

SCHEME OF INSTRUCTION & EXAMINATION

B.E. IIIrd YEAR
(MECHANICAL ENGINEERING)

SEMESTER - I

Sl. No.	Syllabus Ref. No.	SUBJECT	Scheme of Instruction		Scheme of Examination		
			Periods per week		Duration In Hours	Maximum Marks	
			L	D/P		Univ. Exam	Sessi-onals
1.	ME 301	THEORY Applied Thermodynamic	4	-	3	75	25
2.	ME 302	s	4	-	3	75	25
3.	ME 303	Dynamics of Machines	4	-	3	75	25
4.	ME 304	Design of Machine Elements	4	-	3	75	25
5.	ME 305	Hydraulic Machinery & Systems Manufacturing Processes	4	-	3	75	25
1.	ME 331	PRACTICALS	-	3	3	50	25
2.	ME 332	Thermodynamics Lab.	-	3	3	50	25
3.	ME 333	Hydraulic Machinery & Systems Lab. Manufacturing Processes Lab.	-	3	3	50	25
		Total	20	9	--	525	200

ME 301

APPLIED THERMODYNAMICS

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessional	25 Marks

UNIT-I

Reciprocating Air Compressors: Uses of compressed air, Classification of compressors-single stage and multistage compressors, Derivation of work done with and without clearance volume, Work done of multistage compressors-effect of clearance volume on workdone -Inter-cooling and After-cooling

UNIT-II

Internal Combustion Engines : Classification, working principle, Deviation of actual cycles from air standard cycles, Index of compression and expansion for variable specific heats, Battery and Magneto ignition systems, Multipoint fuel injection system, Lubrication systems, Cooling systems, Carburetors-Simple and Zenith carburetors-Valve and Port-timing diagrams. Performance of I.C. engines-Determination of Indicated power, brake power, frictional power, brake thermal efficiency, mechanical efficiency, indicated thermal efficiency, relative efficiency, volumetric efficiency, specific fuel consumption based on brake power and indicated power, Heat balance sheet.

UNIT-III

Combustion in I.C. Engines: Combustion phenomena in spark ignition engines and compression ignition engines-Premixed and diffusion flames, Mechanics of propagation, Self ignition process, Limits of self ignition. Fuel requirements and fuel rating- Anti-knock additives like TEL etc., merits and demerits. Effect of engine variables- Stages of combustion - Delay period, Period of uncontrolled combustion, Period of controlled combustion, Afterburning. Types of combustion chambers in spark ignition and compression ignition engines-Air pollution from 1C engines- Effects and control of exhaust from engines.

UNIT-IV

Steam Boilers: Classification of boilers-Fire tube boilers- Cochran boiler, Locomotive boiler, Water tube boilers-Babcock and Wilcox boiler, Super critical boilers-Benson, Fluidized bed combustion boilers, Boiler mountings and accessories. Boiler performance and boiler draught-Chimney design, Types of condensers Jet and Surface condensers, introduction to cooling towers.

UNIT-V

Steam power plant: Working Carnot and Rankine cycles, cycle analysis, Modified Rankin cycle, Cycle efficiency improvement methods, Reheating, Regeneration and Cogeneration.

Steam nozzles: Types of nozzles, Nozzle efficiency, Velocity of steam flowing through the nozzle. Mass of steam discharged from the nozzle, Condition for maximum discharge, Critical pressure ratio. Diameters of nozzle throat and exit for maximum discharge.

Suggested Reading:

1. Heywood. J.B, “*Internal Combustion Engine Fundamentals* “, Tata McGraw Education Pvt. Ltd., New Delhi 2011.
2. Ganeshan.V, “*Internal Combustion Engines*”, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
3. Ballaney. P.L, “*Thermal Engineering*”, Khanna Publishers, New Delhi, 2010.
4. Rajput. R. K, “*Thermal Engineering*” Laxmi Publishers, New Delhi, 2004.
5. Mahesh M Rathor, “*Thermal Engineering*” Tata McGraw Education Pvt. Ltd., New Delhi 2010.

ME 302**DYNAMICS OF MACHINES**

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessional	25 Marks

UNIT-I

Static and Dynamic: Force analysis of 4-bar and slider crank mechanisms. Study of dynamically equivalent system, Inertia forces on connecting rod. **Gyroscope:** Gyroscopic couple, gyroscopic effects in vehicles.

UNIT-II

Governors: Classification of governors, Watt, Porter, Hartnell and Hartung governors, Controlling Force, Stability, Isochronism, Sensitivity, Power and Effort of governors.

Flywheels: Functions, Differences between flywheel and governor. Turning moment diagrams, flywheel analysis for I.C. Engines and Presses.

UNIT-III

Forces: Forces on bearings due to rotating shaft carrying several masses in several planes. Determination of balance masses from the forces on the bearings, Shaking forces in single cylinder engine, Partial balancing of reciprocating engine. Balancing of two cylinder locomotive engine. Balancing of multi cylinder in-line engines. Balancing of radial engines by direct and reverse cranks method.

UNIT-IV

Vibrations: Vibrations of Single degree freedom system (axial, transverse and torsional). Equivalent system of combination of springs, stepped shaft, whirling speed of shafts.

Damped vibrations: Types of damping, Vibrations with viscous damping.

Forced vibrations: Vibrations with harmonically applied force with viscous damping. Dynamic magnifier, Resonance, Vibration isolation and Transmissibility.

UNIT-V

Torsion: Torsional vibrations of two rotor, three rotor and geared systems. Natural frequencies of two degree freedom systems. Modes of vibration. Approximate methods for determining natural frequencies: Dunkerley's method, Rayleigh's method and Holzer's method for multi rotor system.

Suggested Reading:

1. S.S. Rattan, "*Theory of Machines*", Tata McGraw Hill, Tata McGraw Education Pvt. Ltd., New Delhi 2010.
2. Thomas Bevan, "*The Theory of Machines*", CBS Publishers & Distributors, 2004.
3. John J. Uicker, Jr., Gordon R. Pennock, Joseph E. Shigley, "*Theory of Machines and Mechanisms*", Oxford University Press, 2003.
4. J.S. Rao and Gupta, "*Theory and Practice of Mechanical Vibrations*", Prentice Hall, 1984.
5. R.L. Norton, "*Kinematics and Dynamics of Machinery*" Tata McGraw Education Pvt. Ltd., New Delhi 2009.

ME 303**DESIGN OF MACHINE ELEMENTS**

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessional	25 Marks

UNIT-I

Design considerations of Machine Elements. Materials used in machine design and their specifications according to Indian Standards. Codes and standards used in design. Important mechanical properties of materials used in design. Preferred numbers. Manufacturing considerations in design. Review of types of loads and simple stresses. Stresses due to Biaxial and Triaxial loads. Factor of safety. Theories of failures. Design of components subjected to impact loading.

UNIT-II

Design for Fatigue: Fluctuating stresses, fatigue strength and endurance limit Stress concentration factor and Notch sensitivity. Factors affecting fatigue strength. S-N diagram, Soderberg and Modified Goodman's diagrams for fatigue design. Cumulative fatigue - Miner's rule.

UNIT-III

Design of shafts: solid, hollow and splined shafts under torsion and bending loads. Design of keys. Design of couplings - Muff, Split muff, Flange, Flexible, Marine type couplings.

UNIT-IV

Design of Joints: Cotter and Knuckle joints. Design of pulleys. Design of chain drives linked and laminated chains. Design of bolts and nuts, Locking devices for nuts, Bolts of uniform strength. Bolted joints under eccentric loads. Design of gasket joints.

UNIT-V

Design of Screws: Design of power Screws and screw jack. Differential and Compound Screws. Design of rivetted and welded joints under direct and eccentric loads.

Suggested Reading:

1. M.F. Spotts, “*Design of Machine Elements*”, Pearson Edu, 7th edn. 2003.
2. V. B. Bhandari, “*Design of Machine Elements*”, Tata McGraw-Hill Publ, 3rd Edn. 2010.
3. P.C. Sharma & D.K. Aggarwal, “*Machine Design*”, S.K. Kataria & Sons, 10th edn, 2003.
4. P. Kannaiyah, *Machine Design*, Sci-Tech Publ., 2009.
5. J.E. Shigley & Charles R. Mischke “*Mechanical Engineering Design*”, Tata McGraw-Hill., 6th ed. 2010.

WITHEFFECT FROM THE ACADEMIC YEAR 2012 - 2013

ME 304

HYDRAULIC MACHINERY AND SYSTEMS

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

UNIT-I

Hydraulic Machines: Classification– Impulse momentum equation– Layout of hydraulic power plant – Working principle - Impact of jet on vanes – Force exerted by a jet striking (i) a fixed flat vertical vane held normal to the jet flow (ii) At the centre of a fixed symmetrical curved vane (iii) At one end of fixed symmetrical and unsymmetrical curved vanes (iv) Flat vertical vane moving in the direction of jet (v) A series of flat vertical moving vanes (vi) At the centre of a symmetrical moving curved vane (vii) A symmetrical curved vane moving in the same direction as that of jet at inlet (viii) At one end of an un-symmetrical moving curved vane (ix) Hinged plate

UNIT-II

Reciprocating Pumps: Classification, working principle-single and double acting pumps-discharge, work done and power required to drive the pumps-slip, % slip and negative slip- variation of pressure head in the

suction and delivery pipes due to acceleration of piston- variation of pressure head due to friction in the suction and delivery pipes -Indicator diagrams- Ideal and actual diagrams – Effect of piston acceleration and pipe friction on indicator diagram- Maximum speed at which the pump must run to avoid separation during suction and delivery strokes-Air vessels-Function of air vessels- Work saved by fitting air vessels to single and double acting pumps – Discharge of liquid into and out of air vessels-Performance characteristic curves.

Other types of pumps: Working principles and characteristics of gear pump and jet pump.

UNIT-III

Centrifugal pumps: Classification – Working principle – Comparison over reciprocating pumps – Velocity triangles – Manometric head – Work done per second – Head equivalent of work done – Manometric, mechanical and overall efficiencies – Pressure rise in the impeller – Minimum starting speed – Specific speed – Physical significance of specific speed – Model testing – Conditions of similarity of CF pumps – Priming – Performance characteristic curves – Troubles (operational difficulties), reasons and remedies in CF pumps – Cavitation – Effects of Cavitation – Precautions against Cavitation, working principle and characteristics of a self priming pump.

UNIT-IV

Hydraulic Turbines: Classification of impulse and reaction turbines – Construction and working of Pelton wheels, Francis turbine and Kaplan turbine – Velocity triangles – Work done (power developed) – Hydraulic, Mechanical and Overall efficiencies – Maximum efficiency – Comparison between Impulse and reaction turbines – Comparison between Francis and Kaplan turbines – Specific speed – Physical significance of specific speed – Unit quantities – Model testing of turbines – Conditions for similarity of turbines – Draft tubes – functions and types of draft tubes – Surge tanks – Functions and types of surge tanks – Performance characteristic curves.

UNIT-V

Industrial Hydraulics: Basic components of hydraulic circuits; Properties and types of hydraulic oils; Working principles of external Pumps - gear, lobe, vane, radial piston and axial piston; Construction details and actuating

methods of sliding spool directional control valves. Specification of D.C. valve; Working of - flow control, pressure relief, pressure reducing and sequencing valves; Working and construction details of single acting and double acting actuator and hydraulic motor; Symbolic representation of various components; Circuit for control of single & double acting actuators; Regenerative circuit; Speed control methods of actuators: meter-in, meter-out, and bleed off; Working of various servo systems-hydro mechanical, hydraulic – hydraulic, electro hydraulic; Construction details of oil reservoir and selection criteria for pumps and actuators.

Suggested Reading:

1. Bansal, R.K., “A text book of Fluid Mechanics and Hydraulic Machines”, Laxmi Publication (P) Ltd., New Delhi, 2004
2. Modi, P.N., and Seth, S.M., “Hydraulic and Fluid Machines”, Standard Book House, New Delhi, 2004
3. Ramamrutham, S., “Hydraulics, Fluid Mechanics and Fluid machines”, Dhanpat Rai & Sons, New Delhi, 2004
4. Kumar, K.L., “Engineering Fluid Mechanics”, Eurasia Publishing House (P) Ltd., New Delhi, 2004
5. Kumar, D.S., “Fluid Mechanics and Fluid Power Engineering”, S.K. Kataria & Sons, 2008
6. Majumdar, S.R., “Oil Hydraulic Systems – Principles and Maintenance”, Tata McGrawHill, 2004, New Delhi.

ME 305

MANUFACTURING PROCESSES

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

UNIT-I

Casting Process : Casting terms, pattern materials, types of patterns, pattern allowances, colour code for patterns, Moulding sands, core sands, properties of moulding sand and its ingredients, different types of moulding machines, Directional solidification, use of chaplets, chills, riser and gating design.

UNIT-II

Special Casting Processes: Shell moulding, Co₂ moulding, die casting, centrifugal casting, investment or lost wax process; Casting defects, causes and remedies, Inspection and testing of casting. Furnaces used in foundry- Cupola, Induction and Arc furnace.

Processing of plastics - Extrusion, Injection moulding, Blow moulding and Thermoforming.

Introduction to Composites and MEMS.

UNIT-III

Welding Processes: Solid state welding processes - Friction welding, Forge welding, Explosive welding and ultrasonic welding, Gas welding, Arc welding- SMAW, SAW, GMAW, GTAW, PAW, Atomic hydrogen welding, principle of Soldering and Brazing.

UNIT-IV

Special Welding Processes: Laser beam welding, Electron beam welding, Thermit welding, and Electro slag welding. Resistance welding processes - Spot welding, Projection welding, Seam welding, Butt welding, weldability, Welding defects.

UNIT-V

Forming Processes: Cold & Hot working, Yield criteria, Process description of Forging, Rolling, Extrusion, Wire drawing, Blanking, Piercing,

Bending, Deep drawing, Stretch forming, Spinning. Introduction to unconventional forming processes-Explosive forming, Electro-magnetic forming, Electro-hydraulic and rubber pad forming.

Suggested Reading:

1. P.N.Rao, "Manufacturing Technology," Vol. 1, Tata McGraw Hill Publ., 3rd Ed., 2011.
2. Amitabh Ghosh & Mallick, "Manufacturing Science", Assoc. East west Press Pvt. Ltd. 4th Ed., 2011.
3. Roy A. Lindberg, "Materials & Process of Manufacturing", Prentice Hall of India, 5th Ed.1992.
4. Serope Kalpakjian, "Manufacturing Engineering and Technology", Addison, Wesley Publishing Company, 2006
5. George.E. Dieter, "Mechanical Metallurgy", SI Metric Edition McGraw-Hill Book Company
6. J.P.Kaushish, "Manufacturing Processes", PHI Learning Pvt. Ltd., 2nd, 2010

WITHEFFECT FROM THE ACADEMIC YEAR 2012 - 2013

ME 331

THERMODYNAMICS LAB

Instruction	3	Periods per week
Duration of University Examination	3	Hours
University Examination	50	Marks
Sessional	25	Marks

1. To determine volumetric efficiency, isothermal efficiency and mass flow rate of a two stage reciprocating air compressor.
2. To determine valve/ port timing diagram of a Petrol/Diesel engine.
3. To conduct performance test on single cylinder Diesel engine.
4. To conduct heat balance test on a Diesel engine.
5. To conduct Morse test on multi cylinder Petrol engine.
6. To conduct performance test on multi cylinder Petrol engine.
7. To conduct performance test on a two-stroke Petrol engine.
8. To conduct performance test on multi cylinder Diesel engine.

9. To study the performance of a Petrol engine under different compression ratios.
10. Exhaust gas analysis of Petrol engine for carbon-monoxide and unburnt hydrocarbons.
11. Exhaust gas analysis of Diesel engine for carbon deposits using smoke meter.
12. Determination of viscosity of lubricating oil.
13. Determination of flash and fire points of a fuel

WITHEFFECT FROM THE ACADEMIC YEAR 2012 - 2013

ME 332

HYDRAULIC MACHINERY AND SYSTEMS LAB

Instruction	3	Periods per week
Duration of University Examination	3	Hours
University Examination	50	Marks
Sessional	25	Marks

1. Performance and characteristic curves of reciprocating pump.
2. Performance and characteristic curves of centrifugal pump.
3. Performance and characteristic curves of self priming pump.
4. Performance and characteristic curves of gear pump
5. Impact of jet on fixed flat vanes and curved vanes
6. Performance and characteristic curves of Pelton wheel
7. Performance and characteristic curves of Francis Turbine
8. Performance and Characteristic curves of Kaplan turbine.
9. Study of hydraulic circuits
10. Study of pneumatic circuits.
11. Study of positive displacement and roto dynamic pumps with the help of models.

ME 333

MANUFACTURING PROCESSES LAB

Instruction	3	Periods per week
Duration of University Examination	3	Hours
University Examination	50	Marks
Sessional	25	Marks

Foundry

1. Single piece pattern making with wood as material considering allowances (Draft, Shrinkage and Machining)
2. Green sand mould making processes with complete sprues, gates, riser design.
3. Testing of green sand properties
4. Melting and casting of aluminum metal
5. Study of defects in castings

Welding

1. Study of arc welding, gas welding and resistance welding processes
2. Identification of different types of flames and making a butt joint with gas welding
3. Making a lap joint by resistance welding process and strength evaluation
4. Study of bead geometry in AC and DC welding processes
5. Exercises using TIG and MIG welding processes
6. Study of welding defects

Forming

1. Evaluation of formability using Erichsen cupping test
2. Design study of simple dies and performing blanking and piercing operations using mechanical/ fly presses and measurement of forces in the operation and comparing with the theoretical loads.
3. Study of simple, compound and progressive dies and making simple components
4. Manufacturing of a simple component using Plastic Injection moulding machine

SCHEME OF INSTRUCTION & EXAMINATION

**B.E. IIIrd YEAR
(MECHANICAL ENGINEERING)**

SEMESTER - II

Sl. No.	Syllabus Ref. No.	SUBJECT	Scheme of Instruction		Scheme of Examination		
			Periods per week		Duration In Hours	Maximum Marks	
			L	D/P		Univ. Exam	Sessi-onals
		THEORY					
1.	ME 351	Machine Design	4	-	3	75	25
2.	ME 352	Metal Cutting & Machine Tool	4	-	3	75	25
3.	ME 353	CAD / CAM	4	-	3	75	25
4.	ME 354	Heat Transfer	4	-	3	75	25
5.	ME 355	Control Systems Theory	4	-	3	75	25
6.	ME 356	Refrigeration & Air Conditioning	4	-	3	75	25
		PRACTICALS					
1.	ME 381	Metal Cutting & Machine Lab.	-	3	3	50	25
2.	ME 382	CAD / CAM Lab	-	3	3	50	25
3.	ME 383	Industrial Visit / Study	-	-	-	-	*Gr
		Total	24	6	--	550	200

* *Excellent / Very Good / Good / Satisfactory / Unsatisfactory*

ME 351

MACHINE DESIGN

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

UNIT-I

Mechanical Springs: Types of springs and materials used. Design of helical springs on stress, deflection and energy considerations. Design for fluctuating loads. Concentric springs. Leaf Springs: Stresses and Deflection. Principles of Limit design. Nipping of Leaf springs.

UNIT-II

Gears: Types of gears and materials used. Standards for gear specifications. Design of Spur, Helical, Bevel and Worm Gears - Strength and Wear considerations. Types of failure of gear tooth and preventive measures.

UNIT-III

Bearings: Materials used for Bearings. Classification of Bearings. Viscosity of Lubricants. Theory of Hydrostatic and Hydrodynamic lubrication. Design of sliding contact bearings - for axial and thrust loads.

Rolling Contact Bearings: Different types of rolling element bearings and their constructional details. Static and Dynamic load carrying capacity, Load-life relationship. Design for cyclic loads.

UNIT-IV

I.C. Engine Parts : Design of piston, connecting rod and crank shafts (single throw and overhang). Design of Flywheels for I.C. Engines and presses.

UNIT-V

Theory of bending: Theory of bending of members with initial curvature - rectangular, circular and Trapezoidal sections. Design of crane Hooks, Machine frames and C-clamps.

Suggested Reading:

1. M.F. Spotts, "*Design of Machine Elements*", Pearson Edu, 7th Edn. 2003.
2. V. B. Bhandari, "*Machine Design*", Tata McGraw-Hill Publ, 2010.
3. P.C.Sharma & D.K. Aggarwal, "*Machine Design*", S.K. Kataria & Sons, 10th Edn, 2003.
4. P. Kannaiah, "*Machine Design*", Sci- Tech Publ., 2009.
5. J.E. Shigley & Charles R. Mischke, "*Mechanical Engineering Design*", Tata McGraw-Hill., 6th ed. 2003.



ME 352

METAL CUTTING & MACHINE TOOL DESIGN

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

UNIT-I

Cutting Tool Materials: High carbon steel, HSS, Stellites, Carbides, Coated carbides, Diamonds. Tool material properties.

Tool Geometry: Nomenclature of single point cutting tool by ASA & ORS systems. Geometry of drills, milling cutters.

Chip Formation: Types of chips, BUE, Chip breakers.

Machining: Orthogonal and oblique cutting, Mechanics of metal cutting, Merchant's analysis, Shear angle, Solutions of Merchant and Lee & Shafer.

UNIT-II

Thermal Aspects of Metal Cutting: Sources of heat and heat distribution, Various methods of measurement of temperature, Cutting fluids and applications.

Tool Wear, Tool Life and Machinability: Types of wear, mechanism of tool wear, Tool life & Machinability, Machinability index. Taylor's tool life equation.

Economics of Machining: Tool life for maximum production, minimum cost.

UNIT-III

Machine Tools: Constructional features and specifications of machine tools, various operations on Lathe, Types of Lathes, capstan and turret Lathes, Drilling, Milling and, Boring machines. Indexing methods. Differences between shaper, planer and slotter. Tool holding and work holding devices. Quick return mechanisms.

UNIT-IV

Grinding Machines: Types of grinding, Abrasives and bonds used for grinding wheels. Specification and selection of grinding wheels. Broaching, Lapping, Honing, Polishing, Buffing and super finishing, Burnishing.

Screws and Gear Manufacturing: Tapping, Chasers, Thread rolling, Thread milling, thread grinding. Gear shaping, Gear hobbing, Gear shaving and grinding.

UNIT-V

Jigs and Fixtures: Design principles for location and clamping. Quick clamping devices. Types of Jigs and fixtures.

Unconventional Machining: Principles of working and applications of USM, AJM, EDM, ECM, LBM and EBM (Mechanism and Theory of MRR and Process parameters in each case).

Suggested Reading:

1. B.L. Juneja and Shekon, "*Fundamentals of Metal Cutting & Machines Tools*", Wiley Eastern Ltd. 1987.
2. P.N. Rao, "*Manufacturing Technology – Metal Culling & Machine Tools*", Vol. 2, Tata McGraw Hill Education Pvt. Ltd, 2010.
3. Amitab Ghosh and Mallick, "*Manufacturing Science*", Affiliated East West Press 1985.
4. P.C, Pandey & Shan HS, "*Modern Machining Process*", Tata McGraw-Hill Education 1980.
5. A. Bhattacharyya, "*Metal Cutting Theory and Practice*" New Central Book Agency (P) Ltd., Calcutta, 1996.

ME 353

CAD / CAM

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

UNIT-I

Design Processes: Design criteria, Alternative solutions, Alternative design, Computer Aided Design and Review.

Drafting Techniques: Basic geometric elements and their creation.

Geometric Modelling: Wireframe entities and their definition, Interpolation and Approximation curves. Concept of parametric and non parametric representation of a circle and helix curves, properties of splines.

Synthetic curves: Parametric representation of cubic spline, Bezier and B-spline curves, continuity, properties and characteristics. Introduction to NURBS.

UNIT-II

Surface Modeling: Analytic surfaces: Definitions of planar, surface of revolution, Tabulated cylinder, synthetic surfaces: Cubic and Bezier surfaces.

Solid Modeling: C - rep and B - rep approaches

Design Applications: Mass property calculations, Mechanical tolerancing, Finite Element Analysis, Design Review.

2D Transformations: Translation, Scaling and Rotation about arbitrary point, Shearing and Reflection, Homogeneous representation, concatenation.

UNIT-III

CAD Database and Data Exchange: CAD Database and Structure, IGES, STEP and STL format.

Numerical Control Machine Tools: Features and elements of NC, Positional, paraxial and contouring types. Definitions of axes. Definitions of interpolation, post - processor, preparatory and miscellaneous functions, Canned cycles, Tool length and cutter radius compensation. Manual and

computer aided part programming (APT) for simple components. Programming with MACROS.

UNIT-IV

Computer Numerical Control: CNC, DNC and Adaptive control systems. Typical configurations and relative features. Machining centers, Introduction to FANUC, SINUMERIC controllers. Industrial Robots: Robot Anatomy, Configurations, Controls, Drivers, Programming methods and Applications.

UNIT-V

GT: Part families, layout, part classification and coding system. Opitz, MICLASSCODE system **CAPP:** Variant and Generative process planning. **FMS & CMS:** Building blocks of Flexible Manufacturing systems and their control, Elements of CIMS. **Computer Aided Inspection and QC:** Coordinate Measuring Machine, Non contact inspection: Machine vision, Scanning Laser Beam Devices Quality control. CAD/CAM Integration, Turnkey CAD/CAM Systems, Introduction to Rapid Prototyping Technique, Reverse Engineering.

Suggested Reading:

1. Arvid R. Eide, Roland D. Jenison, Lane H. Mashaw, Larry L. Northup, "Introduction to Engineering Design" McGraw -Hill, 1998.
2. Ibrahim Zeid. CAD/CAM, "Theory and Practice", McGraw. Hill Inc. New York, 2011.
3. Grover, MP and Zimmers E.W. "CAD/CAM", Prentice Hall of India, 1989.
4. Rao, PN. "CAD/CAM: Principles and Applications", 2nd Edition, Tata McGraw Hill, New Delhi, 2004.
5. Yoram Koren, "Computer Control of Manufacturing Systems", McGraw Hill Int, New York, 1994.
6. Elanchezhian. C. Sunder Selwyn. T. Shanmuga Sunder, G, "Computer Aided" Manufacturing, Laxmi Publications (P) Ltd., 2nd Edition, New Delhi, 2007.

ME 354

HEAT TRANSFER

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

UNIT-I

Modes of heat transfer, Laws of heat transfer - Fourier, Newton, Stefan-Boltzmann General conduction equation in cartesian, cylindrical and spherical coordinates, One dimensional steady state conduction through slabs, hollow cylinders and spheres with and without heat generation, Effects of variable thermal conductivity in heat transfer of one dimensional steady state conduction of plate, cylinders and spheres, Steady state heat transfer through composite slabs, cylinders and spheres, Critical radius of insulation, Two dimensional analysis of steady state heat transfer in a plate with prescribed temperature on one boundary, Application of finite difference technique to two dimensional steady state conduction of a plate.

UNIT-II

Fins: Heat transfer analysis of tips with heat dissipation environment - rectangular straight and pin fins, Application of fin to temperature measurement, unsteady state conduction, Lumped parameter, analysis of a body with negligible internal temperature gradients, Transient heat transfer analysis of finite slab with specified temperature and convective boundary conditions, Use of Grober and Heisler charts for solving problems of infinite slabs, cylinders and spheres.

UNIT-III

Convection: Dimensional analysis and its use in free and forced convection, Buckingham theorem, Physical significance of different dimensionless numbers, Application of Von-Karman integral equation for the analysis of thermal boundary layer in forced convection of flat plate, Reynold's analogy for flow over plane surfaces, calculation of heat transfer for flow over plates, cylinders and for flow through tubes in free and forced convection using empirical formulae.

UNIT-IV

Radiation: Definition of absorptivity, reflectivity and transmissivity, Concept of black-body and emissivity. Kirchoffs law, Planck's black body spectral distribution, Wien's and Steffan Boltzmann law, Monochromatic and total emissive power, radiant heat exchange between two gray surfaces, Shape factor, Thermal circuit for radiant heat exchange between infinite parallel plates and between concentric, cylinders, Enclosures with black and gray surfaces, Radiation shields and re-radiation surfaces.

UNIT-V

Heat Exchangers: Classification and applications of heat exchangers in industry, Analysis and design of counter flow and parallel flow heat exchanger, Fouling factors, Solving problems for multi pass heat exchanger using non dimensional parameter plots.

Change of Phase: Boiling-pool boiling regimes nucleate pool boiling, effect of surface wettability on bubble contact angle, Critical heat flux, boiling in forced convection, Condensation: Film condensation, Drop wise condensation, Condensation film thickness, Heat transfer coefficient in film condensation.

Suggested Reading:

1. Holman, J.P., "Heat Transfer", McGraw Hill Publication, New Delhi, 2010
2. Rajput, R.K., "Heat and Mass Transfer", S. Chand & Company Ltd, New Delhi, 2004.
3. Yadav, R., Sanjay. and Rajay., "Heat and Mass Transfer", Central Publishing House, Allahabad, 2004
4. Sachdeva, R.C., "Fundamentals of Engineering Heat and Mass Transfer", New Age International (P) Ltd Publishers, New Delhi,
5. Arora, S.C. and Domkandwar., "A course in Heat and Mass Transfer", Dhanpat Rai & Sons, New Delhi, 2004.

Note: During examination necessary charts and tables will be supplied.

ME 355**CONTROL SYSTEMS THEORY**

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

UNIT-I

Control Systems Classification: Open Loop & Closed Loop Systems. Mathematical models and Transfer functions from governing equations of mechanical, electrical, hydraulic, pneumatic, thermal systems. AC, DC servomotors & Electromechanical servo systems.

UNIT-II

Block diagrams-Block diagram reduction. Signal flow graphs, Mason's gain formula. Transient response. Time domain specifications of 1st and 2nd order systems. Steady state error, Error coefficients, sensitivity Performance indices. Routh criteria.

UNIT-III

Routh criteria-Root Locus method. Frequency Response: Bode, Polar plots. Correlation between transient and frequency response. Bandwidth. Experimental determination of transfer functions.

UNIT-IV

Nyquist criteria. Gain and phase margins, Lead, Lag and Lead-lag compensator design, PID controller, linearization of Non linear systems,

UNIT-V

State-space representation of linear control systems. State transition matrix. Solution of state equations: Zero input response and Zero state response. Concept of controllability and observability.

Suggested Reading:

1. Dorf, R. C., "Modern Control Systems", Addison-Wesley 1989.
2. M. Gopal, "Control Systems", Tata McGraw Hill, 2004.
3. Ogata, K., "Modern Control Engineering", Prentice Hall, 2004.
4. Norman S. Nise, "Control Systems Engineering", John Wiley & Sons, Inc., 2001.

ME 356**REFRIGERATION AND AIR CONDITIONING**

Instruction	4	Periods per week
Duration of University Examination	3	Hours
University Examination	75	Marks
Sessional	25	Marks

UNIT-I

Introduction to Refrigeration: Definition of Refrigeration and Air-conditioning, Necessity of Refrigeration and its applications, Methods of Refrigeration, Unit of Refrigeration and C.O.P. Reversed Carnot cycle, Limitations, Effect of operating temperatures,

Properties of Refrigerants: Survey, Designation, Desirable properties of refrigerants, Thermodynamic, Chemical and Physical properties, Classification of Refrigerants, Alternative refrigerants, Substitute for CFC Refrigerants, Global warming, Green House Effect and Future of Refrigerants.

Air Refrigeration Systems: Analysis of Bell-Coleman Cycle or Reversed Brayton cycle, Open and Dense air system, Application to aircraft refrigeration, Simple cooling system, Bootstrap refrigeration system, Regenerative cooling system and Reduced ambient cooling system.

UNIT-II

Vapour compression system: Working principle and essential components of Simple vapor compression Refrigeration cycle, Compressor, condenser, evaporator, and expansion devices, Analysis of cycle, C.O.P, Representation of the cycle on T-S, P-H and H-S charts. Performance improvement of simple vapour compression refrigeration cycle by means of flash chamber and accumulator.

Dry and wet compression, Effect of operating conditions like evaporating pressure, condenser pressure, Liquid sub-cooling and Vapor super heating, Performance of the system.

Low temperature refrigeration system (with single load system), Compound compression with water inter cooler and Flash intercooler, Cascade refrigeration system-Analysis and advantages

UNIT-III

Vapour Absorption Refrigeration System: Simple absorption systems, COP, Practical ammonia absorption refrigeration system, Lithium bromide absorption system, Electrolux refrigerator, Common refrigerants and absorbents properties, Comparison with vapor compression refrigeration system

Steam Jet Refrigeration : Principle of working, Analysis of the system, Advantages, limitations and applications.

Non-Conventional Refrigeration Systems: Principle and operation of Thermoelectric Refrigeration Systems, Seebeck effect - Peltier effect - Thomson effect, Analysis, Pulse tube refrigeration system.

Introduction to Cryogenics- Advantages, Limitations and applications

UNIT-IV

Psychrometry: Psychrometric properties, Psychrometric chart, construction, Representation of Psychrometric processes on the chart, Heating and Cooling with Humidification and Dehumidification, Adiabatic dehumidification, adiabatic chemical dehumidification and mixing processes

Introduction to Air Conditioning: Requirements of comfort air conditioning, Thermodynamics of human body, Body temperature, Metabolism, Body defense and Human tolerance, Effect of heat on performance, ASHRE comfort chart, Effective temperature.

UNIT-V

Cooling Load Calculations in Air Conditioning: Concept of bypass factor, Sensible heat factor, Apparatus Dew Point, Room Sensible Heat Factor (RSHF), Gross Sensible Heat Factor (GSHF), Different heating and cooling loads, Problems.

Design of air conditioning systems: All fresh air, Re-circulated air with bypassed air, Design of Summer, Winter and Year round air conditioning systems, Energy conservation in air conditioned building, Case study of one building with all load calculations

Air Conditioning Systems: Types, Components of air conditioner equipments, Humidifier, Dehumidifier, Filter, Grills, Fans and Blowers, Duct layout.

Applications of Refrigeration and Air conditioning Food Preservation, Transport air conditioning, and Industrial applications

Suggested Reading :

1. Arora C.P., “*Refrigeration and Air conditioning*”, Tata McGraw Hill, New Delhi, 2009.
2. Arora, S.C. and Domkundwar, S., “*A Course in Refrigeration and Air conditioning*”, Dhanpat Rai & Sons, New Delhi, 2010.
3. Jain, V.K., “*Refrigeration and Air Conditioning*”, S Chand & Company, New Delhi, 2010.
4. Stocker, W.S., “*Refrigeration and Air conditioning* “, McGraw Hill, New Delhi, 2009.

ME 381

**METAL CUTTING AND MACHINE TOOL
ENGINEERING LAB**

Instruction	3	Periods per week
Duration of University Examination	3	Hours
University Examination	50	Marks
Sessional	25	Marks

1. Study of various machine tools, their working principles and kinematic schemes.
2. Exercise with operation of step turning, taper turning and thread cutting and boring.
3. Exercise on shaper to make rectangular and 'V' grooves.
4. Cutting gear teeth using (a) Simple indexing (b) compound indexing (c) differential indexing
5. Finding shear angle by measuring thickness and length of chips.
6. Measuring the forces, by dynamometers and finding friction angle and stress on shear plane and rake plane.
7. Conducting tool life tests and finding the constant and index equation for HSS and carbide tools.
8. Measurement of chip-tool average temperature by thermocouple method.
9. Grinding of HSS tool by tool and cutter grinder to a given geometry.
10. PCD drilling on radial drilling and tapping
11. Grinding of flat surfaces using surface grinding machine and measurement of surface finish.
12. Exposure to operations like trepanning, lapping, honing and broaching
13. Study of Electro Discharge Machining (EDM)

ME 382

CAD / CAM LAB

Instruction	3	Periods per week
Duration of University Examination	3	Hours
University Examination	50	Marks
Sessional	25	Marks

1. Practice in the use of some of the packages like: Pro-E / Solid works / MDT / Inventor / CATIA etc., for Geometric modeling of simple parts (sketching).
2. Part modeling and Assembly of simple parts using any of the above packages.
3. Static Analysis of Plane Truss and 2D beam for different type of loads using ANSYS / NASTRAN / ADINA etc.,
4. Static analysis of Plate with a hole to determine the SCF and Deformations and Stresses.
5. Static Analysis of connecting rod, pressure vessels.
6. Dynamic analysis: Modal Analysis of cantilever Beam and Harmonic analysis of Shaft.
7. Steady state heat transfer Analysis Cross section of chimney and Transient heat transfer analysis of solidification of casting.
8. Facing and turning, step turning, taper turning, contouring on CNC lathe.
9. Pocketing and contouring on CNC milling machine.
10. Simulation and development of NC code using any CAM software.
11. Programming for integration of various CNC machines, robots and material handling systems

ME 383

INDUSTRIAL VISIT / STUDY

At least 3 days in a semester	3 x 8 = 24 hours
Sessional	Grade*

A minimum of two industrial visits will be arranged by department and students have to attend the visits and prepare a data report of their visits to the industries and submit to the department. Students are required to present a seminar based on their report which is evaluated by Head of Department and two senior faculty to award the grade.

**Excellent/Very Good/Good/Satisfactory/Unsatisfactory*