JIS College of Engineering

Mechanical Engineering Department

Curriculum/Syllabus for B.Tech in Mechanical Engineering

Revised syllabus of B.Tech in Mechanical Engineering who were admitted in the academic session 2014-2018

SEMESTER I

A. THEORY							
Sl. No.	**Paper Code**	**Paper Name**	Contact Hours/ Week				
			L	**T**	**P**	**Total**	**Credit points**
1	ME101	ENGINEERING MECHANICS	3	1	0	4	3
2	M(ME)101	ENGINEERING MATHEMATICS - I	3	1	0	4	3
3	PH(ME)101	ENGINEERING PHYSICS - I	3	1	0	4	3
4	EC(ME)101	BASIC ELECTRONICS ENGINEERING	3	1	0	4	3
5	HU(ME)101	BUSINESS COMMUNICATION	2	0	0	2	2
B. PRACTICAL							
6	ME191	ENGINEERING GRAPHICS – I	0	0	3	3	2
7	ME192	WORKSHOP PRACTICE – I	0	0	3	3	2
8	PH(ME)191	ENGINEERING PHYSICS LAB – I	0	0	3	3	2
9	EC(ME)191	BASIC ELECTRONICS ENGINEERING LAB	0	0	3	3	2
10	HU(ME)181	BUSINESS COMMUNICATION LAB	0	0	2	2	1
			Total			32	23

SEMESTER II

A. THEORY							
Sl. No.	**Field**	**Subject**	Contact Hours/ Week				
			L	**T**	**P**	**Total**	**Credit points**
1	ME202	STRENGTH OF MATERIALS	3	1	0	4	3
2	M(ME)201	ENGINEERING MATHEMATICS – II	3	1	0	4	3
3	CH(ME)201	ENGINEERING CHEMISTRY	3	0	0	3	3
4	CS(ME)201	PROGRAMMING IN C	3	0	0	3	3
5	EE(ME)201	BASIC ELECTRICAL ENGINEERING	3	1	0	4	3
B. PRACTICAL							
6	ME291	ENGINEERING GRAPHICS – II	0	0	3	3	2
7	ME292	WORKSHOP PRACTICE – II	0	0	3	3	2
8	EE(ME)291	BASIC ELECTRICAL ENGINEERING LAB	0	0	3	3	2
9	CS(ME)291	PROGRAMMING IN C LAB	0	0	3	3	2
10	CH(ME)291	ENGINEERING CHEMISTRY LAB	0	0	3	3	2
			Total			33	25

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SEMESTER III

Sl. No.	Field	Subject	Contact Hours/ Week				
			L	T	P	Total	Credit points
1	ME301	ENGINEERING THERMODYNAMICS	3	1	0	4	3
2	ME302	FLUID MECHANICS - I	3	1	0	4	3
3	ME303	ENGINEERING MATERIALS	3	0	0	3	3
4	EE(ME)301	ELECTRICAL MACHINES	3	0	0	3	3
5	M(ME)301	ENGINEERING MATHEMATICS – III	3	1	0	4	3
6	PH(ME)301	ENGINEERING PHYSICS – II	3	1	0	4	3
B. PRACTICAL							
7	ME391	STRENGTH OF MATERIALS LAB	0	0	3	3	2
8	ME381	MACHINE DRAWING – I	0	0	3	3	2
9	EE(ME)391	ELECTRICAL MACHINES LAB	0	0	3	3	2
10	PH(ME)391	ENGINEERING PHYSICS LAB – II	0	0	3	3	2
			Total			34	26

SEMESTER IV

A. THEORY							
Sl. No.	Field	Subject	Contact Hours/ Week				
			L	T	P	Total	Credit points
1	ME401	HEAT & MASS TRANSFER	3	1	0	4	3
2	ME402	FLUID MECHANICS - II	3	0	0	3	3
3	ME403	PRIMARY MANUFACTURING PROCESSES	3	1	0	4	3
4	ME404	MECHANISMS	3	1	0	4	3
5	M(ME)401	NUMERICAL METHODS	3	0	0	3	3
6	CH(ME)401	ENVIRONMENT & ECOLOGY	2	0	0	2	2
B.PRACTICAL							
7	ME491	HEAT & MASS TRANSFER LAB	0	0	3	3	2
8	ME 492	MANUFACTURING TECHNOLOGY LAB	0	0	3	3	2
9	ME493	MATERIAL TESTING LAB	0	0	3	3	2
10	ME481	MACHINE DRAWING – II	0	0	3	3	2
11	M(ME)491	NUMERICAL METHODS LAB	0	0	3	3	2
12	HU(ME) 481	TECHNICAL REPORT WRITING & LANGUAGE LAB PRACTICE	0	0	2	2	2
			Total			37	29

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SEMESTER V

A. THEORY							
Sl. No.	**Field**	**Subject**	Contact Hours/ Week				
			L	**T**	**P**	**Total**	**Credit points**
1	ME501	INTERNAL COMBUSTION ENGINE AND GAS TURBINE	4	0	0	4	3
2	ME502	FLUID MACHINERY	3	0	0	3	3
3	ME503	DESIGN OF MACHINE ELEMENTS-I	4	0	0	4	3
4	ME504	DYNAMICS OF MACHINES	3	0	0	3	3
5	ME505	METROLOGY & MEASUREMENT	3	0	0	3	3
6	HU(ME)501	VALUES & ETHICS	3	0	0	3	3
B. PRACTICAL							
7	ME591	INTERNAL COMBUSTION ENGINE LAB	0	0	3	3	2
8	ME592	FLUID MECHANICS & HYDRAULIC MACHINES LAB	0	0	3	3	2
9	ME581	MACHINE DESIGN - I	0	0	3	3	2
10	ME593	METROLOGY & MEASUREMENT LAB	0	0	2	2	2
			Total			31	26

SEMESTER VI

A. THEORY							
Sl. No.	**Field**	**Subject**	Contact Hours/ Week				
			L	**T**	**P**	**Total**	**Credit points**
1	ME601	REFRIGERATION AND AIR CONDITIONING	3	0	0	3	3
2	ME602	MACHINING PRINCIPLES AND MACHINE TOOLS	3	0	0	3	3
3	ME603	DESIGN OF MACHINE ELEMENTS-II	4	0	0	4	3
4	ME604	ADVANCED MANUFACTURING TECHNOLOGY- I	3	0	0	3	3
5	ME 605	POWER PLANT ENGINEERING	4	0	0	4	3
6	HU(ME)601	ECONOMICS & ACCOUNTANCY	3	0	0	3	3
B. PRACTICAL							
6	ME691	REFRIGERATION AND AIR CONDITIONING LAB	0	0	3	3	2
8	ME692	MACHINING & MACHINE TOOLS LAB	0	0	3	3	2
9	ME681	MACHINE DESIGN - II	0	0	3	3	2
10	ME 693	DYNAMICS OF MACHINES LAB	0	0	3	3	2
11	ME682	SEMINAR	0	0	2	2	2
			Total			34	28

Summer training at Industry after sixth semester examination

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SEMESTER VII

Sl. No.	Field	Subject	Contact Hours/ Week				
			L	T	P	Total	Credit points
1	ME701	ADVANCED MANUFACTURING TECHNOLOGY- II	3	0	0	3	3
2	ME702	MATERIALS HANDLING	3	0	0	3	3
3	ME 703	ELECTIVE - I	3	0	0	3	3
4	ME 704	ELECTIVE - II	3	0	0	3	3
5	M(ME)701	OPERATIONS RESEARCH	3	0	0	3	3
		B. PRACTICAL					
6	ME791	ADVANCED MANUFACTURING LAB	0	0	3	3	2
7	ME781	PROJECT: PART – I	0	0	4	4	3
8	ME782	VIVA-VOCE ON VACATIONAL TRAINING	0	0	0	0	2
9	ME783	GROUP DISCUSSION	0	0	0	0	2
			Total			22	24

SEMESTER VIII

Sl. No.	Field	Subject	Contact Hours/ Week				
			L	T	P	Total	Credit points
1	ME801	INDUSTRIAL ENGINEERING	3	0	0	3	3
2	ME802	ELECTIVE - III	3	0	0	3	3
3	ME803	ELECTIVE-IV	3	0	0	3	3
		B. PRACTICAL					
4	ME 881	DESIGN OF A MECHANICAL SYSTEM	0	0	3	3	2
5	ME882	PROJECT: PART - II	0	0	12	12	6
6	ME883	COMPREHENSIVE VIVA	0	0	0	0	2
			Total			24	19

Total Credit Points = 23+25+26+29+26+28+24+19=200

ELECTIVE – I

1. ADVANCED WELDING TECHNOLOGY (ME703 A)

2. CAD/CAM (ME703 B)

3. QUANTITY PRODUCTION METHOD (ME703 C)

4. APPLIED FLUID MECHANICS (ME703 D)

5. BIOMECHANICS & BIOMATERIALS (ME704E)

ELECTIVE - II

1. ENERGY CONSERVATION & MANAGEMENT (ME704A)

2. TRIBOLOGY (ME704B)

3. INDUSTRIAL INSTRUMENTATION (ME 704C)

4. SAFETY & OCCUPATIONAL HEALTH (ME704D)

ELECTIVE – III

1. RENEWABLE ENERGY SYSTEMS (ME802A)

2. QUALITY & RELIABILITY ENGINEERING (ME802B)

3. TURBO MACHINERY (ME802C)

4. MECHATRONICS (ME802D)

5. AUTOMATION & CONTROL (ME 802 E)

ELECTIVE – IV

1. AUTOMOBILE ENGINEERING (ME803A)

2. MAINTENANCE ENGINEERING (ME803B)

3. INDUSTRIAL ROBOTICS (ME803C)

4. FINITE ELEMENT METHOD (ME803D)

TOTAL CREDIT POINTS= 23+25+26+29+26+28+24+19=200

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Paper Name: Engineering Mechanics Paper Code: ME101		
Module No.	**Syllabus**	**Contact Hrs.**
1	Importance of Mechanics in engineering; Introduction to Statics; Concept of Particle and Rigid Body; Types of forces: collinear, concurrent, parallel, concentrated, distributed; Vector and scalar quantities; Force is a vector; Transmissibility of a force (sliding vector). Introduction to Vector Algebra; Parallelogram law; Addition and subtraction of vectors; Lami's theorem; Free vector; Bound vector; Representation of forces in terms of i,j,k; Cross product and Dot product and their applications. Two dimensional force system; Resolution of forces; Moment; Varignon's theorem; Couple; Resolution of a coplanar force by its equivalent force-couple system; Resultant of forces.	**10**
2	Concept and Equilibrium of forces in two dimensions; Free body concept and diagram; Equations of equilibrium. Concept of Friction; Laws of Coulomb friction; Angle of Repose; Coefficient of friction.	**6**
3	Distributed Force: Centroid and Centre of Gravity; Centroids of a triangle, circular sector, quadralateral, composite areas consisting of above figures. Moments of inertia: MI of plane figure with respect to an axis in its plane, MI of plane figure with respect to an axis perpendicular to the plane of the figure; Parallel axis theorem; Mass moment of inertia of symmetrical bodies, e.g. cylinder, sphere, cone.	**7**
4	Introduction to Dynamics: Kinematics and Kinetics; Newton's laws of motion; Law of gravitation & acceleration due to gravity; Rectilinear motion of particles; determination of position, velocity and acceleration under uniform and non-uniformly accelerated rectilinear motion;	**5**

	construction of x-t, v-t and a-t graphs. Plane curvilinear motion of particles: Rectangular components (Projectile motion); Normal and tangential components (circular motion).	
5	Kinetics of particles: Newton's second law; Equation of motion; D.Alembert's principle and free body diagram; Principle of work and energy ; Principle of conservation of energy; Power and efficiency.	**5**

Recommended Books:

1. Engineering Mechanics [Vol-I & II]by Meriam & Kraige, 5th ed. – Wiley India

2. Engineering Mechanics: Statics & Dynamics by I.H.Shames, 4th ed. – PHI

3. Engineering Mechanics by Timoshenko , Young and Rao, Revised 4th ed. – TMH

4. Elements of Strength of Materials by Timoshenko & Young, 5th ed. – E.W.P

5. Fundamentals of Engineering Mechanics by Debabrata Nag & Abhijit Chanda– Chhaya Prakashani

6. Engineering Mechanics by Basudeb Bhattacharyya– Oxford University Press.

7. Engineering Mechanics: Statics & Dynamics by Hibbeler & Gupta, 11th ed. – Pearson

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Paper Name: Strength of Materials Paper Code: ME202		
Module No.	**Syllabus**	**Contact Hrs.**
1.	Concept of mechanics of deformable solids; concept of stress developed against external force/pressure; brief review of normal and shearing stress and strain; Deformation of axially loaded members, statically determinate and indeterminate problems. Strain energy in tension and compression	**6**
2.	Analysis of Biaxial stresses-Mohr's circle for biaxial stress; concept of normal stress, principal stress and pure shear. Shear strain and shear strain energy. Stresses in thin walled pressure vessels- tangential and Hoop stress. Relation between shear modulus and Young's modulus.	**6**
3.	Stresses in beams; shear force (SF), axial force and bending moment (BM); differential relations for BM, SF and load; SF and BM diagrams; bending stresses in straight beams – symmetric loading; stresses in beams of various cross sections; stresses in built-up beams and beams of different materials.	**7**
4.	Torsion of a circular shaft, shear energy in torsion. Concept of closed and open coiled helical springs, Stresses and deflection of helical springs under axial pull.	**4**
5.	Deflection of statically determinate and indeterminate beams due to bending moment, differential equation of elastic line, Area-moment method, Strain energy method- Castigliano's theorem, superposition method.	**7**
6.	Theory of columns; eccentric loading of short strut; column buckling:	**6**

	Euler load for columns with pinned ends and other end restraints; Euler's curve; empirical column formulae – (i) straight line, (ii) parabolic and (iii) Rankine Gordon.	

Recommended Books:

1. Elements of Strength of Materials by Timoshenko & Young, 5th Ed.- East west press.

2. Introduction to Solid Mechanics by Shames & Pitarresi, 3rd Ed., Prentice Hall India.

3. Mechanics of Materials by Beer & Johnston, TMH

4. Engineering Mechanics of Solids by E.P. Popov; 2nd Ed., Prentice Hall India

5. Fundamentals of Strength of Materials by Nag & Chanda, Wiley India

6. Strength of Materials by R.Subramanian, 2nd Ed., Oxford Univ. Press

7. Strength of Materials by Ryder, Mcmillan press

Paper Name: Engineering Thermodynamics **Paper Code: ME301**		
Module No.	**Syllabus**	**Contact Hrs.**
	PART - A	
1.	**Basic Concepts of Thermodynamics** Introduction: Microscopic and Macroscopic viewpoints Definition of Thermodynamic systems: closed, open and isolated systems, Concept of Thermodynamics state; state postulate. Definition of properties: intensive, extensive & specific properties. Thermodynamic equilibrium, Thermodynamic processes; quasi-static, reversible & irreversible processes; Thermodynamic cycles. Zeroth law of thermodynamics. Concept of empirical temperature.	**4**

	Heat and Work Definition & units of thermodynamic work, Examples of different forms of thermodynamic works; example of electricity flow as work, Work done during expansion of a compressible simple system, Definition of Heat; unit of Heat, Similarities & Dissimilarities between Heat & Work **Ideal Equation of State, processes; Real Gas** Definition of Ideal Gas; Ideal Gas Equations of State, Thermodynamic Processes for Ideal Gas; P-V plots; work done, heat transferred for isothermal, isobaric, isochoric, isentropic & polytropic processes, Equations of State of Real Gases: Van der Waal's equation; Virial equation of state. **Properties of Pure Substances** Pure Substance, Properties of pure substance(like H2O); Phases of pure substances- Phase rule; Phase Change Processes of Pure Substances – triple pt., critical pt.; Property diagrams of Phase change Processes; P-V-T surface for phase change; Introduction to steam table with respect to steam generation process; definition of compressed liquid, saturated, wet & superheated vapour, Definition of dryness fraction of steam, degree of superheat of steam, h-s chart of steam (Mollier's Chart)	**5** **5** **5**
2.	**1st Law of Thermodynamics** Definition of Stored Energy & Internal Energy, 1st Law of Thermodynamics for cyclic processes, Non Flow Energy Equation Flow Energy & Definition of Enthalpy, Conditions for Steady State Steady flow: Steady State Steady Flow Energy Equation, First law for unsteady flow system.	**6**
3A.	**2nd Law of Thermodynamics & Entropy** Definition of Sink, Source Reservoir of Heat. Heat Engine, heat Pump & Refrigerator; Thermal efficiency of Heat Engines & co-efficient of performance of Refrigerators, Kelvin – Planck & Clausius statements of 2nd Law of Thermodynamics, the corollaries & their proofs; Carnot Cycle & Carnot efficiency, PMM-2; definition & its impossibility, Absolute or Thermodynamic scale of temperature,	**4**

	PART - B	
3B	Clausius Integral, Entropy, Entropy change calculation for ideal gas processes, Tds equations and calculation of entropy change; concept and uses of entropy; the entropy generation principle. The second law of thermodynamics for an open system.	**4**
4.	Exergy analysis, Reversible work and irreversibility, Exergy change of a system, 2nd Law efficiency. Maxwell relations; Clapeyron Equation, Joule Thompson co-efficient	**7**
5.	**Air standard Cycles for IC engines** Introduction: Concepts of IC engines. Otto cycle; plot on P-V, T-S planes; Thermal efficiency Diesel cycle; plot on P-V, T-S planes; Thermal efficiency Dual Combustion, plot on P-V, T-S planes; Thermal efficiency. **Rankine cycle of steam Power Generation** Simple Rankine cycle plot on P-V, T-S, h-s planes Rankine cycle efficiency with & without pump work **Basic Refrigeration Cycles** Introduction: Concepts of Refrigeration Simple vapour compression Refrigeration cycle, plot on p-v,p-h, T-S planes, COP.	**8**

Recommended Books:

1. Engineering Thermodynamics-4e by P.K .Nag, TMH

2. Fundamentals of Thermodynamics - 6e by Sonntag, Borgnakke & Van Wylen, John Wiley.

3. Engineering Thermodynamics - P.K Chattopadyay, OUP

4. Thermodynamics- an Engineering approach - 6e, Cengel & Boles,TMH

5. Engineering Thermodynamics- M. Achyuthan, PHI

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Paper Name: Fluid Mechanics-I Paper Code: ME302		
	Syllabus	**Contact Hrs.**
1.	Properties of Fluids: Introduction, definition of fluid, difference between a solid and a fluid, difference between liquids and gases, concept of continuum, density, specific weight, specific volume, specific gravity, viscosity, no-slip condition, non-Newtonian fluids, compressibility and bulk modulus of elasticity, surface tension, capillarity, vapour pressure and cavitation.	**2**
2.	Pressure and its measurement: Fluid pressure at a point, Pascal's law for pressure at a point, pressure variation in a fluid at rest, absolute, gauge, atmospheric and vacuum pressures, simple manometers, differential manometers, barometer, pressure variation in a compressible fluid.	**2**
3.	Hydrostatic Forces on Surfaces: Total pressure force and centre of pressure, hydrostatic force on a plane horizontal submerged surface, hydrostatic force on a plane vertical submerged surface, hydrostatic force on a plane inclined surface, hydrostatic force on a curved submerged surface, lock gates, fluids under rigid body motion.	**2**
4.	Buoyancy and Floatation: Buoyancy, stability of a submerged body, metacentre, stability of a floatation body, determination of metacentric height, experimental determination of metacentric height, oscillation of a floating body.	**2**
5.	Kinematics of Fluid Flow: Methods of analyzing fluid motion, types of fluid flows, streamlines, pathlines and streaklines, continuity equation in three dimensions, local and convective acceleration, deformation of fluid elements, circulation, stream function and velocity potential function.	**2**
6.	Dynamics of Inviscid Flows: Differential equation of motion, Euler's equation of motion along a streamline, Bernoulli's equation; static, dynamic, stagnation and total pressures; energy equation for real fluid; application of Bernoulli's equation – measurement of flow rate; momentum equation; applications of the momentum equation, free liquid jets, vortex flows.	**2**
7.	Flow Through Orifices and Mouthpieces: Classification of orifices, flow through an orifice, hydraulic coefficients, determination of coefficient of velocity, coefficient of discharge and coefficient of contraction; flow through large orifices, submerged orifice, partially submerged orifices;	**2**

	time of emptying a tank through an orifice at its bottom, time of emptying hemispherical tank, circular horizontal tank; classification of mouthpieces, flow through external cylindrical mouthpieces, convergent-divergent mouthpieces, internal mouthpieces.	
8.	Flow Over Notches and Weirs: Classification of notches and weirs, discharge over rectangular, triangular, trapezoidal and stepped notches or weirs; effect on discharge over a notch or weir due to error in the measurement of head, velocity of approach, empirical formulae for discharge over rectangular weir, Cippoletti weir, discharge over broad-crested weir, Ogee weir, submerged weir.	**2**
9.	Dimensional and Model Analysis: Review of dimensions and dimensional homogeneity; dimensional analysis, model analysis, similitude, forces influencing hydraulic phenomena, dimensionless numbers and their consequences in fluid mechanics, model laws, classification of models.	**2**
10.	Flow of Ideal Fluids: Stream function and velocity potential function, elementary flows in a two-dimensional plane, superposition of elementary flows.	**1**
11.	Dynamics of Viscous Flows: Navier-Stokes equations, concept of developing and fully developed flow, fully developed laminar flow between two infinite parallel plates, Couette flow, fully developed flow through circular pipe, concentric annulus, flow between two concentric rotating cylinders; power absorbed in bearings, movement of piston in dash-pot, methods of determination of coefficient of viscosity	**2**
12.	Turbulent Flow: Reynold's experiment, loss of head due to fluid friction in pipes, characteristics of turbulent flow, shear stresses in turbulent flows, hydrodynamically smooth and rough boundaries, velocity distribution in turbulent flow through pipes, velocity distribution for turbulent flow in terms of average velocity, velocity distribution for turbulent flow in smooth pipes by power law, resistance to flow of fluid in smooth and rough pipes.	**3**

Recommended Books:

1. A textbook on Fluid Mechanics and Hydraulic Machines – Sukumar Pati, TMH

2. Fluid Mechanics & Machinery – R.K.Bansal, Luxmi Publications.

3. Introduction to Fluid Mechanics & Fluid Machines– Som, Biswas, Chakraborty, TMH.

4. Fluid Mechanics & Turbo Machines – M.M.Das, PHI, 2010.

5. Fluid Mechanics & Machinery – C.Ratnam, A.V.Kothapalli, I.K. International Publishing House Ltd, 2010.

5. Fluid Mechanics & Machinery – C.S.P Ojha, R.Berndtsson, P.N. Chandramouli, OUP.

6. Introduction to Fluid Mechanics – Fox & Macdonald, Wiley.

7. Fluid Mechanics – Fundamentals & Applications – Cengel & Cimbala, TMH.

Paper Name: Engineering Materials **Paper Code: ME303**		
Module No.	**Syllabus**	**Contact Hrs.**
1	**1.1 Introduction:** Material Science—its importance in engineering; Atomic bonding in solids—bonding forces and energies; ionic/covalent/metallic bonding. **1.2 Crystal Structure:** Fundamental concepts; Space lattice; Unit cells; Seven crystal systems; Single crystal; Polycrystalline and Non-crystalline materials; Metallic crystal structures—FCC, BCC & HCP structures ,atomic packing factor calculation. **1.3 Imperfections in Metals:** Point defects due to vacancy & impurities; alloys, solid solutions, Hume Rothery rules; Dislocations—linear defects, interfacial defects, grain boundaries. **1.4 Diffusion:** Definition; Interstitial and Substitutional diffusion Mechanism; Fick's first law and Fick's second law.	**7**
2	**Mechanical Properties of Materials**: Ductile and brittle material, Elastic properties of materials—tensile and compressive stress and strain, stress-strain behaviour, modulus of elasticity (Young's modulus), yield strength, tensile strength, plastic deformation(Slip, Twining), true stress and strain; Ductility; Resilience; Toughness, Concept of ductile and brittle fracture, impact tests; Hardness- Brinell, Rockwell and Vickers hardness and their	**5**

	testing procedures, correlation between hardness and tensile strength; Fatigue strength; Effect of temperature on tensile strength & impact properties, creep(definition, anelastic behavior,creep curve).	
3	**3.1 Phase Diagrams:** Definition and basic concepts; solubility limit; Phase equilibria; Gibb's phase rule; one component phase diagram, binary phase diagram, interpretation of phase diagrams. **3.2 Iron-carbon System:** Allotropy of iron; iron-iron carbide phase diagram, properties and uses of; plain carbon steel. **3.3 Solidification:** Concept of homogeneous heterogeneous nucleation process and free energy calculation for homogeneous nucleation process.	**5**
4	**Heat Treatment:** Definition and purposes; structural change during heating and cooling, Austempering, Martempering; Heat treatment processes for steels—Hardening (Carburizing, nitriding, cyaniding, induction and flame hardening); Tempering; Normalizing; Annealing—full annealing, spheroidising annealing, stress–relieving, recrystallisation annealing; Preciptation or Age Hardening of non-ferrous alloys.	**5**
5	**Classification of Metals and Alloys- compositions, general properties and uses:** **5.1 Ferrous alloys:** Classification –low carbon steels, medium carbon steels, high carbon steels; Stainless steels; alloy steels; tool and die steel; cast irons. **5.2 Non-ferrous alloys:** Copper & Copper alloys; Aluminum alloys; Nickel alloys; Lead & Tin alloys.	**4**
6	**6.1 Polymers & Elastomers:** Definition; advantages and disadvantages; Polymer compounding, Processing- Extrusion, blow molding. **6.2 Ceramic Materials:** What is ceramics; Radius ratio rules; common ceramic materials AX type, Diamond and graphite structures and their characteristics; Properties and applications; Processing of ceramic—sintering and vitrification process. **6.3 Composite materials:** What is composites; Advantages and disadvantages of composites; Polymers matrix and their applications; Metal matrix and ceramic matrix composites and their applications. Processing of composites- autoclave process, compression and injection molding.	**6**
7	**An introduction to advanced materials**— Smart materials; Nano-	**1**

	materials; Biomaterials and Semiconductor.	
8	**Corrosion and Degradation of Engineering Materials:** Definition; Dry and wet corrosion; Introduction to uniform, pitting(P-B ratio), galvanic, intergranular corrosion, stress corrosion cracking and erosion; Corrosion control — material selection, environment control.	**2**
9	**Materials Selection Methodology:** Selection of material based on required properties, availability, cost of material, environmental issues and manufacturing process.	**1**

Recommended Books:

1. Materials Science and Engineering by W.D. Callister and adapted by R. Balasubramaniam, Willey India, 2010 Ed.
2. Materials Science and Engineering (In SI Unit) by William Smith, Javad Hashemi, Ravi Prakash, 4th Ed., The McGraw-Hill Companies.
3. Materials Science and Engineering by V.Raghavan, 5th Ed., Prentice Hall India.
4. Materials Science by S.L.Kakani and Amit Kakani , New age International Publishers.
5. Materials & Processes in Manufacturing by E.P.Degarmo and adapted by Black & Kosher, 10th Ed., Wiley India.

Paper Name: Heat & Mass Transfer

Paper Code: ME401

Module No.	Syllabus	Contact Hrs.
1.	Introduction to modes of Heat Transfer, Basic equations.	**2**
2.	Conduction: Fourier's law for isotropic materials. Thermal conductivity: 1-D and 3- D heat conduction equations, Boundary conditions. Solution of steady 1-D conduction problem with & without heat generation. Analogy with electrical circuits. Critical thickness of insulation.	**4**
3.	Fins- rectangular and pin fins, fin effectiveness and fin efficiency.	**3**
4.	Introduction to transient heat conduction, Lumped parameter approach, Time constant, Biot number: 1-D transient heat conduction solution without heat generation.	**4**
5.	Convective heat transfer, Newton's law of cooling and significance of	**3**

	heat transfer coefficients. Momentum and energy equation in 2-D.	
6.	Non – dimensional quantities in heat transfer, importance and physical significant order of magnitudes, Analysis for a flow over a flat plate, order of magnitude analysis.	**3**
7.	Boundary layer concepts, Velocity and thermal boundary layer by integral method.	**3**
8.	1-D solution for Coutte flow and Poiseullie flow. Concept of developing and developed flow. Introduction to the concept of similarity.	**4**
9.	Natural convection over a vertical plate. Concept and correlation.	**3**
10.	Radiation: Physical mechanism of thermal radiation, laws of radiation, Definition of black body, emissive power, intensity of radiation, emissivity, reflectivity, transmittivity, irradiation, radiosity.	**3**
11.	Radiation exchange between black bodies, concept of Gray- Diffuse Isotropic (GDI) surface. Radiation exchange between GDI surfaces by radiation network and radiosity matrix method. Radiation shielding.	**4**
12.	Heat exchangers: types of heat exchangers, parallel and counter flow types, Introduction to LMTD. Correction factors, fouling factor. E- NTU method for heat exchangers.	**4**

Recommended Books:

1. S.K. Som, Introduction to Heat Transfer, PHI.

2. Yunus A. Cengel, Heat and Mass Transfer, The McGraw-Hill Companies.

3. Sarif K. Das, Fundamentals of Heat & Mass Transfer, Narosa.

4. Incropera, DeWitt, Bergmam, & Lavine, Fundamentals of Heat and Mass Transfer, Wiley India Edn.

5. N.V. Suryanarayana, Engineering Heat Transfer, Penram International.

6. Kreith, Principles of Heat Transfer, Cengage learning.

7. P.K. Nag, Heat & Mass Transfer, TMH.

8. P.S. Ghoshdastidar, Heat Transfer, Oxford University Press.

9. M. Thirumaleshwar, Fundamentals of Heat & Mass Transfer, Pearson.

10. O.P. Single, Heat & Mass Transfer, Macmillan India.

11. J P Holman & Souvik Bhattacharyya, Heat Transfer, TMH.

Paper Name: Fluid Mechanics-II **Paper Code: ME402**		
Syllabus		**Contact Hrs.**
1.	Flow Through Pipes: Loss of energy in pipes, loss of energy due to fluid friction- concept of friction factor, minor losses in pipe, hydraulic and energy gradient lines, momentum and kinetic energy correction factor, flow through siphon, piping systems, flow through branched pipe, power transmission through pipes, flow through nozzles, water hammer.	**6**
2.	Boundary Layer Theory: Boundary layer concept, concepts of displacement thickness, momentum thickness and energy thickness, boundary layer equations, momentum integral equation of the boundary layer, solution of the momentum integral equation for laminar flow over a flat plate, turbulent boundary layer on a flat plate, total drag on a flat plate due to laminar and turbulent boundary layer on a flat plate, boundary layer separation, effects of pressure gradient on boundary layer flow.	**10**
3.	Fluid Flow Around Submerged Bodies: Basic concept of drag and lift, drag on a sphere, terminal velocity of a body, drag on a cylinder, lift on a circular cylinder, lift and drag on an airfoil.	**7**

4.	Compressible Flow: Thermodynamic relations of perfect gas, basic equations of compressible flow, speed of sound wave, Mach number, propagation of pressure waves in a compressible fluid, stagnation properties, area velocity relationship for compressible flow, flow of compressible fluid through a convergent nozzle, mass flow rate of compressible fluid through venturimeter.	**7**
5.	Flow in Open Channels: Characteristics of open channels, classification of flows in open channels, steady uniform flow in open channel - Chezy's equation, empirical formulae for the value of Chezy's constant, hydraulically efficient cross sections/most economical section of channels, flow through channels of circular cross sections partially full, non-uniform flow through open channels, energy concepts in open channel flow, hydraulic jump, gradually varied flow.	**6**

Paper Name: Primary Manufacturing Processes **Paper Code: ME403**		
Module No.	**Syllabus**	**Contact Hrs.**
1	Introduction: Manufacturing; Definitions and broad grouping.	**2**
2	Casting: Introduction, History, Definition, Major Classification, Casting Materials. Sand mould casting: Moulding sands: composition, properties & testing. Design of gating system: sprue, runner, ingate & riser, Estimation of powering time, Foundry equipments, Furnaces Melting, pouring and solidification Type of patterning, use of a core. Different type of sand mould casting: Floor mould casting, Centrifugal casting, Shell mould & CO2 casting ,Investment casting Permanent mould casting: Die casting, types, methods, advantages & applications. Slush casting, principle & use. Casting defects, types, causes	**2**

	& remedy	
3	Forming Processes: Forging: Introduction, definition, classification, hot forging & cold forging, characteristics & applications. Forging material operations, equipments & tools: Smith forging, Drop forging, Pressing or press forging, Forging dies, materials & design. Rolling: Introduction, basic principles, hot rolling & cold rolling, characteristics & applications Rolling processes & applications, operations, equipments & roll stands. Wire drawing & extensions: Basic principles & requirements. Classification, methods & applications.	**2**
4	Welding: Introduction to metallic parts, Major grouping of joining processes, welding, brazing and soldering Broad classification of welding processes, types and principles. Fusion welding: types, principles, equipments, characteristics & applications, Sources of heat-chemical action, Gas welding & thermit welding ,Sources of heat-electrical energy, Arc welding, Submerged arc welding, TIG & MIG; Plasma arc welding, Resistance welding; Spot & butt welding. Solid state welding: Principles, advantages & applications of Hot forge welding, Friction welding, Pressure & percussion welding. Precision welding processes: Ultrasonic welding, Laser beam welding, Electron beam welding. Welding defects, types, causes & remedy.	**2**

5	Press tool works: Basic principles, systems, operations & applications, Shearing, parting, blanking, piercing & notching, Cupping (drawing), Spinning & deep drawing Blanks & forces needed for shearing & drawing operations, Coining & embossing.	**2**

Recommended Books:

1. Manufacturing technology, Foundry, Forming & Welding-P.N Rao.

2. Manufacturing Science-A Ghosh & A Mullick.

3. Manufacturing Engineering & Technology-S Kalpakjian; Pub:Addison Wesley.

4. Principles of manufacturing materials & processes-James & Campbell.

5. Manufacturing engineering & technology-K Jain.

6. Processes & materials of manufacturing-R.A Lindberg.

7. Introduction to manufacturing technology-PP Date, Pub: Jaico.

8. Manufacturing processes-S.K Sharma & S Sharma, Pub: I.K International.

Paper Name: Mechanisms

Paper Code: ME404

Module No.	Syllabus	Contact Hrs.
1.	Introduction to mechanisms, Difference between Machine and Mechanism; Classification of Pairs of Elements, Kinematic chain, types of joints in a chain; Four-bar linkage: motions of links, Grashof's criterion of movability.	**2**
2.	Degrees of freedom for plane Mechanisms, Gruebler's criterion for plane mechanism, Kinematic inversions – four Inversions of a Slider-Crank Chain.	**2**
3.	Velocity analysis in Mechanisms: Relative velocity method – slider crank mechanism, four bar mechanism, Crank and slotted lever mechanism; Instantaneous centre method –kennedy's theorem; Acceleration analysis: Acceleration Images, Klein's construction, analytical expression of velocity & acceleration.	**2**
4.	Belt-drive – introduction; Law of belting, Length of flat belt for open and cross belt connections; Stepped pulley for open flat belt; Tension in flat	**2**

	belt and V-belts; Power transmitted in belt drive.	
5.	Gear terminology, Laws of gearing, types of gears – Spur, Bevel, Helical, Worm; tooth profile, interference; Gear trains – simple, compound, epicyclic gear train; Speed-torque analysis of gear trains.	**2**
6.	Classification of Cams and followers; Radial Cam, Analysis of knife-edge, roller and flat face follower motion – constant velocity, simple harmonic, constant acceleration & deceleration; Offset follower.	
7.	Kinematic Synthesis: Introduction to problems of function generation, path generation and rigid body guidance; Type, Number and Dimensional Synthesis; Two and three position synthesis of four bar mechanism and slider –crank mechanism : Graphical – pole, Relative pole and Inversion method; Analytical solution – Freudenstein's Method.	
8.	Study of lower pair Mechanisms- Pantograph, Parallel linkage mechanisms, Straight line mechanism, Automobile steering mechanism, Hooks joint.	

Recommended Books:

1. Elements of Mechanism – Daughty and James, McGraw Hill

2. Theory of Machines – S S Rattan, Tata McGraw Hill

3. Theory of Mechanisms & Machines – A.Ghosh & A.K.Mallik, AEWP

4. Design of Machinery – R.L.Norton, Tata McGraw Hill

5. Mechanism & Machine Theory – Rao, R.V. Dukkipati, Wiley

6. Theory of Machines, V.P.Singh, Dhanpat Rai & Co

JIS College of Engineering

Mechanical Engineering Department

Paper Name: Internal Combustion Engine And Gas Turbine **Paper Code: ME501**		
Module No.	**Syllabus**	**Contact Hrs.**
1.	Classification and working of basic engine types: 2-stroke, 4- stroke, C.I., S.I., etc.	**3**
2.	Analysis of air standard cycles: fuel- air cycles and actual cycles.	**3**
3.	Fuels: classification and desirable characteristics of I.C. engine fuels, Rating of S.I. and C.I. engine fuels, Alternative fuels (liquid, gaseous, etc.), Analysis of combustion product, HCV and LCV of the fuels.	**4**
4.	Combustion of fuels in I.C. engines, Combustion in S.I and C.I engines, Parameter influencing combustion, Detonation and knocking in S.I. and C.I. engines and their preventions, Combustion chamber types, Basic principles of combustion chamber in I.C. engines.	**4**
5.	Fuel- air mixing in S.I. engines, Working principle of a carburetor, Analysis of simple carburetor, Mechanical and electronic fuel injection system and their control in S.I. engines. Basic principles of MPFI in SI engines.	**4**
6.	Fuel-oil injection in C.I. engines, Fuel injection systems, Working principles, Injection pumps and nozzles.	**4**
7.	Ignition: ignition systems in I.C. engines (Battery, magneto and electronic), ignition timing and spark advance.	**3**
8.	Supercharging and scavenging of I.C. engines, supercharging limits, Turbo charging, Scavenging - ideal and actual, scavenging parameters, and scavenging pumps.	**3**
9.	Principles of lubrication in I.C. engines, Properties of lubricating oil.	**2**
10.	Air and liquid cooling of I.C. engines, Principles and systems.	**2**
11.	Performance and testing of I.C. engines; Measurement of speed, torque, fuel consumption, determination of IHP, BHP and FHP, specific fuel consumption, determination of indicated thermal efficiency, brake thermal efficiency and mechanical efficiency, plot of efficiency vs. speed curves.	**4**

12.	Pollution control of emissions of I.C. engines.	**2**
13.	Introduction to Gas Turbine Cycles & Performance.	**2**

Recommended Books:

1. V. Ganesan, Internal Combustion Engines, The McGraw-Hill Companies.

2. M.L. Mathur and R.P. Sharma, A course in Internal Combustion Engines, Dhanpat Rai & Sons.

3. H.N. Gupta, Fundamentals of Internal Combustion Engines, PHI Learning Private Ltd.

Paper Name: Fluid Machinery

Paper Code: ME502

Module No.	Syllabus	Contact Hrs.
1.	Impact of Jets and Jet Propulsions: Force exerted by a liquid jet on a stationary flat plate, force exerted by a liquid jet on a stationary curved vane, force exerted by a liquid jet on a hinged plate, force exerted by a liquid jet on moving flat plates, force exerted by a liquid jet on moving curved vane, jet propulsion.	**4**
2.	Hydraulic Turbines: Essential element of a hydroelectric power plant; head and efficiencies of hydraulic turbines; classifications of hydraulic turbines, Pelton turbine, reaction turbine, Francis turbine, Kaplan turbine; draft tube; cavitation in hydraulic machines; dimensional analysis and similarity laws for rotodynamic machines; specific speed of hydraulic turbines; unit quantities of hydraulic turbines; characteristic curves of hydraulic turbines; governing of turbines.	**8**
3.	Centrifugal Pump: Components of a centrifugal pump, working principle, work done, different heads in a pumping system, different efficiencies, characteristics, minimum speed for starting a centrifugal pump, multistage centrifugal pumps, specific speed, model testing, cavitation, net positive suction head.	**8**
4.	Reciprocating Pump: Components of a reciprocating pump, working principle, types of reciprocating pumps, discharge and power requirement, slip and coefficient of discharge, variation of velocity and	**8**

	acceleration in the suction and delivery pipes due to acceleration of the piston, frictional head on suction and delivery pipes, indicator diagram, air vessels.	
5.	Miscellaneous Hydraulic Machines: Hydraulic press, hydraulic accumulator, hydraulic intensifier, hydraulic ram, hydraulic lift, hydraulic crane, hydraulic coupling, hydraulic torque converter, gear pump, lobe pump, vane pump, piston pump, hydraulic actuators, hydraulic valves.	**8**

Recommended Books:

1. A textbook on Fluid Mechanics and Hydraulic Machines – Sukumar Pati, TMH

2. Fluid Mechanics & Machinery – R.K.Bansal, Luxmi Publications.

3. Introduction to Fluid Mechanics & Fluid Machines– Som, Biswas, Chakraborty, TMH.

4. Fluid Mechanics & Turbo Machines – M.M.Das, PHI, 2010.

5. Fluid Mechanics & Machinery – C.Ratnam, A.V.Kothapalli, I.K. International Publishing House Ltd, 2010.

5. Fluid Mechanics & Machinery – C.S.P Ojha, R.Berndtsson, P.N. Chandramouli, OUP.

6. Introduction to Fluid Mechanics – Fox & Macdonald, Wiley.

7. Fluid Mechanics – Fundamentals & Applications – Cengel & Cimbala, TMH.

Paper Name: Design Of Machine Elements

Paper Code: ME503

Module No.	Syllabus	Contact Hrs.
1.	Objective and scope of Mechanical Engineering Design; Design considerations; Review and selection of materials and manufacturing processes; codes and standards;	**5**
2.	Modes of failure; Design/allowable stress; Factor of safety (FoS); Theories of failure – maximum normal stress theory, maximum shear stress theory, Distortion energy theory. Choice of Failure criteria; Design for stability : buckling analysis – Johnson and Euler columns.	**6**

3.	Fatigue in metals; S-N curve; Endurance limit and fatigue strength; Stress concentration factors – effect of discontinuity, fillets and notches; Effect of size, surface finish, stress concentration and degree of reliability on endurance limit; Design for finite and infinite life; Goodman, modified Goodman and Soderberg diagrams with respect to fatigue failure under variable stresses; Cumulative fatigue damage – Miner's equation.	**6**
4.	Design of (i) Cotter joint; (ii) Knuckle joint and (iii) Fillet Welded joint of brackets under different types ofloading.	**6**
5.	Bolted joints : Metric thread, standard sizes, use of lock nuts and washers; Applications in structures including brackets, turn buckle; Pre-stressed bolts; Riveted joints : Unwin's formula; Brief discussion on single, double and triple row lap joints, butt joints with single or double strap / cover plate; simple strength design; joint efficiencies.	**6**
6.	Design of : (i) Solid and hollow shafts, strength design of shafts, design based on torsional rigidity; (ii) Shaft coupling-rigid, pin-bush and geared flexible type, alignment of coupling; (iii) Belt drives-geometrical relations, derivation of torque and power transmission by flat and V-belt drives, selection of belt from manufacturers' catalogues, pulley. (iv) Chain drives – roller chains, polygonal effect, power rating, sprocket wheel, silent chain.	**10**
7.	Design of: (i) Transmission screw, Screw jack, (ii) Helical compression spring - stress and deflection equations, stiffness, curvature effect : Wahl's factor, springs in parallel and series; (iii) Multi-leaf springs : load-stress and load-deflection equations, Nipping	**9**

JIS College of Engineering

Mechanical Engineering Department

Recommended Books:

1. V. B. Bhandari, Design of Machine Elements, TMH.

2. Shigley and Mischke, Mechanical Engineering Design, TMH.

3. Hall, Holowenko and Laughlin, Theory and Problems of Machine Design, TMH.

4. P.C. Gope, Fundamentals of Machine Design, PHI.

5. M.F. Spotts, Design of Machine Elements, Prentice Hall.

6. P. Kannaiah, Machine Design, Scitech Publications.

Paper Name: Dynamics of Machines

Paper Code: ME504

Module No.	Syllabus	Contact Hrs.
1.A	Vibration: Definition & types of vibration; Differential equations of vibratory motions (longitudinal & torsional); Natural frequency of free longitudinal vibration-Equilibrium method, Energy method (Rayleigh's maximum energy principle); Effect of inertia in longitudinal vibration; Natural frequency of free transverse vibration of a beam due to point loads - Rayleigh's method.	**6**
1.B	Whirling of shaft, synchronous whirling; critical speed - Dunkerley's method.	**2**
2.	Free damped vibration; Damping factor; Logarithmic decrement.	**2**
3	Forced vibration, concept of under damped, critically damped and over damped system; Dynamic magnifier (magnification factor); Vibration isolation and transmissibility.	**4**
4.	Inertia force and inertia torque in reciprocating engine; Equivalent dynamical system; correction couple (torque); Turning moment diagram and flywheel design.	**6**
5.	Balancing: Static balancing; Dynamic balancing of rotating masses - graphical and analytical methods; Balancing of inline single cylinder and	**9**

	four cylinder engine; Balancing of symmetric two cylinder V-engine; Swaying couple; Hammer blow.	
6.	Governors: Use and classification; Study and analysis of Porter, Proell and Wilson-Hartnell governors; Sensitiveness, stability, isochronism, hunting, effort and power of governors; Controlling force diagram and stability criteria analysis; coefficient of insensitiveness.	**5**
7.	Gyroscope: Gyroscopic couple and precessional motion; Effect of gyroscopic couple on aeroplane and ship; Stability of two wheel and four wheel vehicles taking turn.	**2**

Recommended Books:

1. W.T. Thomson, Theory of vibration with Applications, McGraw Hill.

2. Uicker, Pennock & Shigley, Theory of Machines and Mechanisms, OUP.

3. A. Ghosh & A.K. Mallik, Theory of Mechanisms and Machines, Affiliated East-West Publication.

4. Rao & Dukkipati, Mechanism and Machine Theory, New Age Int. Pub.

5. J.S. Rao, The Theory of Machines Through Solved Problems, New Age Int. Pub.

6. S.S. Rattan, Theory of Machines, Tata McGraw Hill.

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Mechanical Engineering Department

Paper Name: Metrology & Measurement **Paper Code: ME505**		
Module No.	**Syllabus**	**Contact Hrs.**
1.	Introduction: Definition and importance of Metrology Measurement; Methods of measurements – direct, indirect, comparison, substitution, transposition, deflection and null measurement; Errors in measurement – absolute, relative, parallax, alignment, loading, dynamic and calibration error; Units of measurements – SI base and derived units, SI prefixes of units.	**3**
2.A	Linear Metrology: Vernier scale; construction and use of Vernier calliper, Vernier height and depth gauge, micrometer; slip gauge.	**3**
2.B	Angular Metrology: Constructional features and use of protractor, Vernier bevel protractor, angle gauges, sine bar and slip gauges.	**2**
2.C	Measurements of : (i) Level using spirit-level; (ii) Flatness using straight edge, interferrometry (Newton's rings) and surface plate; Parallelism, cylindricity and concentricity using dial indicator.	**3**
3.	Interchangeability of components; concept of limits, tolerances and fits; Hole basis and shaft basis system of fits; Go and No Go limit gauges; plug, ring, snap, thread, radius and filler gauges.	**5**
4.	Definition, use and essential features of Comparators; working principle and application of (i) dial gauge, (ii) Cook optical comparator, (iii) back pressure Bourdon gauge pneumatic comparator, (iv) optical comparator-profile projector.	**4**
5.	Measuring Instruments: Functional elements of an instrument – sensing, conversion & manipulation, data transmission and presentation element; Characteristics – accuracy, precision, repeatability, sensitivity, reproducibility, linearity, threshold, calibration, response, dynamic or measurement error; Transducers – definition, primary and secondary,	**5**

	active and passive.	
6.	Measurement of Surface Finish: Definition; Terminologies – geometrical surface, effective surface, surface roughness, roughness (primary texture), waviness (secondary texture), form, lay, sampling length; Numerical evaluation of surface roughness: peak-to-valley height (Rmax), centre line average (CLA, Ra), average depth (Rm), smoothness value (G); Principle of operation of a Talysurf.	**4**
7.	Principle of operation of a few measuring instruments: displacement by LVDT; force by strain – gauge load cell and piezoelectric load cell; pressure by Bourdon – tube gauge; temperature by liquid-in-glass thermometer, thermocouples, optical pyrometer; liquid velocity by pitot tube; water flow by orifice meter.	**7**

Recommended Books:

1. E.O. Doebelin and D.N. Manik, Measurement Systems– Application and Design, TMH

2. R. Rajendra, Principles of Engineering Metrology, Jaico Pub. House.

3. Beckwith, Lienhard and Marangoni, Mechanical Measurements, Pearson.

4. Bewoor and Kulkarni, Metrology & Measurement, TMH.

5. R.K. Jain, Metrology, Khanna Publication, New Delhi.

Paper Name: Air Conditioning & Refrigeration

Paper Code: ME601

Module No.	Syllabus	Contact Hrs.
1.	Introduction: Concepts of Refrigeration and Air-conditioning. Unit of refrigeration, Refrigerants– Desirable Properties, Nomenclature	**2**
2.	Simple Vapour Compression Refrigeration System (Simple VCRS): Vapour compression cycle on ph and T-s diagrams. Cycles with subcooling and superheating, their effects; Effect of changes in evaporator pressure and condenser pressure on the performance of a simple VCRS; dry	**5**

	compression, wet compression of refrigerant; actual Vapour Compression Cycle.	
3.	Air Refrigeration System (ARS): Bell-Coleman refrigerator. COP determination, actual air refrigeration cycle.	**3**
4.	Vapour Absorption Refrigeration System (VARS): Advantages of VARS over VCRS. Working principle of simple VARS, practical VARS. Limitations of VARS, maximum COP of a VARS, Lithium bromide - water System; Aqua-ammonia systems.	**4**
5.	Equipment and Control: Major Refrigeration Equipment - Compressors: Types; reciprocating, rotary & centrifugal, volumetric efficiency, Condensers: types used in refrigeration systems; Evaporators: expansion devices: capillary tubes and thermostatic expansion valves.	5
6.	Ventilation – Definition & Requirement, Natural & Mechanical Ventilation, Ventilation Load Calculation.	**3**
7.	Basic definitions and principles related to Psychometry ; Psychometric Charts & Their Uses; Heating, Cooling, Heating & Humidification & Cooling & Dehumidification processes. Adiabatic Saturation, Cooling Coils, By-pass Factor.	**5**
8.	Sensible Heat Factors. Heat Load estimation: Simple cases of Cooling and Dehumidification.	**4**
9.	Duct Sizing & Design.	**2**
10.	Air-conditioning equipment: Air handling units, Cooling Towers.	**3**

Recommended Books:

1. Stocker & Jones, Refrigeration and Air Conditioning, McGraw Hill.

2. C.P. Arora, Refrigeration and Air Conditioning.

3. P.L. Ballaney, Refrigeration and Air Conditioning.

4. R.C.Arora, Refrigeration and Air Conditioning, TMH.

5. Arora and Domkundwar, Refrigeration and Air Conditioning, Dhanpat Rai Publication.

JIS College of Engineering

Mechanical Engineering Department

Paper Name: Machine Tools & Machining Paper Code: ME602		
Module No.	**Syllabus**	**Contact Hrs.**
1.	Introduction: Machining: Basic principle, purpose, definition and requirements	**1**
2.	Geometry of cutting tools: 1. Geometry of single point turning (shaping, planning and boring) tools in ASA, ORS and NRS systems. 2. Conversion of tool angles from one system to another by graphical and vector methods. 3. Geometry of drills and milling cutters.	**4**
3.	Mechanism of machining: 1. Chip formation mechanism, yielding and brittle fracture, chip reduction coefficient, cutting ratio, shear angle and cutting strain. 2. Built-up edge formation, cause, type and effects, orthogonal cutting and oblique cutting. 3. Machining chips: types and conditions, chip formation in drilling and milling.	**3**
4.	Mechanics of machining: 1. Purposes of determination of cutting forces and basic two approaches, cutting force components in ORS and Merchant's circle diagram. 2. Determination of cutting forces, analytical methods, measurement. 3. Dynamometers, construction and working principles of strain gauge type and piezoelectric crystals type turning drilling, milling and grinding dynamometers.	**3**

5.	Cutting temperature: 1. Heat generators and cutting zone temperature, sources, courses and effects on job and cutting tools, role of variation of the machining parameters on cutting temperature. 2. Determination of cutting temperature by analytical and experimental methods. 3. Control of cutting temperature and application of cutting fluids (purpose, essential properties, selection and methods of application).	**3**
6.	Cutting tools-failure, life and materials: 1. Methods of failure of cutting tools mechanisms, geometry and assessment of tool wear. 2. Tool life, definition, assessment and measurement, Taylor's tool life equation and its use. 3. Cutting tool materials, essential properties, characteristics and applications of HSS, carbide (uncoated/coated), ceramic, diamond and CBN tools.	**3**
7.	Broaching and grinding: 1. Modes and mechanisms of chip formation, selection and application. 2. Grinding forces, surface roughness and wheel life.	**2**
8.	Machinability and machining economics: 1. Machinability and grindability, definition, assessment, improvement and evaluation of optimum cutting velocity and tool life.	**1**
9.	Machine tools – Introduction : 1. Purpose of use, definition and general features of machine tools. 2. Generatrix and Directrix and tool – work motions in different	**2**

	operations of conventional machine tools.	
10.	General constructions function of machine tools : 1. Major components and their functions in lathes; shaping, planning and slotting machines; drilling machines and melting machines. 2. Machining operations and application of the common machine tools and their way of specification.	**2**
11.	Automation and classification : 1. Purposes, degree, type and economy of machine tool automation; broad classification of machine tools.	**1**
12.	Kinematic structure of machine tools : 1. Kinematic structure of centre lathe, shaping, planning and slotting machine. 2. Kinematic structure of drilling (column/radial) and milling machines, capstan lathe, turret lathes.	**3**

Recommended Books:

1. A.B.Chattopadhyay, Machining and Machine Tools, Wiley India (P) Ltd., New Delhi.

2. G. Kuppuswamy, Principles of Metal Cutting, University Press, Hyderabad.

3. Stephenson & Agapion, Metal Cutting Theory and Practice, Taylor and Francis, NY.

4. M.C. Shaw, Metal Cutting Principles and Practices, Oxford University Press.

5. G.C. Sen and A. Bhattacharyya, Principles of Machine Tools, New Cantral Book Agency (P) Ltd., Kolkata.

6. Acharkan, Machine Tool Design, Vol. I, II, III and IV, Mir Publication, Moscow.

JIS College of Engineering

Mechanical Engineering Department

Paper Name: Machine Design - II Paper Code: ME603		
Module No.	**Syllabus**	**Contact Hrs.**
1.	Clutches: Function, types; Friction clutches – torque capacity based on uniform pressure and uniform wear theory for disc and cone clutch; Centrifugal clutch; Friction materials; Considerations for heat dissipation.	**4**
2.	Brakes: Function, types; pivoted block brake (single and double block brakes), internal expanding shoe brake, self energizing and self locking; Pivoted block brake; Band brake-simple and differential; Energy equation for braking time calculation; Magnetic and hydraulic thruster operated fail-safe brakes; Brake lining materials; Thermal considerations during braking.	**4**
3.	Gears: Design objectives, types, terminologies, conjugate action and involute tooth profile, tooth systems, standard modules; Gear materials. Spur Gear : Strength design, static and dynamic considerations in strength design, Lewis formula, Lewis form factor, beam strength, Buckingham equation for dynamic tooth load; Endurance strength and wear strength; Designing a pinion based on above considerations; Helical Gear: Helix angle, minimum face width, virtual number of teeth; Strength design, Buckingham formulae for checking dynamic load and wear load.	**6**
4.	Bevel Gear: Terminologies, formative number of teeth; Lewis equation, dynamic load, endurance strength and wear strength checking. Worm- worm wheel: Terminologies and their inter-relation; Preferred	**4**

	combination of various parameters; Efficiency; Materials.	
5.	Pressure vessels– thin cylinder, thick cylinder, Lame's equation, Clavarino's equation, Birnie's equation, Autofrettage– compound cylinders, End Covers, Opening in pressure vessel – area compensation method, Fired and unfired vessels – category, Industrial Code.	**6**
6.	Flywheel design for application to: (i) Punching press; (ii) 2-stroke engine; (iii) 4-stroke engine, Torque analysis, Solid disc and rimmed flywheel.	**2**
7.	Sliding contact bearings: Bearing types and materials; Stribeck Curve, Petroff equation, Hydrodynamiclubrication theory - pressure development; Tower experiment, Reynolds equation, Finite bearings – RaimondiBoyd charts, Design factors/variables, Heat Generation & dissipation; Hydrostatic bearing; Plummer block.	**6**
8.	Rolling contact bearings: Bearing types, nature of load; Static and dynamic load capacity, Stribeck equation, Load - Life relation; Bearing selection from manufacturers' catalogues; Methods of lubrication; Bearing mounting on journal and bearing block.	**4**

Recommended Books:

1. V. B. Bhandari, Design of Machine Elements, TMH.

2. Shigley and Mischke, Mechanical Engineering Design, TMH.

3. Hall, Holowenko and Laughlin, Theory and Problems of Machine Design, TMH.

4. Hamrock, Schmid, Jacobson, Fundamentals of Machine Elements, Mcgraw Hill.

5. Burr and Cheatham, Mechanical Analysis and Design, Prentice Hall.

6. P. Kannaiah, Machine Design, Scitech Publications.

7. P.C. Gope, Fundamentals of Machine Design, PHI.

JIS College of Engineering

Mechanical Engineering Department

Paper Name: Advanced Manufacturing Technology-I Paper Code: ME604		
Module No.	**Syllabus**	**Contact Hrs.**
1.	Introduction to and scope of the subject of Advanced Manufacturing Technology.	**2**
2.	Manufacturing Systems and Automation : Job shop, Flowlines, Transfer lines, Project shop, Continuous processes, Cellular manufacturing system, Flexible Manufacturing System: Automation: (i) degree of automation and their justified application in different levels of production (ii) benefits and draw backs of employing automation (iii) examples of conventional non-automatic, semi-automatic and automatic machine tools (iv) extent of automation in transfer machines Integrated Manufacturing Production System: Steps involved in implementation, forming the linked-cell factory.	**18**
3.	CNC machine tools and systems (i) types of automation ; fixed (or hard), programmable and flexible	**16**

	(ii) need and advantages of flexible automation (iii) basic principles of NC system Components and their functions in NC machines (i) Control ; MCU, DPU and CLU (ii) feed drives ; special motors and screw-nut system (iii) advantages of CNC over NC machines Basic systems of NC and CNC machines (i) coordinate system (ii) control – open loop and closed loop (iii) dimensioning – absolute and incremental CNC machine tools ; (i) structure and working principle (ii) examples and use of CNC machines (iii) machining centre (MC) – characteristics and applications. Control of tool – work travel ; (i) point – to – point and contouring (ii) interpolation – linear and circular Part programming for NC, CNC and MC systems Manual part programming (i) definition and codes used (ii) sequential steps (iii) examples ; part programming for machining in CNC lathes, drilling machines and milling. Computer aided part programming (i) definition and advantages (ii) programming languages	

	(iii) statements in APT (iv) examples of CA part programming in APT	

Recommended Books:

1. Fundamentals of Modern Manufacturing by Mikeel P. Grover– 3E Wiley

2. Automation, Production systems and CIM – M.P. Groover , Prentice Hall

3. Non conventional machining – P.K. Mishra, Narosa

4. Manufacturing science – Ghosh & Mullick, EWP

5. Rapid prototyping – A. Ghosh, EW Press

6. Non traditional Manufacturing Processes by Gary F. Benedict– Marcel Dekker

7. Micromaching of Engineering Material by Mc Geongh, J.A. – Marcel Dekker

8. Advanced Machining Process, Nontraditional and Hybrid Machining Processes by Hassan Abdel- Gawad El- Hofy – McGraw Hill, Mechanical Engineering Science

Paper Name: Power Plant Engineering

Paper Code: ME605

Module No.	Syllabus	Contact Hrs.
1.	Power plant cycles, reheat, regenerative and binary vapor and co-generation cycles.	**4**
2.	Boilers: Definition, classification, fire tube and water tube boilers, mountings and accessories. Draft in boilers, performance of boiler - boilers efficiency, equivalent evaporation, Losses in boilers. Coal and combustion: Properties of coal, ultimate analysis and proximate analysis, combination calculation.	**6**
3.	Fuel bed firing, PF firing and Fluidized bed boilers. Introduction to boiling and circulation in boilers. Power station boilers - Benson, Lamont. Supercritical boiler.	**5**
4.	Boilers accessories: Super heater, economizer and air-pre heater.	**5**

	Handling of coal and ash.	
5.	Steam turbine- i) parts and classification, ii) nozzles types, flow through nozzles and nozzle efficiency. Impulse turbine - velocity diagram, work done and blade efficiency.	**7**
6.	Pressure compounding and velocity compounding of steam turbine.	**4**
7.	Impulse reaction turbine - Velocity diagram, degree of reaction and Parsons turbine.	**4**
8.	Governing in Steam turbine. Condensers – Basic ideas.	**5**
9.	Power plant economics: load curve and various factors, cost of power generation. Introduction to Hydel, Nuclear and Renewable power plants.	**4**

Recommended Books:

1. P.K. Nag, “Power plant Engineering,” Tata McGraw - Hill.

2. Arora and Domkundwar, “A course in Power plant Engineering” Dhanpat Rai & Sons.

3. M.M.EI- Wakil, “Power plant technology,” Tata McGraw - Hill.

Paper Name: Advanced Manufacturing Technology-II

Paper Code: ME701

Module No.	Syllabus	Contact Hrs.
1.	An overview of Non Traditional Manufacturing - Advantages over traditional, classification, characteristics of all processes: Abrasive Jet Machining (AJM) Working principle with help of layout, Applications, Effect of pressure, strand-off distance, grain size, abrasive flow rate on material removal rate (mrr) Mechanism of material removal. Advantages and limitations. Water Jet Machining: Introduction, Machining System, Basic principle, Process parameters, Applications, Advantages and Disadvantages.	**9**

	Ultrasonic Machining (USM) Schematic Diagram of USM- Working principle, Functions of each equipment used in the set up, Material removal process. Influence of Process parameters on (i) machining rate (ii) Surface finish and accuracy and repeatability, Applications. Plasma Arc Machining Basic principle, applications	
2.	Chemical Machining- Introduction, Blanking, Chemical Machining to multiple depths, Design factors, advantages and disadvantages. Electro-Chemical Machining- Process principle, Equipment, Applications. Electron Beam Machining Set up, Basic Principle, Applications. Electrical Discharge Machining (EDM) Diesinking- Basic principle, Schematic diagram of EDM setup, Dielectric fluid, Electrode materials. System for maintaining the spark gap constant, Effect of cutting parameters- pulse-on-time, pulse off time, peak current setting, no load voltage, servo reference voltage, Applications. Wire-cut EDM: Schematic diagram, working principle Dielectric fluid, use. Advantages & Disadvantages of EDM, Applications.	**9**
3.	Laser Beam Machining (LBM) Characteristics of Laser light, Basic mechanism of Ruby laser, Energy level diagram of Ruby laser. Carbon Dioxide laser, Energy level diagram. Commercial lasers available for machining, welding Heat treating, cladding. Hybrid Machining- Introduction, Methodology for Hybrid Machining-	**9**

	thermal interaction, chemical and electrochemical interaction, mechanical interaction, Electromechanical Discharge Machining (ECDM/ECAM), Electrical Discharge Machining with Ultrasonic Assistance (EDMUS).	
4.	Rapid Prototyping- Overview of Rapid Prototyping, Basic Process- CAD Model Creation, Conversion to STL format, Slice the STL File, Layer by layer construction, Clean and finish. Principles, systems, relative advantages and applications of the common RP methods ; (i) stereo lithography (SLG) (ii) selective laser sintering (SLS) (iii) fused deposition modelling (FDM) (iv) laminated objects manufacturing (LOM) (v) 3-D Inkjet Printing	**9**

Recommended Books:

1. Fundamentals of Modern Manufacturing by Mikeel P. Grover– 3E Wiley

2. Automation, Production systems and CIM – M.P. Groover , Prentice Hall

3. Non conventional machining – P.K. Mishra, Narosa

4. Manufacturing science – Ghosh & Mullick, EWP

5. Rapid prototyping – A. Ghosh, EW Press

6. Non traditional Manufacturing Processes by Gary F. Benedict– Marcel Dekker

7. Micromaching of Engineering Material by Mc Geongh, J.A. – Marcel Dekker

8. Advanced Machining Process, Nontraditional and Hybrid Machining Processes by Hassan Abdel- Gawad El- Hofy – McGraw Hill, Mechanical Engineering Science

Paper Name: Materials Handling

JIS College of Engineering

Mechanical Engineering Department

Paper Code: ME702		
Module No.	**Syllabus**	**Contact Hrs.**
1.	Introduction : Definition, importance and scope of materials handling (MH); classification of materials; codification of bulk materials ; utility of following principles of MH – (i) materials flow, (ii) simplification, (iii) gravity, (iv) space utilization, (v) unit size, (vi) safety, (vii) standardization, (viii) dead-weight, (ix) idle time, (x) motion.	**4**
2.	Unit load : Definition; advantages & disadvantages of unitization; unitization by use of platform, container, rack, sheet, bag and self contained unit load; descriptive specification and use of pallets, skids, containers, boxes, crates and cartons; shrink and stretch wrapping.	**3**
3.	Classification of MH Equipment : Types of equipment – (i) industrial trucks & vehicles, (ii) conveyors, (iii) hoisting equipment, (iv) robotic handling system and (v) auxiliary equipment; Independent equipment wise sub classification of each of above type of equipment..	**3**
4.	Industrial trucks & vehicles : Constructional features and use of the following equipment – (i) wheeled hand truck, (ii) hand pallet truck, (iii) fork lift truck; Major specifications, capacity rating and attachments of fork lift truck.	**5**
5.	Conveyors : Use and characteristics of belt conveyor, constructional features of flat and troughed belt conveyor; Use and constructional features of Flg. types of chain conveyors – (i) apron, car and trolley type; Construction of link-plate chains; Dynamic phenomena in chain drive; Use and constructional features of roller conveyors; Gravity and powered roller conveyor; Pneumatic conveyor-use and advantages; Positive, negative and combination system of pneumatic conveyors; constructional feature, application and conveying capacity of screw conveyor.	**8**
6.	Hoisting Equipment : Advantage of using steel wire rope over chain; constructional features of wire ropes; Rope drum design; Pulley system-simple vs. multiple pulley; Load handling attachments : hooks, grabs, tongs, grab bucket; Arrangement of hook suspension with cross piece and pulleys (sheaves); Use and constructional features of (i) hand operated trolley hoist , (ii) winch; (iii) bucket elevator, (iv) Jib crane, (v) overhead traveling crane and (vi) wharf crane; Level luffing system of a wharf crane; Utility of truck mounted and crawler crane.	**3**

7.	Robotic handling: Materials handling at workplace; Major components of a robot; Applications of robotic handling.	**2**
8.	Auxiliary Equipment: Descriptive specification and use of – (i) Slide and trough gates, (ii) belt, screw and vibratory feeders, (iii) Chutes, (iv) positioners like elevating platform, ramps, universal vise; (v) ball table.	**3**

Recommended Books:

1. S. Ray, Introduction to Materials Handling, New Age Int. Pub.

2. T. K. Ray, Mechanical Handling of Materials, Asian Books Pvt. Ltd.

3. T.H. Allegri, Materials Handling: Principles and Practices, CBS Publishers and Distributors.

4. J.A. Apple, Material Handling System Design, John Wiley & Sons.

PROFESSIONAL ELECTIVE – I

1. ADVANCED WELDING TECHNOLOGY (ME703 A)
2. RENEWABLE ENERGY SYSTEMS (ME703 B)
3. QUANTITY PRODUCTION METHOD (ME703 C)
4. APPLIED FLUID MECHANICS (ME703 D)
5. MAINTENANCE ENGINEERING (ME 703E)

Paper Name: Advanced Welding Technology

Paper Code: ME703A

Module No.	Syllabus	Contact Hrs.
1.	Review of welding processes, joint design.	**3**
2.	Process descriptions of and parametric influences on fusion welding; arc welding- SMAW, stud arc welding, GMAW, GTAW and FCAW, solid state welding processes- pressure welding, friction welding, diffusion welding;	**6**

	resistance welding processes.	
3.	Arc welding- different types of equipment, power sources, arc characteristics, electrode selection.	**5**
4.	Critical and precision welding processes like: PAW, LBW, EBW, USW, friction stir welding, under-water welding. Welding of plastics, ceramics and composites.	**7**
5.	Welding metallurgy, HAZ, effects of different process parameters on the characteristics of weldment. Welding fixtures, welding automation and robotic applications	7
6.	Weldability of plain carbon steels, stainless steel, cast iron, aluminium and its alloys.	**4**
7.	Welding defects- types, causes, inspection and remedial measures; testing of welded joints by visual inspection, dye-penetration (DP) test, ultrasonics and radiography. Safe Practices in Welding.	**4**

Recommended Books:

1. O.P. Khanna, A Text Book of Welding Technology, Dhanpat Rai & Sons.

2. R.S. Parmar, Welding Engineering and Technology, Khanna Publishers.

3. M. Bhattacharyya, Weldment Design, The Association of Engineers, India Publication, Kolkata.

4. J.C. Lippold and D.J. Kotecki, Welding Metallurgy and Weldability of Stainless Steels, Wiley-India (P) Ltd., New Delhi.

5. Udin, Funk and Wulf, Welding for Engineers, John Wiley and Sons.

6. J.L. Morris, Welding Process and Procedures.

7. S.V. Nadkarni, Modern Arc Welding Technology, Oxford & IBH Publishing Co. Pvt. Ltd./ Advani-Oerlikon Ltd.

Paper Name: Renewable Energy Systems

JIS College of Engineering

Mechanical Engineering Department

Paper Code: ME703B		
Module No.	**Syllabus**	**Contact Hrs.**
1.	Principles of Renewable Energy: (i) The history of energy scene (ii) The energy future: energy and sustainable Development and role of renewable energy (iii) Scientific Principles of renewable energy.	**4**
2.	Review of principles of thermodynamics, fluid dynamics and heat transfer.	**1**
3.	Solar radiation: (i) Sun-Earth geometry (ii) Extraterrestrial Solar Radiation (iii) Measurement and estimation of solar radiation.	**4**
4.	Solar Water Heating: (i) Flat Plate Collectors: Heat Transfer analysis, Testing (ii) Evacuated Tube Collectors.	**5**
5.	Other Solar Thermal Applications: (i) Air heaters (ii) Water Desalination (iii) Space Cooling (iv) Solar Concentrators (v) Solar ponds.	3
6.	Photovoltaic Generation: (i) Photon absorption at Silicon p-n junction (ii) Solar Cell (iii) Application and Systems.	**4**
7.	Wind Power: (i) Turbine types & terms (ii) Mechanical & Electrical Power from Wind Turbines.	**3**
8.	Biomass & Bio fuels: (i) Use of Biomass (ii) Classification & Use of Bio fuels.	**3**
9.	Wave Power & tidal Power: Basic Concepts.	**3**
10.	Ocean Thermal Energy Conversion.	**2**
11.	Geothermal Energy.	**2**
12.	Energy Storage.	**2**

Recommended Books:

1. Renewable Energy – G. Boyle, 2nd edition, OUP,2010.
2. Renewable Energy Resources- Twidell, J & Weir, T, 2nd edition, Taylor & Francis, 2006.

3. Non Conventional Energy Resources- B.H. Khan, T M H, 2010.

4. Non Conventional Energy Sources- G.D. Rai, Khanna Publishers.

FREE ELECTIVE

1. INDUSTRIAL INSTRUMENTATION (ME704A)
2. SAFETY & OCCUPATIONAL HEALTH (ME704B)
3. MECHATRONICS (ME 704 D)
4. BIOMECHANICS & BIOMATERIALS (ME704C)

Paper Name: Mechatronics **Paper Code: ME704D**		
Module No.	**Syllabus**	**Contact Hrs.**
1.	Introduction to Mechatronics: Definition, Mechatronics in design and manufacturing, Comparison between Traditional and Mechatronic approach; Concurrent engineering.	**3**
2.	Review of fundamentals of electronics, Logic gates and their operations, Signal processing devices, Data conversion devices, Input and output devices. Sensors and Transducers, Actuators, Limit switches, Relays.	**6**
3.	Control Systems: Open loop and closed loop control, block diagrams,	**3**

	transfer functions, Laplace transforms.	
4.	Electrical Drives: Stepper motors, servo drives.	**2**
5.	Mechanical Drives: Different mechanisms, Ball screws, Linear motion bearings, Transfer systems.	**3**
6.	Pneumatic and Hydraulic Drives: Elements of pneumatic and hydraulic drives, comparison between them. Design of pneumatic and hydraulic circuits, symbolic representations of such circuits indicating different valves, actuators, etc.	**4**
7.	Basics of 8085 microprocessor, programmable register architecture, buses, memory mapping, clock pulse and data transfer operations, and simple assembly and mnemonic programming on 8085 microprocessor.	**5**
8.	Use of On-Off, PI and PID controllers to control different drives, Programming in PLC controller using Ladder diagram.	**4**
9.	Mathematical modeling of physical systems, such as spring-mass vibration system, linear and rotary motion and its Laplace Transform.	**2**
10.	Basics of time domain analysis, Introduction to discrete-time systems and Z-transform.	**2**
11.	Introduction to Mechatronic systems, such as automatic brake, door closing and opening, robot, CNC machine, AGV, etc.	**2**

Recommended Books:

2. N.P. Mahalik, Mechatronics, Tata McGraw Hill Publication

3. W. Bolton, Mechatronics, Pearson Education

4. A. Smaili and F. Arnold, Mechatronics, Oxford University Press, Indian Edition

5. M.D. Singh and J.G. Joshi, Mechatronics, Prentice Hall of India Pvt. Ltd.

6. K.K. Appuu Kuttan, Mechatronics, Oxford University Press, New Delhi

7. HMT Ltd., Mechatronics, Tata McGraw Hill Publication

8. F.H. Raven, Automatic Control Engineering, McGraw Hill International.

9. K. Ogata, Modern Control Engineering, Prentice Hall.

10. B.C. Kuo, Automatic Control Systems, Prentice Hall.

JIS College of Engineering

Mechanical Engineering Department

Paper Name: Industrial Engineering Paper Code: ME801		
Module No.	**Syllabus**	**Contact Hrs.**
1.	Production Planning and Control.	**5**
2.	Product: product design, customer requirements, value engineering, quality, reliability, service life, competitiveness.	**6**
3.	Plant: location, layout, material handling, equipment selection, maintenance of equipment and facilities.	**7**
4.	Processes: Job, batch and flow production methods, Group Technology Work study and Time and Motion study, Work/job evaluation, quality control (SPC), control charts.	**9**
5.	Resource planning: production/ operation control, forecasting, capacity management, scheduling and loading, line balancing, break-even analysis, inventory of materials and their control, manufacturing planning, MRP - II, JIT.	9

Recommended Books:

1. Production, Planning and Inventory Control by S.L.Narasimhan, D.W.McLeavey, P.J.Billington, Prentice Hall.

2. Production Systems: Planning, Analysis and Control by J.L.Riggs, 3rd ed., Wiley.

3. Productions and Operations Management by A.Muhlemann, J.Oakland and K.Lockyer, Macmillan

PROFESSIONAL ELECTIVE – II

1. CAD/CAM (ME802A)
2. TRIBOLOGY (ME802B)
3. ENERGY CONSERVATION & MANAGEMENT (ME802C)
4. TURBO MACHINERY (ME802D)
5. INDUSTRIAL ROBOTICS (ME802E)

Paper Name: CAD/CAM **Paper Code: ME802A**		
Module No.	**Syllabus**	**Contact Hrs.**
1.	Fundamentals of CAD- Design process, benefits of computer aided design, graphics standards	**3**
2.	Geometric modeling- wire-frame, surface and solid modeling Transformation- translation and rotation exercise problems and programming	**6**
3.	Stress analysis- basics of FEM, formation of stiffness matrix for two elements.	**8**
4.	Introduction to computer aided manufacturing (CAM) systems, basic building blocks of computer integrated manufacturing (CIM).	**4**
5.	Toolings of CNC machines, tool and work handling systems involving robot, AGV, RTV, AS/RS, ATC, APC	

		3
6.	Robotics; types, anatomy, drives and applications.	**3**
7.	Computer aided production planning and control, Manufacturing from product design- CAD-CAM interface, concept of group technology (GT), CAPP.	**6**
8.	Control systems, Process monitoring, Adaptive control systems, etc.,	**2**
9.	Automatic inspection systems, use of CMM, Reverse Engineering.	**1**

Recommended Books:

1. P.N. Rao, N.K. Tewari and T.K. Kundra, Computer Aided Manufacturing, Tata McGraw-Hill Publication.
2. M.P. Groover and E.W. Zimmers Jr., CAD/CAM, Prentice Hall of India
3. P. Radhakrishnan, S. Subramanyan and V. Raju, CAD/CAM/CIM, New Age International Publishers.
4. P.N. Rao, CAD/CAM, Tata McGraw Hill Publication.
5. M.P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, Prentice Hall of India.
6. I. Zeid, CAD/CAM - Theory and Practice, Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
7. S.R. Deb, Robotics Technology and Flexible Automation, Tata McGraw-Hill Publication.
8. S.K. Saha, Introduction to Robotics, The McGraw-Hill Publication
9. P.B. Mahapatra, Computer-Aided Production Management, Prentice Hall of India.

JIS College of Engineering

Mechanical Engineering Department

Paper Name: Tribology **Paper Code: ME802B**		
Module No.	**Syllabus**	**Contact Hrs.**
1.	Introduction: History, Industrial Importance. Engineering Surfaces: Properties and Measurement: Measurement Methods, Surface Profilometry, Statistical Description of Roughness.	**4**
2.	Surface Contact: Hertz contact theory, Greenwood-Williamson model, Elastic-plastic contact. Adhesion: Basic Models, Factors influencing Adhesion.	**4**
3.	Friction: Measurement Methods, Origin of Friction, Friction Theories – adhesion and ploughing, Mechanisms, Friction of Metals, Non-metallic Materials.	**6**
4.	Wear: Types: Adhesive, Abrasive, Corrosive, Fatigue, Minor Forms: Fretting, Erosion, Percussion, Delamination Theory, Wear Debris Analysis, Wear Testing Methods, Wear of Metals, Ceramics, Polymers.	**6**
5.	Surface Engineering: Surface Treatments: Microstructural and Thermochemical Treatments, Surface Coatings: Hard Facing, Vapour Deposition Processes: PVD, CVD, PECVD etc.	4
6.	Lubrication: Basic Equations for Fluid Film Lubrication. Hydrodynamic lubrication -Thrust and Journal bearings, Squeeze Film Bearings, Hydrostatic lubrication, Gas-Lubrication. Lubrication of rolling element bearings. Boundary lubrication – metal working lubrication, solid film lubrication. Hygiene of lubricants.	**10**
7.	Nanotribology: Measurement Tools: Surface Force Apparatus, Scanning Tunnelling Microscope, Atomic / Friction Force Microscope.	**2**

Recommended Books:

1. P. Sahoo, Engineering Tribology, Prentice Hall-India, New Delhi, 2009.

2. B. Bhushan, Introduction to Tribology, Wiley, 2002.

3. G W Stachowiak and A W Batchelor, Engineering Tribology, Butterworth-Heinemann,

2005.

4. S.K. Basu, S.N. Sengupta, B.B. Ahuja, Fundamentals of Tribology, Prentice Hall-India, 2005.

5. B C Majumdar, Introduction to Tribology of Bearings, S Chand & Co, 2012.

PROFESSIONAL ELECTIVE – III

1. AUTOMATION & CONTROL (ME803A)
2. AUTOMOBILE ENGINEERING (ME803B)
3. QUALITY & RELIABILITY ENGINEERING (ME803C)
4. FINITE ELEMENT METHOD (ME803D)
5. FLUID POWER CONTROL (ME 803 E)

Paper Name: Automation & Control **Paper Code: ME803A**		
Module No.	**Syllabus**	**Contact Hrs.**
1.	Introduction to control system: Concept of feedback and Automatic control, Effects of feedback, Objectives of control system, Definition of linear and nonlinear systems, Elementary concepts of sensitivity and robustness. Types of control systems, Servomechanisms and regulators, examples of feedback control systems. Transfer function concept. Pole and Zeroes of a transfer function. Properties of Transfer function. Mathematical modeling of dynamic systems: Translational systems, Rotational systems, Mechanical coupling, Liquid level systems, Electrical analogy of Spring–Mass-Dashpot system. Block diagram representation of control systems. Block diagram algebra. Signal flow graph. Mason's gain formula. Control system components: Potentiometer, Synchros, Resolvers, Position encoders.	**8**
2.	Time domain analysis: Time domain analysis of a standard second order closed loop system. Concept of undamped natural frequency, damping, overshoot, rise time and settling time. Dependence of time domain performance parameters on natural frequency and damping ratio. Step and Impulse response of first and second order systems. Effects of Pole and Zeros on transient response. Stability by pole location. Routh-Hurwitz	**8**

	criteria and applications. Error Analysis: Steady state errors in control systems due to step, ramp and parabolic inputs. Concepts of system types and error constants.	
3.	State variable Analysis: State variable model of Linear Time-invariant system, properties of the State transition matrix, State transition equation, Definition of transfer function & Characteristic equation, definition of controllability and observability.	**8**
4.	Stability Analysis using root locus: Importance of Root locus techniques, construction of Root Loci for simple systems. Effects ofgain on the movement of Pole and Zeros. Frequency domain analysis of linear system: Bode plots, Polar plots, Nichols chart,Concept of resonance frequency of peak magnification. Nyquist criteria, measure of relativestability, phase and gain margin. Determination of margins in Bode plot. Nichols chart. Mcircle and M-Contours in Nichols chart.	**12**
5.	Control System performance measure: Improvement of system performance through compensation. Lead, Lag and Lead- lag compensation, PI, PD and PID control.	4

Recommended Books:

1. K. Ogata, Modern Control Engineering, 4th Edition, Pearson Education.

2. I. J. Nagrath and M. Gopal, Control System Engineering, New Age International Publication.

3. D. Roy Choudhury, Control System Engineering, PHI

4. B.C. Kuo and F. Golnaraghi, Automatic Control Systems, 8th Edition, PHI

5. Bandyopadhyaya, Control Engineering Theory & Practice, PHI

6. K.R. Varmah, Control Systems, Mc Graw hill

7. Norman Nise, Control System Engineering, 5th Edition, John Wiley & Sons

8. R.C. Dorf and R.H. Bishop, Modern Control System, 11th Edition, Pearson Education.

9. C. G. Graham, F. Graebe, F. Stefan, S.E. Mario, Control System Design, PHI

10. Macia and Thaler, Modeling & Control of Dynamic System, Thompson

11. C.T. Kilian, Modern Control Technology Components & Systems, 3rd edition, Cengage Learning.

12. Y. Singh and S. Janardhanan, Modern Control Engineering, Cengage Learning

13. R. Anandanatarajan and R. Ramesh Babu, Control System Engineering, SCITECH

14. A. William and Wolovich, Automatic Control system, Oxford

Paper Name: Automobile Engineering **Paper Code: ME803B**		
Module No.	**Syllabus**	**Contact Hrs.**
1.	Introduction: History & Development of Automobile. various sub system of Automobile.	**1**
2.	Prime Mover: Engine for Two –Wheeler & Three- Wheeler vehicles, Engine for passenger cars, commercial and other vehicle, Fuel system for carburetted engine, MPFI engine and Diesel engine, Lubrication and cooling system.	**5**
3.	Auto Electrical: Electric Motor as prime mover, Battery, generator, Ignition system, Starting system, lighting & signalling	**6**
4.	Steering System: Devis steering & Ackerman steering system. Rack & pinion, cam & lever, worm & sector system.	**3**
5.	Transmission System: Flywheel & clutch. Gearbox sliding and constant mesh type, Automatic Transmission, Universal joint, Propeller shaft.	6
6.	Differential & Axle: Construction & function of differential, Different types of front & rear axles.	**3**
7.	Suspension System: Conventional and independent suspension system, application.	**3**
8.	Brake System: Disc & drum brake, Hydraulic brake, Parking brake. Stopping distance.	**3**
9.	Power Requirement: Various resistances such as air resistance, gradient resistance, rolling resistance. Tractive effort. Torque- Speed curve. Horse power calculation.	**4**

10.	Maintenance of Vehicle.	**2**

Recommended Books:

1. Motor Vehicle by Newton, Steed and Garrette 2nd ed, Butter worth.

2. Automobile Mechanics by N.K.Giri, 7th ed, Khanna Publishers.

3. Automobile Engineering by Amitosh De, Revised edition 2010, Galgotia Publication Pvt. Ltd.

4. Automobile Mechanics by Heitner Joseph, East West Press.

Paper Name: Quality & Reliability Engineering

Paper Code: ME803C

Module No.	Syllabus	Contact Hrs.
1.	Management of Product Quality: Evolution of Quality Control; Changing Quality Concepts; Modern Concept of Total Quality Management; Contribution of Quality masters (Deming, Juran, Crosby, Ishikawa, Taguchi);	**3**
2.	Creating Quality by Design: Assessment of Customer's needs; Formulation of Design Specifications; Standardization; Costs of Quality; Quality Circles; 5-S concept;	**4**
3.	Total Quality Management: Concept of Total Quality, Difference between "Quality" Management and "Total Quality" Management, total quality maintenance, total quality in service sector; Role of Customer and People in Total Quality Management; Steps for Quality Improvement, Kaizen; Organizing for effective Quality Management;	**4**
4.	Process Control: Control Charts; Statistical Quality Control Tools; Statistical Process Control and Process Capability, Zero defect programme; Six – Sigma approach;	**4**
5.	Quality Management Systems: ISO 9000 Series of Standard; ISO 14000	

	Series of Standards;	4
6.	Strategic tools and Techniques for TQM: Need for Tools and Techniques in TQM; Commonly used Tools for TQM; Approaches and Deployment of Tools for Quality Planning – Quality Function Deployment (QFD), concurrent engineering; Tools for continuous Improvement – Deming's Plan – Do – Check – Act (PDCA) cycle, Poka – Yoke (Mistake – Proofing), Taguchi's Quality Loss Function.	**5**
7.	Reliability: Concept and definition of reliability; Reliability Parameters: Reliability as a function of time, failure rate as a function of time, constant failure rate, mean time to failure (MTTF), MTTF as a function of failure rate, mean time between failure (MTBF), mean down time (MDT), maintainability & availability, increasing failure rate, bath-tub curve; Brief discussion on hazard models: constant hazard model, linearly increasing hazard model, nonlinear hazard model and weilbull distribution, Advantages of weibull distribution; System reliability models: series system, parallel system, series-parallel system.	**7**
8.	Risk Assessment & Reliability in Design: Causes of failures, Failure modes & Effects Analysis (FMEA), faulty tree analysis (FTA); Tribological failure and monitoring techniques; Design based on reliability, redundancy in design.	**5**

Recommended Books:

1. H. Lal, Total Quality Management – A Practical Approach –– New Age International (P) Ltd. Publishers
2. S. K. Mondal –Total Quality Management Principles and Practice –Vikas Publishing House Pvt. Ltd.
3. A. V. Feigenbum– Total Quality Control, Mcgraw-Hill Book Company
4. Juran's Quality Control Handbook –McGraw Hill Book Company
5. Amitava Mitra, Fundamentals of quality Control and Improvement –– PHI
6. Grant and Leavenworth-Statistical Quality Control, 7th Edition, Tata Mcgraw Hill
7. E. Balaguruswamy , Reliability Engineering – TMH
8. Bhadury and Basu- Terotechnology: Reliability Engineering and Maintenance

Management, Asian Books Pvt. Ltd. 9. Paul Kales- Reliability of Technology,

Engineering and Management- PHI