of soot and NOx formation, industrial furnace emissions. Quantification of emission, emission control methods, modelling of emissions. Emission standards. Instrumentation to measure pollutants.

References

1. Stephen R Turns, An Introduction to Combustion, Mc-Graw Hill, 2nd Edn., (2006).
2. Mukunda, H. S., Understanding Combustion, University Press, 2nd Edn., (2009).
3. Kanury A Murty, Introduction to Combustion Phenomena, Gordon and Breach, (1975).
4. Kenneth K Kuo, Principles of Combustion, John Wiley and Sons, (1986).
5. Forman A Williams, Combustion Theory - The Fundamentals Benjamin and Cummings publishing, 2nd Ed., (1985).

6. Irvin Glassman and Yetter, R. A., Combustion, Academic press, 4th Ed., (2008).
7. Law, C. K., Combustion Physics, Cambridge University Press, (2006).
8. Strehlow R. A., Fundamentals of Combustion, McGraw Hill Book Company, (1984).
9. Thring, M.W., The science of Flames and Furnace, Chapman & Hill Ltd, London, (1962).
10. Trinks, W., Industrial Furnaces, Vol.1, 4th Edn., John Wiley, New York, (1951).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-16L1: CAD/CAM LAB

Course Objectives:
To get familiarized with CNC machines, operate robotic arm and use modelling softwares.

Course Outcomes:
On completion of this course the student will be able:
1. To get famliarised with using modelling software packages.
2. To get exposed with analysis using software packages.
3. To get famliarised with working on CNC machines
4. To get exposed with the operation of robotic arm.

Practicals:

1. Use of CAD/CAM software packages
2. Use of project management software packages
3. Maintenance of PC and peripherals
4. Operation of CNC milling machine and CNC Lathe
5. Manual part programming exercises (editing and simulation)
6. Part programming using APT or APT like languages
7. Operation of Robots
8. Programming of Robots
9. Operation Coordinate Measuring Machine.

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

ME15-16L2: HEAT & MASS TRANSFER LABORATORY

Course Objectives:
To get exposed to heat transfer equipments and apply the concepts in practical situations.

Course Outcomes:
On completion of this course the student will be able:
1. To design the required experiments
2. To conduct different heat transfer experiments using the theoretical knowledge
3. To tabulate the data and use necessary theoretical knowledge to find out the results
4. To interpret the results.

Introduction to fundamentals of heat transfer - condensation and boiling heat exchanges experimental techniques in thermal sciences

Practicals:

1. Performance studies on a shell and tube heat exchanger
2. Performance studies on parallel and counter flow arrangements in a concentric pipe heat exchanger
3. Emissivity measurement of a radiating surface
4. Measurement of solar radiation
5. Thermal conductivity of a metal rod
6. Measurement of unsteady state conduction heat transfer
7. Experimental study on forced convection heat transfer
8. Experimental study of dropwise and flimwise condensation
9. Experiments on boiling heat transfer
10. Measurement of critical heat flux.

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass

ME15-1701: REFRIGERATION AND AIR CONDITIONING

Course Objectives:

To get the concept of vapour compression and absorption refrigeration systems, selection of refrigerants and cooling load calculations for air conditioning systems.

Course Outcomes:

On completion of this course the student will be able:

1. To understand the basics of different refrigeration cycles.
2. To study the vapour compression and vapour absorption refrigeration cycles- both theoretical and practical cycles, properties of refrigerants, and selection criteria for refrigerants.
3. To understand the different components of refrigeration systems.
4. To get knowledge of psychrometry, air-conditioning systems and will be able to do the cooling load calculation

Module I

Principles of refrigeration-unit of refrigeration - capacity - Coefficient of Performance - refrigeration systems: Carnot refrigeration cycle - Steam jet refrigeration - Thermoelectric refrigeration - vortex tube - pulse tube - air refrigeration cycle boot strap & boot strap evaporating cooling - thermodynamic analysis of Bell- Coleman cycle.

Module II

Vapour compression system - theoretical and practical cycles - simple and multi pressure systems - thermodynamic analysis - vapour absorption system - principle of operation of aqua - ammonia and lithium bromide - water systems - Electrolux system - comparison between vapour compression and absorption systems - refrigerants - thermodynamic, physical and chemical properties of refrigerants, environment friendly refrigerants and its properties, selection criteria of refrigerants.

Module III

System components - compressors - reciprocating compressors - single and multistage compressors - rotary compressors – centrifugal and axial flow compressors - screw type and vane type compressors - hermetic, semi hermetic and open compressors - condensers - water cooled and air cooled condensers - evaporative condensers - expansion devices - capillary tube - thermostatic expansion valve - float valves - evaporators - natural convection and forced convection coils - flooded evaporators - direct expansion coils.

Module IV

Psychrometry - Psychrometric properties and processes - determination of air entering conditioned space - air conditioning systems – Summer and Winter air conditioning systems - central and unitary systems - human comfort - comfort chart and limitations - effective temperature - factors governing effective temperature.

Cooling Load Calculation - various heat sources - design of air conditioning systems: duct design - air distribution systems - heating systems.

Note: Refrigeration Data Books are permitted for examination

1. Domkundwar A. V., & Domkundwar, V. M., Refrigeration and Air conditioning Data Book, Dhanpat Rai & Co., Delhi, (2013).

References:

1. Roy J. Dossat, Thomas J. Horan, Principles of Refrigeration, 5th edition, Prentice Hall, (2001).
2. Stoecker W. F. and Jones J. W., Refrigeration and Air Conditioning, 2nd Ed., Tata McGraw Hill, (1982).
3. Jordan R. C. and Priester G. B., Refrigeration and Air Conditioning, 2nd Ed., Prentice Hall, (1969).
4. Arora, C. P., Refrigeration and Air Conditioning, Tata McGraw Hill, (2001).
5. Norman Harris, Modern Air Conditioning Practice, McGraw Hill, (1974).
6. Arora, R. C., Refrigeration and Air Conditioning, Prentice Hall, (2010).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1702: VIBRATION AND NOISE CONTROL

Course Objectives:
To analyze single, multi degrees of freedom and continuous systems, get the concept of frequencies and mode shapes and also the noise control measures adopted.

Course Outcomes:
On completion of this course the student will be able:
1. To understand, model, and analyze single degree of freedom vibrating systems with and without damping.
2. To get the concept of natural frequencies and mode shapes of multi degrees of freedom system.
3. To analyze continuous systems for axial, transverse,and torsional vibrations.
4. To gain knowledge on the effects of noise and the control measures adopted

Module I

Introduction to mechanical vibrations: Free vibrations, Response of single degree of freedom system, Viscous damping, Under damped, Critically damped and Over damped vibrations, Forced vibrations, Support excited motion, Rotating Unbalance, Coulomb damping

Module II

Multi degree freedom systems: two degree of freedom and three degree of freedom spring mass systems, Matrix formulation, Eigen value problems, Mode shapes, Coordinate Coupling, Lagrange’s equations. Torsional vibratory systems, Torsionally equivalent shaft, Two rotor system, Three rotor system, Geared system, Location of Nodes, Frequency of torsional vibration.
Vibration isolation, Measurement of vibration, Accelerometer and Seismometer.

Module III

Transverse vibration of shafts, Whirling speed of shafts, Approximate methods to analyse vibratory system: Rayleigh's energy method, Dunkerleys method.
Vibration of continuous systems: exact methods, boundary value problem, Eigen value problem, Axial vibration of rods, Transverse vibration of beams.

Module IV

Noise, Sound level meter scales, Psychophysical indices, Equivalent sound level, Noise and loss of hearing, Normal hearing and hearing loss, Temporary hearing loss from continuous noise, Permanent haring loss from continuous noise, Physiological effects of noise, Specific effects of noise, Noise exposure limits, Continuous and intermittent noise, Impulse noise, Annoyance of noise, Noise control; control at the source, control at the receiver, control along the path.

References:
1. Rao, S. S., Mechanical Vibrations, 5th edition, Prentice Hall, (2010).

2. Mark S. Sanders, Ernest J. Mc Cormick, Human Factors in engineering and design, Mc Graw Hill, (1993).
3. Thomson, W. T., Theory of Vibrations with applications, 3rd Edn., CBS Publishers, (2002).
4. Benson H. Tongue, Principles of Vibration, Oxford University Press, (2002).
5. Shabana, A. A., Theory of Vibration: An Introduction, Springer International Edition, (1974).
6. Rossing T. D. & Fletcher, N. H., Principles of Vibration & Sound, 10th Edn., Springer, (1995).
7. Ambekar, A. G., Mechanical Vibrations and Noise Engineering, PHI, (2006).
8. Nag, D., Mechanical Vibrations, Wiley India Pvt. Ltd., (2011).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1703: MACHINE DESIGN - II

Course Objectives:
To design gears, clutches, brakes, mechanical power transmission systems, journal and ball/roller bearings and attain information on general design recommendations followed.

Course Outcomes:
On completion of this course the student will be able:
1. To understand and design clutches, brakes, gears and different types of power transmission systems like belt drives and chain drives.
2. To familiarize with different types of lubrication systems, design journal bearings, select ball & roller bearings based on the service conditions.
3. To have an understanding of general design recommendations for rolled sections, forgings, screw machine parts, turned parts, machined round holes, parts produced on milling machines, welded parts, castings etc.

Module I
Design of Clutches : Friction clutches, uniform wear and uniform pressure assumptions, centrifugal clutches. Brakes : Design of internal expansion elements, assumptions, design of external contraction elements, band type brakes.
Belt and chain drives : flat belts, V-Belts, roller chain.

Module II
Design of Gears : Spur, helical, bevel and worm gears-tooth loads, design stresses, basic tooth stresses, stress concentration, overload factor, velocity factor, bending strength of gear teeth, Buckingham equation for dynamic load, surface durability, surface strength, heat dissipation, gear material, design for strength and wear, gear box design (description only).

Module III
Bearings and lubrication: types of lubrication, viscosity, journal bearing with perfect lubrication, hydrodynamic theory, design factors, bearing load, bearing dimensions, journal bearing design. Ball and roller bearings- bearing life, static and dynamic capacity, selection of bearings with axial and radial loads, bearing materials used. Thrust bearings, lubrication, wear of metal, adhesive wear, abrasive wear, corrosion wear, fatigue and impact wear, measurement of friction and wear.

Module IV
Product design for manufacturing : general design recommendations for rolled sections, forgings, screw machine parts, turned parts, machined round holes, parts produced on milling machines, welded parts, castings etc., Modification of design for manufacturing easiness for typical products – preparation of working drawings for manufacture of parts with complete specifications including manufacturing details like tolerance, surface finish.

Data books allowed for Examination:
1. Mahadevan K. and Balaveera Reddy, Design data hand book, 4th Edn., CBS Publishers, (2013).
2. P.S.G.TECH, Design Data Hand Book, DPV Printers, (1993).
3. Linghaigh K.and Narayana Iyengar, B.R., Design Data Book, Vol. I & II, Mc. Graw Hill, (1994).
4. Bhandari, V. B., Machine Design Data Book, Tata Mc Graw Hill, (2014).

References:

1. Shigley, J.E., Mechanical engineering design, 5th edition, McGraw Hill, (2009).
2. James G. Bralia, Handbook of product design for manufacturing, 2nd Edn., McGraw Hill, (1998).
3. Bhandari, V. B., Design of machine elements, third edition, Tata Mc Graw Hill, (2010).
4. Doughtie, V. L., Design of machine members, McGraw Hill, (1964).
5. Siegel, Maleev, Machine design of machines, International and Hartman text book Co, (2007).
6. Donald J. Myatt, Machine design, McGraw Hill, (1962).
7. Sadhu Singh, Mechanical Machine Design-I, S. K. Kataria & Sons, (2011).
8. Pandya & Shah, Machine Design, 17th edition, Charotar Publishing House Pvt. Limited, (2009).

Type of Questions for End Semester Exam.

PART - A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.

Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1704: AUTOMOBILE ENGINEERING

Course Objectives:

To get exposed to different systems such as fuel, ignition, cooling, lubrication, injection etc. and also on the constructional details of clutch, steering, brakes, chassis and transmission systems of an automobile.

Course Outcomes:

On completion of this course the student will be able:

1. To know the various types of internal combustion engines, their working and the functions of important engine components.
2. To gain knowledge about the fuel supply systems, ignition systems, cooling systems and lubrication systems used in automobiles.
3. To understand chassis construction details, types of clutch mechanisms and transmission systems used in automobiles.
4. To know about various types of brakes, steering mechanisms, suspension systems and electrical systems used in automobiles.

Module I

Automotive engine classification, S.I. & C.I. engines, combustion chamber types, engine balancing, multi cylinder arrangements.

Automobile engine parts: Cylinder block, cylinder head, crank case, oil pan, cylinder liners, piston, arrangements to control piston slap, piston rings, connecting rod, crank shaft, valves, materials used, valves lay out, valve and port timing diagrams, valves actuating mechanism, Variable Valve Timing, Method used to effect variable Valve Timing, Electromagnetic Valves, Cam less engine actuation.

Module II

Fuel supply system: Simple carburetor, constant choke, constant vacuum carburetor, types of carburetor, mixture strength requirements, fuel pumps for petrol engines, petrol injections, diesel fuel pump and fuel injector for diesel engines, Multi-Point Fuel Injection systems, Common Rail Direct Injection systems, Alternate fuels, CNG, advantages, Characteristics of CNG with relation to conventional fuels.

Ignition System: Battery ignition system, comparisons between battery ignition and magnetic ignition system, ignition advance methods, electronic ignition.

Cooling System: Necessity, Properties of coolants, methods of cooling, Liquid cooled system, Thermosyphon system, Pressure cooling system.

Lubrication System: Objectives, properties of lubricants, systems of engine lubrication, Mist lubrication system, Wet sump and dry sump lubrication, Crank case ventilation.

Module III

Chassis construction: The frame and its functions, unitary or frameless, Layout of the components of transmission system.

Clutches: Purpose, requirements, Single plate, multi-plate clutch, centrifugal clutch, electromagnetic clutch.

Gear box: sliding mesh gear box, constant mesh gear box, synchromesh gear box, epicyclic gear box, overdrive, torque converter, automatic transmission an overview.

Module IV

Universal coupling, propeller shaft, final drive, Steering mechanisms, wheel suspension.
Factors for wheel alignment: camber, caster, kingpin inclination, toe–in, toe–out.
Brakes: Types of brakes, Braking requirements, drum brake and disc brakes, brake efficiency, stopping distance, fading of brakes, Mechanical, Hydraulic and Pneumatic brakes, Power assisted brakes. Anti-lock braking systems.
Electrical systems: Electrical lighting system, brake lighting system, warning system and indicators.

References:

1. Newton, Steed and Garette, Motor Vehicle, 2nd edition., Butterworths, (1989).
2. Kirpal singh, Automobile Engineering Vol- I & Vol- II, Standard Publishers Distributors, (2004).
3. Heitner Joseph, Automotive mechanics, 2nd edition, East- west press, (1974).
4. William Harry Crouse, Automotive mechanics, 10th edition, McGraw Hill book Co., (2007).
5. Giri, N.K., Automobile mechanics, 7th Ed, Khanna publishers, (1996).
6. Giles, K.G., Steering, Suspension and Tyres, Illiffe Books Ltd., London, (1988).
7. Gupta, R. B., Automobile Engineering, Tech India publication series, 9th edition, (2014).
8. Young A. P., and Griffiths, Automotive Electrical systems, Elsevier Butterworth Heinemann, 3rd edition, (2004).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1705 E1: AEROSPACE ENGINEERING

Course Objectives:
To impart knowledge on flow over aerofoils, aircraft performance and stability.

Course Outcomes:
On completion of this course the student will be able:
1. To know the variations of properties in the international standard atmosphere.
2. To gain knowledge 2D viscous flow over bodies.
3. To understand aircraft performance and stability.
4. To learn about the principles of wind tunnel testing.

Module I
The atmosphere: characteristics of troposphere, thermosphere, ionosphere, pressure –temperature- density variations in the international standard atmosphere, correction of charts, The standard atmosphere.
Review of basic fluid dynamics**:** continuity, momentum, and energy equations for compressible and incompressible flows, static, dynamic and stagnation pressure, stagnation enthalpy, temperature.

Module II
Aerodynamics: 2D viscous flow over bodies, 2D airfoils, nomenclature and classification, pressure distribution in viscid and real flows, circulation theory of air foils, centre of pressure and aerodynamic centre, 2D air foil characteristics, aspect ratio, induced drag, calculation of induced drag from momentum considerations, skin friction and form drag – Drag divergence - Propellers - Blade element theory, propeller coefficients and charts.

Module III
Aircraft performance**:** flight envelops, v-n diagrams for manoeuvres, straight and level flight, gliding and climbing, rate of climb, service and absolute ceilings, gliding angle and speed of flattest glider take off, landing performance and length of run way required, range and endurance of aero planes, charts for piston and jet engine aircraft, aircraft instruments - Qualitative ideas of Stability.

Module IV
Aircraft engines: thrust equations- thrust power, propulsive power, propulsive efficiency, principle of turbo jet engines, engine performance characteristics – Rocket engines.
Principles of wind tunnel testing: open and closed types of wind tunnels, wind tunnel balances, pressure and velocity measurements, supersonic wind tunnels.

Note: Standard Atmospheric tables is permitted in the exam hall.

References:

1. John D Anderson, Introduction to flight, 7th Edition, McGraw Hill, (2011).
2. Kermode, A. C., Mechanics of flight, 11th Edition, Prentice Hall, (2006).
3. Francis J. Hale, Aircraft performance selection & Design, John Wiley & Sons, (1984).
4. Houghton & Brock, Aero dynamics for Engg. Students, 2nd edition, Hodder & Stoughton Educational, (1977).
5. Piercy, N. A. V., Aerodynamics, The English Universities Press, (1944).
6. Dommasch, D. O., Sherby S. S., Connolly T. F., Airplane Aerodynamics, Pitman Publishing, (1967).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1705 E2: FINITE ELEMENT METHOD

Course Objectives:
To analyse one, two and three dimensional problems using finite element analysis.

Course Outcomes:
On completion of this course the student will be able:
1. To understand the concepts of variational methods of approximation.
2. To analyse one dimensional problems using finite element analysis.
3. To analyse two dimensional problems using finite element analysis.
4. To use alternative formulations for 3D problems using FEA.

Module I
Linear vector spaces- Linear transformations and functionals- linear, bilinear and quadratic forms- theory of normed spaces- theory of inner products spaces- concepts from variational calculus- variational methods of approximation- Ritz method- weighted residual method- Galerkin method- subdomain method- collocation method.

Module II
Finite element analysis of one dimensional problems- procedure- I-D elements and interpolation functions-analysis of one dimensional second and fourth order equations- approximation errors in FEM- computer implementation.

Module III
Finite element analysis of two dimensional problems- 2-D elements and interpolation functions- 2^{nd} order equations involving a scalar valued function- comments on mesh generation and composition of boundary condition- analysis of plane elasticity and incompressible fluid flow problems- time dependent problems - transient heat transfer- isoparametric elements and numerical integration.

Module IV
Alternative formulations - the least square formulations- the mixed formulation- eigen value problem- non linear problems- 3-D elements and interpolation functions- formulation of 3-D problems (2 & 3-D Navier Stokes equations, 3D heat transfer equations).

References:

1. Reddy J. N., An Introduction to Finite Element Method, McGraw Hill, (2005).
2. Reddy J. N., Applied Functional Analysis and Variational Methods in Engineering, McGraw Hill, (1986).
3. Zienkiewicz, O., Finite Element Method, 5^{th} Edition, Butterworth Heinemann, (2000).
4. Huebner K. H., The Finite Element Method for Engineers, John Wiley, (1975).
5. Saeed Moaveni, Finite element analysis, Prentice Hall, (2014).
6. Rao, S. S., The Finite Element Method in Engineering, 4^{th} Edition, Elsevier, (2005).

Type of Questions for End Semester Exam.

PART - A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1705 E3: QUALITY ENGINEERING

Course Outcomes:

To improve concepts on quality control, assurance and management, probability distributions for reliability and reliability systems.

Course Outcomes:

On completion of this course the student will be able:

1. To understand the concepts of quality, quality control, quality assurance, and quality management.
2. To apply techniques of statistics and probability to assess, analyze and improve quality related issues.
3. To study process capability, process capability indices and use statistical process control to monitor processes.
4. To understand the use and design of acceptance sampling plans.
5. To get the concepts of reliability, failure rate models, probability distributions for reliability, reliability of systems, availability and maintainability and life testing.

Module I

Fundamentals of the theory of probability: objectives and applications; variable and attributes, fundamentals concepts; patterns of variation, frequency distribution; cells and cell boundaries, cumulative frequency distribution, the normal distribution, average, measure of dispersion, statistical concept of universe.

Binomial distribution, mean and standard deviation, Poisson distribution as an approximation to the binomial, use of tables for solving Poisson problems.

Module II

Shewhart's control charts for variables: X bar and R charts, relationship between sample parameters and universe parameters, control limits for X bar and R charts, examples of processes in control, examples of processes out of control, process capability

Control chart for fraction defective: necessary steps for selection of sub groups, choice between p chart and npchart, control limits, charts showing control and lack of control, sensitivity of the p chart.

Control charts for defects: control limits for c charts; preparation and use of c charts.

Module III

Acceptance sampling : lot by lot acceptance using single sampling by attributes, operating characteristics curves, producer's risk, consumer's risk, AOQL, LTPD, quality protection, selection of sampling plans, choice of sampling plans to minimize average total inspection, ATI curves, double and sequential sampling plans, concept of AQL

Module IV

Life testing and reliability: concept & definition of reliability, analysis of life test, failure distribution- probability of equipment failure, conventional model, failure rate, MTBF, OC curves ,exponential reliability function, series, parallel, and combinational reliability, redundant system, maintainability, and availability.

References:

1. Grant, E. L., Statistical Quality Control, McGraw Hill, (1996).
2. Srinath, L.S., Reliability Engineering, East West Press, (2005).
3. Mahajan, Statistical Quality Control, Dhanpat Rai Publications, (2012).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1705 E4: MECHANICAL BEHAVIOUR OF MATERIALS

Course Objectives:
To impart the concept of elastic, permanent, plasctic and high temperature deformation in materials.

Course Outcomes:
On completion of this course the student will be able:
1. To understand the elastic deformation of materials and viscoelasticity.
2. To learn about the permanent deformation and slip line field theory.
3. To study dislocations and plastic deformation in single and polycrystalline materials.
4. To learn about high temperature deformation of crystalline materials.

Module I
Elastic deformation-Description of stress at a point-state of stress in two and three dimensions-stress tensor-Mohr's circle-description of strain at a point-Mohr's circle of strain- hydrostatic and deviator component of stress-elastic stress-strain relations-strain energy-anisotropy of elastic behaviour-rubber elasticity-viscoelasticity-mechanical damping.

Module II
Permanent deformation-Flow curve- True stress and true strain-yielding criteria for ductile metals-combined stress tests- yield locus-anisotropy in yielding-yield surface and normality-octahedral shear stress and shear strain-Invariants of stress and strain-Plastic stress –strain relations-Two dimensional plastic flow-slip line field theory.

Module III
Dislocations-Edge, screw and mixed dislocations-Properties of dislocations-dislocation stress fields, energies, forces between dislocations, kinks in dislocations, dislocation velocities-Dislocation geometry and crystal structure-slip systems-partial dislocations, interaction of dislocations, dislocation density and macroscopic strain-Plastic deformation in single and polycrystalline materials-initiation of plastic flow in single crystals-stress strain behaviour of single crystals-plastic flow in polycrystals.

Module IV
High temperature deformation of crystalline materials- creep mechanism, creep in two phase alloys, independent and sequential processes- deformation mechanism map- Engineering aspects of creep design –creep resistance as related to n\material properties and structure, estimates of creep behaviour, strain rate sensitivity and superplasticity, mechanisms of superplasticity.

References:

1. Dieter, G. E., Mechanical Metallurgy, McGraw Hill, (2001).
2. Courtney, T. H., Mechanical Behaviour of Materials, 2nd Edn., Waveland Pr Inc., (2005).
3. Hertzberg R. W., Deformation and Fracture Mechanics of Engineering Materials, 4th Edn., John Wiley & Sons, (1995).
4. McClintock F. A. and Argon A. S., Mechanical Behavior of Materials, 1st Ed., Addison- Wesley Publications, (1966).
5. Reed Hill R. E., Physical Metallurgy Principles, 2nd Ed., Affiliated East-West Press, (2008).

6. Honeycombe R. W. K., Plastic Deformation of Metals, 2nd Edn., Edward Arnold, (1984).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1705 E5: SUPPLY CHAIN MANAGEMENT

Course Objectives:
To recognize the main drivers of supply chain performance, measure them using precise metrics and also identify the modes of transportation.

Course Outcomes:
On completion of this course the student will be able:
1. To define a supply chain and understand its different structures and its importance to the success of a firm.
2. To understand the concept of strategic fit between the SC strategy and the competitive strategy of the firm and how to achieve it.
3. To identify the main drivers of supply chain (SC) performance and measure them using precise metrics.
4. To assess the importance of distribution networks and the different options available for their design.
5. To develop a methodological framework for network design and facility location and use optimization models and techniques for facility location and capacity allocation.
6. To use safety inventory to deal with demand uncertainty in the supply chain.
7. To understand the importance of transportation in the SC, and identify the different modes of transportation and the role played by infrastructure and policies.

Module I
Introduction and a strategic view of supply chains, Evolution of Supply Chain Management (SCM), Importance of the supply chain, Decision phases in a supply chain, Process views of supply chain, Enablers of supply chain performance, Supply chain performance in India – challenges in maintaining supply chain in India, Supply chain strategy and performance measures– competitive and supply chain strategies – customer service and cost trade – offs, Achieving strategic fit, Supply chain performance measures – enhancing supply chain performance.

Module II
Supply chain drivers – framework for structuring drivers, Introduction to inventory management – types of inventory – inventory related costs, Managing inventories in a supply chain – single stage inventory control, Inventory control policies – periodic review and continuous review – deterministic and probabilistic models – managing cycle stock, safety stock and seasonal stock.

Module III
Drivers of transportation decisions – modes of transportation– choices and comparison of their performance measures, Devising a strategy for transportation – distribution network design options for a transportation network – cross docking practices, Network design and operation decisions – role of network design in the supply chain – factors influencing network design decisions – framework for network design decisions.

Module IV
Models for facility location and capacity allocation – network optimization models – capacitated plant location models – gravity location models – network

operations model, Strategic role of units in the network, Innovations in supply chains– supply chain integration – internal and external, Bullwhip effect – quantifying the bullwhip effect, Remedial strategies for coping with the bullwhip effect.

References

1. Shah, J., Supply Chain Management –Text and Cases, Pearson Education, (2009).
2. Chopra, S., and Meindel, P., Supply Chain Management: Strategy, Planning, and Operation, Pearson Prentice Hall, (2007).
3. Levi, D.S., Kaminsky, P., Levi, E.S., and Shankar, R., Designing and Managing the Supply Chain: Concepts, Strategies, and Case Studies, Tata McGraw Hill, (2008).
4. Chase, R.B., Shankar, R., Jacobs, F.R., and Aquilano, N.J., Operation and Supply Chain Management, Tata McGraw Hill, (2010).
5. Shapiro, J.F., Modeling the Supply Chain, Thomson Learning, (2007).
6. Vollmann, T.E., Berry, W.L., Whybark, D.C., and Jacobs, F.R., Manufacturing Planning and Control for Supply Chain Management, Tata Mc Graw Hill, (2006).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-17L1: THERMAL ENGINEERING LAB

Course Objectives:
To get exposed to the performance of different types of engines, load testing procedures, fuel consumption rate, calculation of power and efficiency of engines and COP of refrigeration systems.

Course Outcomes:
On completion of this course the student will be able:
1. To design the required experiments.
2. To conduct different performance tests on engines and refrigeration equipments using the theoretical knowledge
3. To tabulate the data and use necessary theoretical knowledge to find out the results
4. To interpret the results.

Practicals:

1. Determination of flash and fire points of fuels and oils
2. Viscosity of fuels and oils and its variation with temperature
3. Determination of Calorific values of fuels
4. Performance of simple journal bearings
5. Valve timing diagrams of I.C. engines
6. Performance test on Petrol and Diesel engine
7. Forced convection heat transfer for tube flow
8. Performance test on air compressors
9. Test on air conditioning equipment and refrigeration equipment.

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

ME15-17L2: AUTOMATION LAB

Course Objectives:
To get exposed to hydraulic and pneumatic actuators, concepts of stepper motors, familiarisation with data acquisition systems and softwares for PLC controllers.

Course Outcomes:
On completion of this course the student will be able:
1. To make the students learn the basic concepts of hydraulic and pneumatic actuators and their applications in product and processes.
2. To make the students learn the basic concepts of stepper motors, AC/DC motors and their applications in products and processes
3. To interface hydraulic, pneumatic actuators, stepper motors, AC/DC motors and sensors with PC/ PLC (Programmable Logic Controllers) based controllers using LabView Software.
4. To learn and use SCADA systems for data acqiuisition and control of product and Processes

Practicals:
Application of hydraulics and pneumatic actuators, stepper motors, A/C and D/C servomotors and various types of sensors and their interface with PC based controllers.

Pneumatic and Hydraulic Circuits
1. Exercises on Pneumatic circuits using Pneumatic trainer unit.
2. Exercises on Hydraulic circuits using Hydraulic tainer unit
3. Exercises on electro pneumatic and electro hydraulic circuits using trainer kits
4. Exercises on Hydraulic and Pneumatic circuits using PLC and PC with LabView

Electromechanical Devices
5 Exercises on Motion controller using AC/DC motor, servo motors and encoders to determine the operating characteristics.
6 Exercises on stepper motor to determine the operating characteristics.
7 Exercises on PC based based data acquisition system and LabView.
8 Study of SCADA and PLC programming
9 Interfacing SCADA with PLC and PC.
10 Controlling variable speed drive through PLC/SCADA

Sensors
11 Study of Sensors and Transducer – Potentiometer, Strain gauge, Torque, LVDT, Hall – Effect, Speed, Vibration, Pressure, Optical transducer and Temperature transducer.
12 Interfacing various sensors with PC based data aquisition systems and exercises on data aquisition and analysis using Labview Software.

Note : 50 % marks is earmarked for continuous evaluation, and 50% marks for end semester examination to be conducted by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

GE15-17L3: ENTREPRENEURSHIP DEVELOPMENT

Course Objectives:

Study of this subject provides an understanding of the scope of an entrepreneur, key areas of development, financial assistance by the institutions, methods of taxation and tax benefits, etc.

Course Outcomes:
On completion of this course the student will be able to:
1. Develop awareness about the importance of entrepreneurship opportunities available in the society
2. Get acquainted with the challenges faced by the entrepreneur

Exercises:

1) To study the types of entrepreneurs and the factors affecting entrepreneurial growth.
2) To make an assessment of the major motives influencing an entrepreneur
3) To make an overview of the various stress management techniques
4) How to identify and select a good business opportunity?
5) Preparation of a techno economic feasibility report for a given project
6) Preparation of a preliminary project report for a given project
7) To identify the various sources of finance and management of working capital
8) Carry out the costing and break even analysis of a proposed project
9) Preparation of a PERT / CPM chart for the various activities involved in a project
10) To make a study of the various causes and consequences of sickness in small business and identify corrective measures.

References:

1. Roy Rajeev, Entrepreneurship, Second edition, Oxford Latest Edition, (2011).
2. Gordon E. & Natarajan, K., Entrepreneurship Development, Fourth edition, Himalaya, (2007).
3. Coulter, Entrepreneurship in Action, Second edition, PHI, (2008).
4. Jain, P. C., Handbook for New Entrepreneur, Oxford University Press, (2003).
5. Khanka, S. S., Entrepreneurial Development, Fifth edition, S. Chand and Co., (2013).

Note: *There will only be continuous evaluation for this course. The evaluation will be based on the performance of the student in the exercises given above. A minimum of 50% marks is required for a pass.*

ME15-17L4: PROJECT PHASE 1 & INDUSTRIAL INTERNSHIP

Course Objectives:
To identify a research / industry related problem for the undergraduate project work with the guidance of the respective faculty and prepare a design and work plan.

Course Outcomes:
On completion of the Project the student will be able to:

1. Conduct literature survey in a relevant area of one's course of study and finally identify and concentrate on a particular problem.
2. Formulate a project proposal through extensive study of literature and / or discussion with learned resource persons in industry and around.
3. Generate a proper execution plan of the project work to be carried out in Phase II through thorough deliberations and improve presentation skills.

Each batch comprising of 4 to 6 students shall identify a project related to the curriculum of study. At the end of the semester, each student shall submit a project synopsis comprising of the following.

- Application and feasibility of the project
- Complete and detailed design specifications.
- Block level design documentation
- Detailed design documentation including block/line diagrams and algorithms
- Project implementation action plan using standard presentation tools

Guidelines for evaluation:

i)	Attendance and Regularity	10
ii)	Quality and adequacy of design documentation	10
iii)	Concepts and completeness of design	10
iv)	Theoretical knowledge and individual involvement	10
v)	Quality and contents of project synopsis	10
	Total	**50** Marks

†Industrial internship of a minimum duration of 2 weeks during May - June vacation before the commencement of 7th Semester classes is desirable

Note: Points (i)-(iii) to be evaluated by the respective project guides and project coordinator based on continuous evaluation. (iv)-(v) to be evaluated by the final evaluation team comprising of 3 internal Examiners.

ME15-1801: COMPRESSIBLE FLUID FLOW

Course Objectives:

To apply governing equations for isentropic, Fanno and Rayleigh flows, occurance of normal and oblique shocks and also get exposed to flow measuring/visualizing devices.

Course Outcomes:

On completion of this course the student will be able:

1. To understand the significance of governing equations such as continuity, momentum and energy equations in fluid flows with density variation and get concepts of adiabatic flow, isentropic flow, static and stagnation conditions existing in a compressible flow
2. To analyze the occurrence of normal shocks, oblique shocks and expansion waves in propulsive devices
3. To study the influence of friction and heat transfer in the flow characteristics
4. To get exposure to the devices used for the measurement of pressure, velocity, flow, density, Mach number and temperature

Module I

Introduction to gas dynamics : System and Control Volume approach, Conservation of Mass, Momentum and Energy, Steady Flow Energy Equation, Entropy changes in fluid flow, Stagnation state, Sonic state, Mach number, Effect of Mach number on compressibility, Classification of fluid flow based on Mach number, Acoustic wave propagation speed, Mach cone.

Isentropic flow with variable area: Isentropic flow of an ideal gas, Comparison of isentropic and adiabatic processes, Mach number variation with Area, Mass flow rate, Critical state, Geometric chocking, Area ratio as a function of Mach number, Impulse function, Isentropic flow through Convergent nozzle and Convergent Divergent nozzle, Isentropic flow through Diffusers.

Module II

Normal Shocks : Fundamental relations for normal shock, Prandtl Meyer relation for normal shock, Rankine-Hugoniot relation for normal shock, Change in entropy across a shock, Impossibility of shock in subsonic flow, Strength of a shock, Variation of flow properties across a normal shock.

Oblique Shocks and Expansion waves : Fundamental relations, Prandtl’s relation and Rankine-Hugoniot relation for oblique shock, θ-β-M diagram, Reflected shocks, Variation of flow parameters, Expansion of supersonic flow, Supersonic flow around a convex corner, Prandtl Meyer angle, Mach Waves.

Module III

Fanno flow : Adiabatic flow in constant area duct with friction, Fanno line, Fanno relation for perfect gas, Friction chocking, Variation of Mach number with duct length, Variation of flow properties.

Rayleigh flow : Frictionless flow in constant area duct with heat transfer, Raleigh line, Rayleigh equations for a perfect gas, Thermal chocking, Maximum heat transfer, Variation of flow properties.

Module IV

Methods of flow measurement : Methods of measurement of pressure, temperature, density and velocity, Pitot tube, Prandtl Pitot static tube, Supersonic Pitot tube, Shock tube, Rayleigh Supersonic Pitot formula, Temperature recovery factor, Hot wire anemometer, Working principle of Shadow graph, Velocimeter, Schlieren

apparatus and Interferometer, Wind Tunnels – Subsonic and Supersonic Wind tunnels.

Note: Gas Table is permitted for the examination

References:

1. Shapiro, Dynamics and thermodynamics of compressible fluid flow, 1st edition, Wiley, (1953).
2. John D. Anderson, Modern Compressible Flow, Mc Graw Hill, (2003).
3. Babu, V., Fundamentals of Compressible Flows, Ane Publishers, (2008).
4. James John, Theo Keith, Gas Dynamics, Pearson, (2005).
5. Patrick H. Oosthuizen, William E. Carscallen, Introduction to Compressible fluid flow, Taylor and Francis, (2014).
6. Yahya, S. M., Fundamentals of compressible flows, 2nd edition, New Age International Publishers, (1991).
7. Balachandran, P., Fundamentals of Compressible Fliuid Dynamics, Prentice Hall, (2006).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1802: PRODUCTION TECHNOLOGY

Course Objectives:

To get information on kinematics of machine tools, non-traditional machining processes and hydraulic operation of machine tools.

Course Outcomes:

On completion of this course the student will be able:

1. To understand the kinematics of machine tools.
2. To study the non traditional machining processes
3. To learn the basic concepts of powder metallurgy process.
4. To get knowledge on the hydraulic operation of machine tools

Module I

Kinematics of Machine Tools: Selection of range of speeds and feeds, layout of speeds, graphical representation of speed and structural diagrams, ray diagrams for machine tool gear boxes, speed chart, speed box design, feed chart, feed box design, gearing diagram, stepped and step less regulation of speeds, feed and speed mechanisms in lathe, milling and drilling machines.

Module II

Non-traditional machining processes: Principles, machining unit, process characteristics and applications of Electro Discharge Machining, Electro Chemical Machining, Abrasive Jet Machining, Ultrasonic Machining, Electron Beam Machining, Laser Beam Machining, and Plasma Arc Machining-capability analysis of non traditional processes.

Module III

Powder Metallurgy: Definition and basic concept of the powder metallurgy process, powder manufacture, characteristics of metal powders, mixing and blending, compacting, pre-sintering, sintering, hot pressing, secondary P/M operations like infiltration, impregnation, sizing, properties of P/M products, product applications, advantages & disadvantages.

Module IV

Hydraulic operation of Machine Tools: Elements of a hydraulic circuit, JIC symbols hydraulic valves, flow, pressure and direction control valves, oil hydraulic circuits of shaping, drilling and grinding machines.

Estimation and Costing: estimation and costing in foundry shop, sheet metal shop, welding shop, and machine shop- simple examples in lathe, drilling, milling, shaping and grinding machines.

References:

1. Geoffrey Boothroyd, Fundamentals of Metal Machining and Machine Tools, 3rd Ed., CRC Press, (1988).
2. Sen J. N., & Amithab Bhattacharya, Principles of Machine tools, New central book agency, (1988).
3. Mehta, N. K., Machine tool design & Numerical control, Tata McGraw-Hill Education, (2012).
4. Sharma, P. C., A text book of production engineering, 2nd edition, S Chand & Co., (2014).
5. Dalela, Manufacturing Science & Technology Vol II, Umesh Publication, (1999).
6. Pandey P. C., and Shah, H. S., Modern machining processes, Tata McGraw Hill, (1980).

7. Kronenberg, M., Machining Science & their application, Pergamon Press, (1966).
8. Jones, E. J. H., Production Engineering: Jig and Tool Design, Read Books, (2009).
9. Cyril Donaldson, Goold, V. C., Tool Design, Mc Graw Hill, (1976).
10. ASTME, Fundamentals of Tool Design, Prentice- Hall, (1962).
11. Ranganath, B. J., Metal Cutting and Tool Design, Vikas Publishing House, (1994).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1803: OPERATIONS RESEARCH

Course Objectives:

To apply linear programming techniques, solve transportation problems and apply game and queueing theory.

Course Outcomes:

On completion of this course the student will be able:

1. To understand the fundamental theorem of linear programming.
2. To get the concept of Simplex method
3. To analyze transportation problems
4. To gain knowledge on the Game Theory and Queueing Theory

Module I

Linear Algebra : Review of the properties of matrices and matrix operations, partitioning of matrices, vectors and Euclidean spaces, unit vectors, sum vectors, linear dependence, bases, spanning set, rank, product form of inverse, simultaneous equations, basic solutions, point sets, lines and hyper planes, convex sets, extreme points.

Module II

Linear Programming : Fundamentals Theorems of Linear programming, Mathematical formulation of the problem, Assumption of Linear programming, graphical Method.

Simplex Method – Slack & surplus variables, basic feasible solution, reduction of a feasible solution to basic feasible solution, artificial variables, optimality conditions. Charnes ‘M’Method.

Module III

Transportation Problems : Definition of a transportation model, North-west Corner Rule, Least Cost or Matrix Minima Method, Vogel’s approximation method, Degeneracy in Transportation problem.

Assignment Problems: Theorems of Assignment problem, Zero assignments, Unbalanced problems. Comparison with Transportation Models.

Module IV

Game Theory : Von Neuman’s theorem, saddle points, pure and mixed strategies, formulation of primal and dual LP problems for mixed strategies, dominance, graphical solutions.

Queueing Theory : Basic structures of queueing models, exponential and poisson distribution, Kendall’s Notation, Queueing models – M/M/1 and M/M/K.

Simulation : Definition, Simulation Models – Monte-Carlo Simulation, Application of Simulation, Advantages and limitations of Simulation.

References:

1. Goel and Mittal, Operations Research, Pragti Prakasan, Meerut, (2000).
2. Kanti Swarup, Gupta and Manmohan, Operations Research, Sultan Chand and Sons Publishers, New Delhi, (1977).
3. Kalavathy, S., Operations Research, Vikas Publishing House, (2002).
4. Kothari, C. R., Introduction to operational research, Vikas Publishing House, (2009).
5. Nair, N. G., Resource Management, Vikas Publishing House, (2002).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1804 E1: PROPULSION ENGINEERING

Course Outcomes:
To acquire information on types of propulsive devices, component efficiencies and calculation of thrust and power for aircraft and rocket engines.

Course Outcomes:
On completion of this course the student will be able:
1. To understand the different types of propulsive devices
2. To calculate the thrust and thrust power and also analyse the component efficiencies in various jet engines.
3. To get a concept and operating principles of rocket motors and their performance parameters
4. To have an understanding on aspects of launching and boost dynamics

Module I
Fundamentals of propulsion: Types of propulsive devices - Turbo prop, Turbo jet, Turbo fan, Turbo shaft, Ram jet, Scramjet, Pulse jet, Ram rocket, Comparative study of performance characteristics, Propellers, Advance ratio, Types of combustion chambers, Operating characteristics, Fuel injection in combustion chamber, Factors limiting turbine design, materials for turbine blades, cooling of turbine blades, Surging in compressors and its control, comparison of centrifugal and axial flow compressors

Module II
Thrust equation, Calculation of thrust and thrust power, propulsive efficiency, thermal efficiency, transmission efficiency, and overall efficiency of turbo jet engines, isentropic flow through nozzles, Thrust Augmentation methods, Analysis of turbo jet engine cycle, Component efficiencies, Diffuser efficiency, Compressor efficiency, Burner efficiency, Turbine efficiency, Nozzle efficiency, Velocity coefficient, Performance characteristics of a turbo jet engine, Analysis of Turboprop, Turbofan and Ramjet engine cycles.

Module III
Rocket Propulsion: General operating principles of rocket motors, performance parameters for rocket motors and their relationship, Rocket equation, Burn out velocity, Specific Impulse, Specific Propellant Consumption, Characteristic Velocity, Thrust Vector Control, Altitude gain, Solid propellant Rocket motor, Grain configuration, Propellant area ratio, Liquid propellant Rocket engines, Gas pressure feed systems, Turbo-pump feed system, Injectors, Hybrid rockets, Nuclear, Solar and Electrical rockets.

Module IV
Liquid fuels, Liquid Oxidizers, Liquid monopropellants, Cryogenic fluids as rocket propellants, Properties of cryogenic rocket propellants, Cryogenic rocket engine, Manufacture of cryogenic fluids, Igniters – Pyrotechnic & Pyrogen Igniters, Combustion instability, Cooling of Thrust Chambers – Radiation cooling, Ablative cooling, Regenerative cooling, Film cooling, Transpiration cooling, Aspects of Launching, Boost dynamics, Orbit equation, Space vehicle trajectories, Kepler’s Law, Atmospheric Re-entry of Space vehicles.

Note: *Gas table is permitted in the exam hall.*

References:

1. Zucrow, Air craft and missile propulsion, John Wiley, (1958).
2. Sutton, G. P., Rocket Propulsion Elements, 8th Edition, John Wiley & Sons, (2010).
3. Babu, V., Fundamentals of Propulsion, Ane Publishers, (2009).
4. Hosny, Propulsion Systems, University of South Carolina Press, (1974).
5. Treager, Aircraft Gas Turbine engine technology, 3rd Edition, TMH, (1995).
6. Cohen & Rogers, Gas Turbine Theory, 6th Edition, Pearson, (2008).
7. Mathur & Sharma, Gas Turbines & Jet and Rocket Propulsion, Standard Pub., (1976).
8. Yahya, S. M., Fundamentals of Compressible Flow, New Age International Publishers, (1991).

Type of Questions for End Semester Exam.

PART - A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)

Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.

Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.

Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.

Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1804 E2: MATERIALS MANAGEMENT

Course Objectives:
To get the concept of static and dynamic inventory problems, process and lot sizing in MRP

Course Outcomes:
On completion of this course the student will be able:
1. To understand the scope, objectives and phases in material management.
2. To get concept of static inventory problems.
3. To study dynamic inventory problems under risk.
4. To learn about lot sizing in material requirement planning.

Module I
Introduction: Scope, objectives and phases in materials management.
Procurement: purchase procedure, tender, earnest money, security deposit, purchase order, vendor rating. Receipt: Invoice, cash memo, inspection. Storage: methods of storage.
Selective control techniques of inventory – ABC & VED analysis.
Inventory Theory: objectives of keeping inventory, structure of inventory problems and their analysis, relevant cost.

Module II
Static inventory problems under risk : general characteristics, Christmas tree problem, total cost matrix, opportunity cost matrix, cost of risk, mathematical formulation of discrete and continuous cases.
Dynamic inventory problems under certainty: general characteristics, optimal lot size models with constant demand and infinite delivery rate with and without back ordering, quantity discounts.

Module III
Dynamic inventory problems under risk: general characteristics, basic kinds of inventory control systems – demand probability distribution – approximate methods to find optimal P & Q systems of inventory, optimal selling policy with fluctuating prices.

Module IV
Material requirement planning: master production schedule, bill of materials, inventory stock, files, MRP process, logic and computational procedure using simple example, lot sizing in MRP

References:

1. Deb, A., Materilas Management, Academic Publishers, India, (1974).
2. Starr & Miller, Inventory control: theory and practice, Prentice Hall, (1997).
3. Monks, G., Operations Management, 3rd Edition, McGraw Hill, (1987).
4. Kanishka Bedi, Production & Operations Management, 2nd Ed., Oxford University Press, (2007).

Type of Questions for End Semester Exam.

PART - A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1804 E3: COMPUTATIONAL FLUID DYNAMICS

Course Outcomes:
To classify partial differential equations, conduct stability analysis for implicit and explicit schemes and apply boundary conditions for solving equations.

Course Outcomes:
On completion of this course the student will be able:
1. To understand the classifications of partial differential equations
2. To get an insight on consistency, stability, error analysis and finite difference formulations
3. To use numerical algorithms for the solving Navier Stokes equations
4. To attain information on grid, domain, boundary conditions, solving equations and post processing of the data

Module I
Classification of partial differential equations – system of first and second order partial differential equations – initial and boundary conditions – finite difference formulations – finite difference equations – finite difference approximation of mixed partial derivatives.

Module II
Parabolic partial differential equations – explicit methods – implicit methods – parabolic equation in two space dimensions – consistency, stability and error analysis of finite difference equations – artificial viscosity.

Module III
Elliptic equations – finite difference formulations – solution algorithms – finite difference formulations – splitting methods – multiple step methods.

Module IV
Scalar representation of the Navier-Stokes equations – model equations – numerical algorithms – incompressible Navier-Stokes equation – primitive variable and vorticity -stream function formulations – Poisson equation for pressure – numerical algorithms – boundary conditions – staggered grids.

Reference:

1. Anderson, Computational Fluid Dynamics, 1st edition, Mcgraw Hill Education, (1995).
2. Hoffmann Klaus, Computational Fluid Dynamics for Engineers vol.2, Engineering Education System, (1993).
3. Malalasekhar & Veerstag, Introduction to Finite Volume Method, Pearson, (2010).
4. Sundararajn & Muralidhar, Computational Fluid Flow and Heat Transfer, Narosa Publishing House, (2001).
5. Fletcher, Computational Technique for Fluid Dynamics, Springer- Verlag, (2001).
6. Patankar Suhas, Numerical Heat Transfer and Fluid Flow, CRC Press, (1980).

Type of Questions for End Semester Exam.

PART - A

Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1804 E4: CRYOGENIC ENGINEERING

Course Objectives:
To get the concept of gas liquefaction systems and cryogenic storage vessels.

Course Outcomes:
On completion of this course the student will be able:
1. To understand about the low temperature properties of engineering materials.
2. To learn about the critical components of the gas liquefaction systems.
3. To study cryogenic fluid storage and transfer systems.
4. To get insight on the insulation and transportation of cryogenic storage vessels.

Module I
Introduction to Cryogenic Systems, Historical development, Low Temperature properties of engineering materials, Mechanical properties-Thermal properties-Electric and magnetic properties –Cryogenic fluids and their properties. Applications of Cryogenics: Applications in space, Food Processing, super Conductivity, Electrical Power, Biology, Medicine, Electronics and Cutting Tool Industry.

Module II
Liquefaction systems: ideal system, Joule Thomson expansion, Adiabatic expansion, Linde Hampson Cycle, Claude & Cascaded System, Magnetic Cooling, Stirling Cycle Cryo Coolers.
Gas liquefaction systems: Introduction -Production of low temperatures-General Liquefaction systems-Liquefaction systems for Neon. Hydrogen and Helium – Critical components of Liquefaction systems.

Module III

Cryogenic Refrigeration systems: Ideal Refrigeration systems-Refrigeration using liquids and gases as refrigerant-Refrigerators using solids as working media, cryogenic fluid storage and transfer systems.

Module IV
Cryogenic Storage vessels and Transportation, Thermal insulation and their performance at cryogenic temperatures, Super Insulations, Vacuum insulation, Powder insulation, Cryogenic fluid transfer systems, Pressure flow-level and temperature measurements – Types of heat exchangers used in cryogenic systems. Cryo pumping Applications.

References

1. Klaus D.Timmerhaus, Thomas M. Flynn, Cryogenic Process Engineering, Plenum Press, (1989).
2. Randal F. Barron, Cryogenic systems, McGraw Hill, (1986).
3. Scott, R. B., Cryogenic Engineering, VanNostrand Co., (1962).
4. Flynn T. M., Cryogenic Engineering, Taylor and Francis Inc., (2005).
5. Mamata Mukhopadhyay, Fundamentals of Cryogenic Engineering, Prentice Hall, (2010).
6. Thipse, S. S., Cryogenics – A Text book, Narosa Publishing House, (2013).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-1804 E5: THEORY OF PLATES AND SHELLS

Course Objectives:
To analyse circular plates under axi-symmetric loading and simply supported cylindrical shell.

Course Outcomes:
On completion of this course the student will be able:
1. To study small deflection theory of thin plates
2. To analyse of circular plates under axi-symmetric loading
3. To understand the equations of shell surface.
4. To study membrane theory and bending theory for cylindrical shell.

Module I
Introduction of plate: Thin and thick plates, small and large deflections. Small deflection theory of thin plates: Assumptions, Moment Curvature relations. Stress resultants. Governing differential equation in Cartesian coordinates, various boundary conditions, Analysis of Rectangular Plates, Navier solution for plates with all edges simply supported. Distributed loads, point loads and rectangular patch load. Levy's Method: Distributed load and line load. Plates under distributed edge moments. Raleigh- Ritz approach for simple cases in rectangular plates.

Module II
Circular Plates, Analysis of circular plates under axi-symmetric loading. Moment Curvature relations. Governing differential equation in polar coordinates. Simply supported and fixed edges. Distributed load, ring load, a plate with a central hole.

Module III
Introduction of shell: Classification of shells on geometry, thin shell theory, equations to shell surfaces, stress resultants, stress- displacement relations, compatibility and equilibrium equations. Shells of Revolution: Membrane theory, equilibrium equations, strain displacement relations, boundary conditions, cylindrical, conical and spherical shells.

Module IV
Circular cylindrical shells, Circular cylindrical shells: Membrane theory: Equilibrium equations, strain displacement relations, boundary conditions. Bending Theory: Equilibrium equation, strain displacement relations, governing differential equation, solution for a simply supported cylindrical shell.

References:
1. Timoshenko, S.P., Winowsky. S., & Kreger, Theory of Plates and Shells, Mc Graw-Hill, (1990).
2. Flugge, W., Stresses in Shells, Springer Verlag, (1985).
3. Timoshenko, S.P. & Gere, J. M., Theory of Elastic Stability, McGraw-Hill Book Co., (1986).

Type of Questions for End Semester Exam.

PART - A
Question No. I (a) to (j) – Ten short answer questions of 2 marks each with at least two questions from each of the four modules (10 x 2 = 20 marks).

PART - B (4 x 10 = 40 marks)
Question nos. II, III with sub sections (a), (b) ---- (10 marks each with options to answer either II or III) from Module I.
Question nos. IV , V with sub sections (a), (b) ----(10 marks each with options to answer either IV or V) from Module II.
Question nos. VI , VII with sub sections (a), (b) ----(10 marks each with options to answer either VI or VII) from Module III.
Question nos. VIII , IX with sub sections (a), (b) ----(10 marks each with options to answer either VIII or IX) from Module IV.

ME15-18L1: SEMINAR

Course Objectives:
To encourage and motivate the students to read and collect recent and relevant information from their area of interest confined to the relevant discipline from technical publications including peer reviewed journals, conferences, books, project reports, etc., prepare a report based on a central theme and present it before a peer audience.

Course Outcomes:
On completion of this course the student will be able to:
1. Identify and familiarize with some of the good publications and journals in their field of study.
2. Acquaint oneself with preparation of independent reports, name them based on a central theme and write abstracts, main body, conclusions and reference identifying their intended meaning and style.
3. Understand effective use of tools of presentation, generate confidence in presenting a report before an audience and improve their skills in the same.
4. Develop skills like time management, leadership quality and rapport with an audience.

Students shall individually prepare and submit a seminar report on a topic of current relevance related to the field of Mechanical Engineering. The reference shall include standard journals, conference proceedings, reputed magazines and textbooks and technical reports. The references shall be incorporated in the report following International standards reflecting the state-of-the-art in the topic selected. Each student shall present a seminar for about 30 minutes duration on the selected topic. The report and presentation shall be evaluated by a team of internal experts comprising of 3 teachers based on style of presentation, technical content, adequacy of references, depth of knowledge and overall quality of the seminar report.

ME15-18L2: PROJECT PHASE II

Course Objectives:

To enable students to apply any piece of theory and experiments which they have learned to a specific problem related to industry / research which is identified with the help of a guide in Phase I and solve it in Phase II.

Course Outcomes:

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

1. Realize various steps involved in conducting a project work, like literature survey, methodology adopted – field study / survey / experiments / numerical work, analysis of the data to arrive at final results and conclusions, etc.
2. Initiate a habit of proper report writing with all of its major components, proper style of writing and preparation of a distinct abstract and carved out conclusions.
3. Conceive the pros and cons of working in a team and the wonderful results which could evolve through team-work.
4. Present and defend self-prepared and corrected report (with the help of project guide) of a self-created work to a peer audience.

Each batch of students shall develop the project designed during the VII semester. The implementation phase shall proceed as follows:

- A detailed project report in the prescribed format shall be submitted at the end of the semester. All test results and relevant design and engineering documentation shall be included in the report.
- The work shall be reviewed and evaluated periodically

A committee consisting of the Project Coordinator (appointed by the Head of the Department / Division), project guide and at least one senior faculty member will carry out the assessment based on at least one interim review and a final review just before the submission of the project report.

The final evaluation of the project shall include the following.

Presentation of the work
Oral examination
Demonstration of the project against design specifications
Quality and content of the project report.

Guidelines for evaluation:

1.	Regularity and progress of work	20
2.	Work knowledge and Involvement	50
3.	End semester presentation and oral examination	50
4.	Level of completion & demonstration of Functionality / Specifications	50

5. Project Report – Presentation style and content	30
Total	**200** marks

Note: Points (i) and (ii) to be evaluated by the respective project guide and the project coordinator based on continuous evaluation. (iii)-(v) to be evaluated by the final evaluation team.

ME15-18L3: COMPREHENSIVE VIVA - VOCE

Course Objectives:
To test the student's learning and understanding of the theory and applications of the various concepts taught during the entire course of their programme and to prepare the students to face interviews in both the academic and industrial sectors.

Course Outcomes:
The student will be able to:
1. Refresh all the subjects covered during the programme
2. Gain good knowledge of theory and practice
3. Develop oral communication skills and positive attitude
4. Face technical interviews with confidence

Each student is required to appear for a comprehensive viva-voce examination at the end of the complete course work. The examination panel shall comprise of a minimum of one internal examiner and one external examiner, both appointed by the University. The examiners shall evaluate the students in terms of their conceptual grasp of the entire course of study and practical/analysis skills in the field.

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