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	Sessionals
		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 flames 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. Bhattacraryya, "*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 girding 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 / C ATIA 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 Hannonic 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*