

Semester IV

S/No.	Title of Theory Course	L-T-P
1	HME 401 Manufacturing Science and Engineering-I	3-1-0
2	HME 402 Heat and Mass Transfer	3-1-0
3	HME 403 Energy Conversion Systems	3-1-0
4	HME 404 Kinematics of Machines	3-1-0
5	HMA 401 Computer Oriented Numerical Methods	3-1-0
	Lab Course	
1	HME 451 Manufacturing Science and Engineering-I Lab	0-0-2
2	HME 452 Heat and Mass Transfer Lab	0-0-2
3	HME 453 Energy Conversion Lab	0-0-2
4	HMA 451 Numerical Techniques Lab	0-0-2

HME 401

MANUFACTURING SCIENCE AND ENGINEERING-I

L:T: P
3 :1 :0

Unit-I

Importance of manufacturing towards technological and social economic development. Classification of manufacturing processes. Survey of manufacturing processes. Manufacturing processes for common items, Concepts of Manufacturing Systems

Unit II:

Casting: Basic principle & survey of casting processes. Types of patterns and allowances. Types and properties of moulding sand. Elements of mould and design considerations, Gating, Riser, Runnes, Core. Solidification of casting, Sand casting, defects & remedies and inspection. Cupola furnace. Die Casting, Centrifugal casting. Investment casting, CO₂ casting and Stir casting etc.

Unit III:

Metal Forming Processes: Elastic & plastic deformation, yield criteria. Hot working vs cold working. Analysis (equilibrium equation method) of Forging process for load estimation with sliding friction sticking friction and mixed condition for slab and disc. Work required for forging, Hand, Power, Drop Forging. Analysis of Wire/strip drawing and maximum-reduction, Tube drawing, Extrusion and its application. Condition for Rolling force and power in rolling. Rolling mills & rolled-sections. Design, lubrication and defects in metal forming processes.

Unit-IV

Sheet Metal working: Presses and their classification, Die & punch assembly and press work methods and processes. Cutting/Punching mechanism, Blanking vs Piercing. Compound vs Progressive die. Flat-face vs Inclined-face punch and Load(capacity) needed. Analysis of forming process like cup/deep drawing. Bending & spring-back.

Unit-V

Powder Metallurgy : Powder metallurgy manufacturing process. The need, process, advantage and applications.

Manufacturing of Plastic components: Review of plastics, and its past, present & future uses. Injection moulding. Extrusion of plastic section. Welding of plastics. Future of plastic & its applications. Resins & Adhesives.

Books:

1. Manufacturing Science by Ghosh and Mallik
2. Production Engg. Science by P.C. Pandey
3. Production Technology by R.K. Jain
4. Manufacturing Technology by P.N. Rao., TMH
5. Materials and Manufacturing by Paul Degarmo.
6. Manufacturing Engineering & Technology by Kalpakjian, Pearson Pub.

HME 402

HEAT & MASS TRANSFER

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UNIT-1

Introduction to Heat Transfer:

Concepts of the mechanisms of heat flows; Conduction, convection and radiation; Effect of temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism. 2

Conduction:

One-dimensional general differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems; Initial and boundary conditions. 3

Steady State one-dimensional Heat conduction :

Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation; Thermal resistance concept; Analogy between heat and electricity flow; Thermal contact resistance; Critical thickness of insulation. 3

UNIT-2

Numerical methods in heat conduction:

Finite difference formulation of differential equation, One-dimensional steady-state heat conduction, Solution methods for systems of algebraic equations, Two-dimensional heat conduction, Transient heat conduction.

Fins:

Heat transfer from extended surfaces, Fins of uniform cross-sectional area; Errors of measurement of temperature in thermometer wells. 3

Transient Conduction:

Transient heat conduction; Lumped capacitance method; Time constant; Unsteady state heat conduction in one dimension only, Heisler charts. 4

UNIT-3

Forced Convection:

Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer; Approximate integral boundary layer analysis; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Mixed boundary layer; Flow over a flat plate; Flow across a single cylinder and a sphere; Flow inside ducts; Empirical heat transfer relations; Relation between fluid friction and heat transfer; Liquid metal heat transfer. 4

Natural Convection:

Physical mechanism of natural convection; Buoyant force; Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders, and sphere ; Combined free and forced convection. 3

UNIT-4

Thermal Radiation:

Basic radiation concepts; Radiation properties of surfaces; Black body radiation Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchoff's law; ; Gray body; Shape factor; Black-body radiation; Radiation exchange between diffuse non black bodies in an enclosure; Radiation shields; Radiation combined with conduction and convection; Absorption and emission in gaseous medium; Solar radiation; Green house effect. 8

UNIT-5

Heat Exchanger:

Types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; Effectiveness-NTU method; Compact heat exchangers. 3

Condensation and Boiling:

Introduction to condensation phenomena; Heat transfer relations for laminar film condensation on vertical surfaces and on outside & inside of a horizontal tube; Effect of non-condensable gases; Dropwise condensation; Heat pipes; Boiling modes, pool boiling; Hysteresis in boiling curve; Forced convective boiling. 3

Introduction to Mass Transfer:

Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion through a stagnant gas film. 2

Books:

1. Elements of Heat transfer by Bayazitoglu & Ozisik, McGraw-Hill Book Company.
2. Heat Transfer By J.P. Holman, McGraw-Hill International edition.
3. Schaum's outline of Heat Transfer by Pitts & Sisson McGraw-Hill International edition.
4. Principles of Heat Transfer by Frank Kreith, McGraw-Hill Book co.
5. Fundamentals of Momentum, Heat and Mass Transfer by James R. Welty; John Wiley & Sons (Pvt). Ltd.
6. Heat Transfer, by Cengel, Tata Mc Graw Hill

HME 403

ENERGY CONVERSION SYSTEMS

L:T:P
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Unit-I

Boilers: Steam generators-classifications. Working of fire-tube and water-tube boilers, boiler mountings & accessories, Draught & its calculations, air pre heater, feed water heater, super heater. Boiler efficiency, Equivalent evaporation. Boiler trial and heat balance. 6

Condenser: Classification of condenser, Air leakage, Condenser performance parameters 2

Unit-II

Steam Engines: Rankine and modified Rankine cycles, Working of steam engine, Classification of steam engines, Indicator diagram, Saturation curve, Missing quantity. 3

Steam & Gas Nozzles: Flow through nozzle, Variation of velocity, Area and specific volume, Choked flow, Throat area, Nozzle efficiency, Off design operation of nozzle, Effect of friction on nozzle, Super saturated flow. 4

Unit-III

Vapour Power cycles: Carnot vapour power cycle, Effect of pressure & temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, Combined cycles, Cogeneration. 3

Steam Turbines : Classification of steam turbine, Impulse and reaction turbines, Staging, Stage and overall efficiency, Reheat factor, Bleeding, Velocity diagram of simple & compound multistage impulse & reaction turbines & related calculations work done efficiencies of reaction, state point locus, Losses in steam turbines, Governing of turbines. 4

Unit-IV

Gas Turbine: Gas turbine classification Brayton cycle, Principles of gas turbine, Gas turbine cycles with intercooling, reheat and regeneration and their combinations, Stage efficiency, Polytropic efficiency. Deviation of actual cycles from ideal cycles. 4

Jet Propulsion: Introduction to the principles of jet propulsion, Turbojet and turboprop engines & their processes, Principle of rocket propulsion, Introduction to Rocket Engine. 3

Unit-V

Compressors:

Classification, Reciprocating compressors, Single and Multi stage compressors. 3

Rotary compressors, Classification, Centrifugal compressor fundamentals, Surging and stalling, Roots blower, Vaned compressor, Air Motors. 3

Unconventional Energy Systems: sterling engines, Thermo-ionic converters, thermoelectric generators, photovoltaic generators, Magneto-hydrodynamic generators 2

Books:

1. Applied thermodynamics by Onkar Singh, New Age International (P) Publishers Ltd.
2. Basic and Applied Thermodynamics by P.K. Nag, Tata Mc Graw Hill

3. Theory of Stream Turbine by W.J. Kearton
4. Steam & Gas Turbine by R.Yadav, CPH Allahabad
5. Gas Turbine, by V. Ganeshan, Tata Mc Graw Hill Publishers.
6. Gas turbine Theory & Practice, by Cohen & Rogers, Addison Wesley Long man
7. Reciprocating and Rotary Compressors, by Chlumsky, SNTI Pub., Czechoslovakia
8. Turbines, Compressors and Fans, by S.M.Yahya, Tata Mc Graw Hill Pub.

HME 404

KINEMATICS OF MACHINES

L:T:P
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UNIT 1: Introduction: Aims & scope of the course & Basic concepts of Mechanisms.

Basic definitions, Difference between structure & Machine, Links & their types, Types of constrained motion, Kinematic pair & their classification, Grubler's mobility criteria, Inversion of a kinematic chain, and applications hooks joint, Devis and Ackermann steering mechanism. An introduction to approximate and exact straight line mechanism.

UNIT 2: Graphical (vector) method for velocity and acceleration of various mechanisms e.g. slider crank and four bar, Coriolis acceleration. Instantaneous method, Kennedy theorem, Klien's construction

UNIT 3:

Belt, Rope and Chain drives: Types and materials, Power transmission fundamentals considering slip, centrifugal and initial tensions. Max. Power transmission conditions.

UNIT 4: Brakes & Clutches: Types of braking systems force & torque analysis for block, band and band and block brake.

Friction clutches: types, uniform pressure and uniform wear theory.

UNIT 5

Theory of gearing: classification of gears and terminology, Law of gearing, systems of gear teeth, gear profiles, Interference, and efficiency of gears, epicyclical gear train, Compound gear train, Torque analysis and various applications of complex gear trains.

Reference Books:

1. Theory of Machines by Thomas Bevan
2. Kinematics by HN Tyson
3. Theory of Machines by J E Shingley
4. Theory of Machines by S. S. Rattan

HME 451
MANUFACTURING SCIENCE & ENGINEERING - I LAB

L:T:P
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Experiments :

Say minimum 8 experiments out of following (or such experiment).

1. Design of pattern for a desired casting (containing hole)
2. Pattern making
3. Making a mould (with core) and casting.
4. Injection moulding with plastics
5. Forging hand forging processes
6. Forging - power hammer study & operation
7. Tube bending with the use of sand and on tube bending m/c.
8. Press work experiment such as blanking/piercing, washer, making etc.
9. Bending & spring back.
10. Jigs & Fixture experiment

HME 452
HEAT & MASS TRANSFER LAB

L:T:P
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Minimum 8 experiment of the following

1. Conduction - Composite cylinder experiment
2. Convection - Pool Boiling experiment
3. Convection - Experiment on heat transfer from tube-natural convection.
4. Convection - Heat Pipe experiment.
5. Convection - Heat transfer through fin-natural convection .
6. Convection - Heat transfer through tube/fin-forced convection.
7. Experiment on Stefan's Law, on radiation determination of emissivity, etc.
8. Experiment on solar collector, etc.
9. Heat exchanger - Parallel flow experiment
10. Experiment on Cooling tower
11. Experiment on critical insulation thickness.
12. Conduction - Determination of thermal conductivity of fluids.
13. Conduction - Thermal Contact Resistance Effect.

HME 453
ENERGY CONVERSION LAB

L:T:P
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1. Study of Fire Tube boiler models
2. Study of Water Tube boiler models
3. Study of Reaction turbine models
4. Study of Impulse turbine models
5. Study of Steam Engine models.
6. Study of Gas Turbine Model
7. Study of mini steam power plant and experimentation

VISIT : Study through visit of a nearby Power Plant

Any other experiment as per need of the subject.