

J. S. University, Shikohabad



# B.TECH

5<sup>th</sup> Semester & 6<sup>th</sup> Semester

(Mechanical Engineering)

## *Scheme & Syllabus*

[ Effective from the session 2015-16 ]

**STUDY AND EVALUATION SCHEME FOR  
B.TECH  
MECHANICAL ENGG.**

**SEMESTER - Fifth**

S.No.	Subject Code	Name of Subject	Periods Per Week				Evaluation Scheme			
			L	T	P	D	Sessional	End Exam	Total	Duration
THEORY SUBJECT										
1	BTME-51	Manufacturing Science & Technology-II	3	1	-	-	50	100	150	3
2	BTME-52	Heat & Mass Transfer	3	1	-	-	50	100	150	3
3	BTME-53	I.C.Engine & Compressor	3	1	-	-	50	100	150	3
4	BTME-54	Kinematics of Machines	3	1	-	-	50	100	150	3
5	BTME-55	Machine Design-I	2	1	-	-	25	50	75	2
6	BTMB-51	Engineering Economics	2	1	-	-	25	50	75	2
PRACTICA/DRAWING SUBJECTS										
7	BTME-51P	Manufacturing Science & Technology-II Lab	-	-	4	-	20	30	50	3
8	BTME-52P	Heat & Mass Transfer Lab	-	-	4	-	20	30	50	3
9	BTME-55P	Machine Design-I Lab			4		20	30	50	3
10	BTME-53P	Seminar	-	-	4	-	50	-	50	3
11	BTGD-50	Games//Social and Cultural Activities + Discipline ( 30 + 20)							50	
Grand Total									1000	

**STUDY AND EVALUATION SCHEME FOR  
B.TECH  
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**SEMESTER - Sixth**

S.No.	Subject Code	Name of Subject	Periods Per Week				Evaluation Scheme			
			L	T	P	D	Sessional	End Exam	Total	Duration
THEORY SUBJECT										
1	BTME-61	Machine Design-II	2	1	-	-	50	100	150	3
2	BTME-62	Dynamics of Machines	3	1	-	-	50	100	150	3
3	BTME-63	Refrigeration & Air Conditioning	3	1	-	-	50	100	150	3
4	BTME-64	Fluid Machinery	3	1	-	-	50	100	150	3
5	BTME-65	Unconventional Manufacturing Processes	3	1			25	50	75	2
6	BTMB-61	Industrial Management	2	1	-	8	25	50	75	2
PRACTICA/DRAWING SUBJECTS										
7	BTME-61P	Machine Design-II Lab	-	-	4	-	20	30	50	1
8	BTME-62P	Theory of Machine Lab	-	-	4	-	20	30	50	1
9	BTME-63P	Refrigeration & Air Conditioning Lab					20	30	50	1
10	BTME-64P	Fluid Machinery Lab	-	-	4	-	20	30	50	1
11	BTGD-60	Games//Social and Cultural Activities + Discipline ( 30 + 20)							50	
Grand Total									1000	

# **BTME-51 MANUFACTURING SCIENCE& TECHNOLOGY-II**

## **Unit I**

### ***Metal Cutting-***

Mechanics of metal cutting. Geometry of tool and nomenclature .ASA system Orthogonal vs. oblique cutting. Mechanics of chip formation, types of chips. Shear angle relationship. Merchant's force circle diagram. Cutting forces, power required. Heat generation and cutting tool temperature, Cutting fluids/lubricants. Tool materials. Tool wear and tool life. Machinability. Dynamometer, Brief introduction to machine tool vibration and surface finish. Economics of metal cutting.

## **Unit-II**

### ***Machine Tools***

- (i) Lathe: Principle, construction, types, operations, Turret/capstan, semi/Automatic, Tool layout
- (ii) Shaper, slotter, planer: Construction, operations & drives.
- (iii) Milling: Construction, Milling cutters, up & down milling. Dividing head & indexing. Max chip thickness & power required.
- (iv) Drilling and boring: Drilling, boring, reaming tools. Geometry of twist drills.

## **Unit-III**

### ***Grinding & Super finishing***

- (i) Grinding: Grinding wheels, abrasive & bonds, cutting action. Grinding wheel specification. Grinding wheel wear - attritions wear, fracture wear. Dressing and Truing. Max chip thickness and Guest criteria. Surface and cylindrical grinding. Centerless grinding
- (ii) Super finishing: Honing, lapping and polishing.

### ***Limits, Fits & Tolerance and Surface roughness:***

Introduction to Limits, Fits, Tolerances and IS standards, Limit-gauges, and surface-roughness.

## **Unit-IV**

### ***B. Metal Joining (Welding)***

Survey of welding and allied processes. Gas welding and cutting, process and equipment. Arc welding: Power sources and consumables. TIG & MIG processes and their parameters. Resistance welding - spot, seam projection etc. Other welding processes such as atomic hydrogen, submerged arc, electroslag, friction welding. Soldering & Brazing. Adhesive bonding. Thermodynamic and Metallurgical aspects in welding and weld, Weldability, Shrinkage/residual stress in welds. Distortions & Defects in welds and remedies. Weld decay in HAZ.

## **Unit-V**

### ***C. Introduction to Unconventional Machining and Welding***

Need & benefits, application and working principle of EDM, ECM, LBM, EBM, USM. AJM, WJM. Similarly, non-conventional welding applications such as LBW, USW, EBW, Plasma-arc welding, Diffusion welding, Explosive welding/cladding. Introduction to Hybrid machining processes

### ***Books and References:***

1. Manufacturing Science – A. Ghosh and A.K. Mallik, Affiliated East-West Press
2. Fundamentals of Metal Machining and Machine Tools – Geoffrey Boothroyd, CRC Press
3. Production Technology - R.K. Jain Khanna Publishers.
4. Introduction to Manufacturing Processes – John A. Schey, McGraw-Hill
5. Production Engineering Science - P.C. Pandey, Standard Publishers Distributors,

# BTME-52 HEAT & MASS TRANSFER

## UNIT-1

### **Introduction to Heat Transfer:**

Thermodynamics and Heat Transfer. Modes of Heat Transfer: Conduction, convection and radiation. Effect of temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism.

### **Conduction :**

General differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems. Initial and boundary conditions.

### **Steady State one-dimensional Heat conduction :**

Simple and Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation; Concept of thermal resistance. Analogy between heat and electricity flow; Thermal contact resistance and overall heat transfer coefficient; Critical radius of insulation.

## UNIT-2

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

### **Transient Conduction:**

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

## 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; Thermal entrance region, Empirical heat transfer relations; Relation between fluid friction and heat transfer; Liquid metal heat transfer.

### **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.

## UNIT-4

### **Thermal Radiation :**

Basic radiation concepts; Radiation properties of surfaces; Black body radiation Planck's law, Wien's displacement law, Stefan Boltzmann law, Kirchhoff'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.

## 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.

### **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 convection boiling.

### **Introduction to Mass Transfer:**

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

### **Books:**

1. Fundamentals of Heat and Mass Transfer, by Incropera & DeWitt, John Wiley and Sons
2. Heat and Mass Transfer by Cengel, McGraw-Hill
3. Heat Transfer by J.P. Holman, McGraw-Hill
4. Heat and Mass Transfer by Rudramoorthy and Mayilsamy, Pearson Education
5. Heat Transfer by Ghoshdastidar, Oxford University Press

## **BTME-53 I C ENGINES & COMPRESSORS**

### **Unit-1**

Introduction to I.C Engines: Engine classification and basic terminology, Two and four stroke engines, SI and CI engines, Valve timing diagram. Thermodynamic analysis of Air standard cycles, Otto cycle, Diesel cycle, Dual cycle, Stirling cycle, Ericsson cycles, Comparison of Otto, Diesel and Dual cycles Fuel air cycle, factors affecting the fuel air cycle, Actual cycle.

### **Unit-II**

SI Engines: Combustion in SI engine, Flame speed, Ignition delay, Abnormal combustion and its control, combustion chamber design for SI engines. Carburetion, Mixture requirements, Carburetors and fuel injection system in SI engine Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition, Scavenging in 2 Stroke engines, Supercharging and its effect

### **Unit-III**

CI Engine: Combustion in CI engines, Ignition delay, Knock and its control, Combustion chamber design of CI engines. Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings Exhaust emissions from SI engine and CI engine and its control

### **Unit-IV**

Engine Cooling and Lubrication: Different cooling systems, Radiators and cooling fans, Engine friction, Lubrication principle, Type of lubrication, Lubrication oils, Crankcase ventilation. Fuels: Fuels for SI and CI engine, Important qualities of SI and CI engine fuels, Rating of SI engine and CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas, Alternative fuels for IC engines. Testing and Performance: Performance parameters, Basic measurements, Blow by measurement, Testing of SI and CI engines

### **Unit V**

Compressors: Classification, Reciprocating compressors, Single and Multi stage compressors, Intercooling, Volumetric efficiency. Rotary compressors, Classification, Centrifugal compressor, Axial compressors, Surging and stalling, Roots blower, Vaned compressor.

### **BOOKS:**

1. Fundamentals of Internal Combustion Engine by Gill, Smith, Ziurs, Oxford & IBH Publishing CO.
2. Fundamentals of Internal Combustion Engines by H.N. Gupta, Prentice Hall of India
3. A Course in Internal Combustion Engines, by Mathur & Sharma, Dhanpat Rai & Sons.
4. I.C Engine Analysis & Practice by E.F Obert.
5. I.C Engine, by Ganeshan, Tata McGraw Hill Publishers.
6. I.C Engine, by R. Yadav, Central Publishing House, Allahabad

## **BTME-54 KINEMATICS OF MACHINES**

### **Unit I**

Introduction, mechanisms and machines, kinematics and kinetics, types of links, kinematic pairs and their classification, types of constraint, degrees of freedom of planar mechanism, Grubler's equation, mechanisms, inversion of four bar chain, slider crank chain and double slider crank chain.

#### **Velocity analysis:**

Introduction, velocity of point in mechanism, relative velocity method, velocities in four bar mechanism, slider crank mechanism and quick return motion mechanism, rubbing velocity at a pin joint, instantaneous center method, types and locations of instantaneous center, Kennedy's theorem, velocities in four bar mechanism and slider crank mechanism.

### **Unit II**

#### **Acceleration analysis:**

Introduction, acceleration of a point on a link, acceleration diagram, Corioli's component of acceleration, crank and slotted lever mechanism, Klein's construction for slider crank mechanism and four bar mechanism, analytical method for slider crank mechanism.

### **Kinematic synthesis of mechanism:**

Introduction, dimensional synthesis of mechanisms, motion, path and function generation, Chebyshev spacing, three position synthesis, graphical approach for four link mechanisms, straight line mechanisms, special mechanisms – indicator diagram mechanisms, steering mechanisms, Hook's Joint

### **Unit III**

#### **Cams**

Introduction, classification of cams and followers, cam profiles for knife edge, roller and flat faced followers for uniform velocity, uniform acceleration, simple harmonic and cycloidal motions of follower. Analytical methods for cam profile.

### **Unit IV**

#### **Gears and gear trains**

Introduction, classification of gears, law of gearing, tooth forms and their comparisons, systems of gear teeth, length of path of contact, contact ratio, interference and undercutting in involute gear teeth, minimum number of teeth on gear and pinion to avoid interference, simple, compound, reverted and planetary gear trains, sun and planet gear train.

### **Unit V**

#### **Friction drives**

Introduction, belt and rope drives, open and crossed belt drives, velocity ratio, slip, power transmission, effect of mass of belt on power transmission, maximum power transmission, initial tension and maximum tension, pivots and collars, uniform pressure and uniform wear, clutches.

### **Books:**

1. Theory of Mechanisms and Machines: A Ghose and A K Malik, East West Press Pvt Ltd.
2. Theory of Mechanisms and Machines: J J Uicker, G R Pennock and J E Shigley, Oxford University Press.

## **BTME-55 Machine Design-I**

### **UNIT I**

#### **Introduction**

Definition, Design requirements of machine elements, Design procedure, Standards in design, Selection of preferred sizes, Indian Standards designation of carbon & alloy steels, Selection of materials for static and fatigue loads.

#### **Design for Static Load**

Modes of failure, Factor of safety, Principal stresses, Stresses due to bending and torsion, Theory of failure.

### **UNIT II**

**Design for Fluctuating Loads** Cyclic stresses, Fatigue and endurance limit, Stress concentration factor, Stress concentration factor for various machine parts, Notch sensitivity, Design for finite and infinite life, Soderberg, Goodman & Gerber criteria.

#### **Riveted Joints**

Riveting methods, materials, Types of rivet heads, Types of riveted joints, Caulking and Fullering, Failure of riveted joint, Efficiency of riveted joint, Design of boiler joints, Eccentric loaded riveted joint.

### **UNIT III**

#### **Shafts**

Cause of failure in shafts, Materials for shaft, Stresses in shafts, Design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments, Shafts subjected to fatigue loads, Design for rigidity.

#### **Keys and Couplings**

Types of keys, splines, Selection of square & flat keys, Strength of sunk key, Couplings, Design of rigid and flexible couplings.

## **UNIT IV**

### **Mechanical Springs**

Types, Material for helical springs, End connections for compression and tension helical springs, Stresses and deflection of helical springs of circular wire, Design of helical springs subjected to static and fatigue loading.

### **Power Screws**

Forms of threads, multiple threads, Efficiency of square threads, Trapezoidal threads, Stresses in screws, Design of screw jack

**Note: Design data book is allowed in the examination**

### **Books and References:**

1. Design of Machine Elements, V.B. Bhandari, Tata McGraw Hill Co.
2. Machine Design-Sharma and Agrawal, S.K. Kataria & Sons.
3. Machine Design, U C Jindal, Pearson Education.
4. Design of Machine Elements, Sharma and Purohit, PHI.

## **[BTMB-51]**

## **Engineering Economics**

**Unit-1** Introduction to Engineering Economics and Managerial Economics Concept of Efficiency, Theory of Demand, Elasticity of Demand, Supply and Law of Supply indifference Curves, Budget Line, Welfare Analysis, Scope of Managerial Economics, Techniques and Applications of Managerial Economics.

**Unit-2** Market Structure Perfect Competitions Imperfect- Monopolistic, Oligopoly, duopoly sortent features of price determination and various market conditions.

**Unit-3** Demand Forecasting and cost Estimation Characteristics of Forecasts, Forecasting Horizons, Steps to Forecasting, Forecasting Methods, Seasonal Adjustments, Forecasting Performance Measures, Cost Estimation, Elements of cost, Computation of Material Variances Break-Even Analysis.

**Unit-4** Management Aspects Functions of Management, Project Management, Value Engineering, Project Evaluation, Decision Making.

## **BTME-51P MANUFACTURING TECHNOLOGY -II – LAB**

**Minimum eight experiments out of the following along-with study of the machines / processes**

1. Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe machine.
2. Bolt (thread) making on Lathe machine
3. Tool grinding (to provide tool angles) on tool-grinder machine.
4. Gear cutting on Milling machine.
5. Machining a block on shaper machine.
6. Finishing of a surface on surface-grinding machine.
7. Drilling holes on drilling machine and study of twist-drill.
8. Study of different types of tools and its angles & materials.
9. Experiment on tool wear and tool life.
10. Experiment on jigs/Fixtures and its uses
11. Gas welding experiment
12. Arc welding experiment
13. Resistance welding experiment.
14. Soldering & Brazing experiment
15. Experiment on unconventional machining.
16. Experiment on unconventional welding.
17. Experiment on TIG/MIG Welding.
18. Macro and Microstructure of welding joints.



## **BTME-52P HEAT & MASS TRANSFER – LAB**

### **Minimum eight experiment of the following**

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

## **BTME-55P MACHINE DESIGN-I Lab**

### **Minimum eight experiments out of the following are to be performed.**

**Students are advised to use design data book for the design. Drawing shall be made wherever necessary on small drawing sheets**

1. Design & drawing of Cotter joint.
2. Design & drawing of Knuckle joint
3. Design of machine components subjected to combined steady and variable loads
4. Design of eccentrically loaded riveted joint
5. Design of boiler riveted joint
6. Design of shaft for combined constant twisting and bending loads
7. Design of shaft subjected to fluctuating loads
8. Design and drawing of flanged type rigid coupling
9. Design and drawing of flexible coupling
10. Design and drawing of helical spring
11. Design and drawing of screw jack

## **BTME-61 MACHINE DESIGN-II**

### **UNIT I**

Principle of transmission and conjugate action

#### **Spur Gears**

Tooth forms, System of gear teeth, contact ratio, Standard proportions of gear systems, Interference in involute gears, Backlash, Selection of gear materials, Gear manufacturing methods, Design considerations, Beam strength of gear tooth, Dynamic tooth load, Wear strength of gear tooth, Failure of gear tooth, Design of spur gears, AGMA and Indian standards.

#### **Helical Gears**

Terminology, Proportions for helical gears, Forces components on a tooth of helical gear, Virtual number of teeth, Beam strength & wear strength of helical gears, Dynamic load on helical gears, Design of helical gears.

### **UNIT II**

#### **Bevel gears**

Terminology of bevel gears, Force analysis, Virtual number of teeth, Beam strength and wear strength of bevel gears, Effective load of gear tooth, Design of a bevel gear system.

## **Worm Gears**

Types of worms, Terminology, Gear tooth proportions, Efficiency of worm gears, Heat dissipation in worm gearing, Strength and wear tooth load for worm gears, Design of worm gearing system.

## **UNIT III**

### **Sliding Contact Bearing**

Types, Selection of bearing, Plain journal bearing, Hydrodynamic lubrication, Properties and materials, Lubricants and lubrication, Hydrodynamic journal bearing, Heat generation, Design of journal bearing, Thrust bearing-pivot and collar bearing, Hydrodynamic thrust bearing,

## **UNIT IV**

### **Rolling Contact Bearing**

Advantages and disadvantages, Types of ball bearing, Thrust ball bearing, Types of roller bearing, Selection of radial ball bearing, Bearing life, Selection of roller bearings, Dynamic equivalent load for roller contact bearing under constant and variable loading, Reliability of Bearing, Selection of rolling contact bearing, Lubrication of ball and roller bearing, Mounting of bearing

## **UNIT V**

### **IC ENGINE parts,**

Selection of type of IC engine, General design considerations, Design of cylinder and cylinder head; Design of piston and its parts like piston ring and gudgeon pin etc.; Design of connecting rod; Design of crankshaft

**Note: Design data book is allowed in the examination**

### **Books and References:**

1. Design of Machine Elements-V.B. Bhandari, Tata McGraw Hill Co.
2. Machine Design-Sharma and Agrawal, S.K. Kataria & Sons.
3. Machine Design, U C Jindal, Pearson Education.
4. Design of Machine Elements, Sharma and Purohit, PHI.
5. Design of Machine Design-M.F. Spott, Pearson Education
6. Machine Design-Maleev and Hartman, CBS Publishers.
7. Mechanical Engineering Design, 9e – Joseph E. Shigely, McGraw Hill Education.
9. Elements of Machine Component Design, Juvinall & Marshek, John Wiley &

## **BTME-62 DYNAMICS OF MACHINES**

### **Unit I**

#### **Force analysis:**

Static force analysis of mechanisms, D'Alembert's Principle, dynamics of rigid link in plane motion, dynamic force analysis of planar mechanisms, piston force and crank effort. Turning moment on crankshaft due to force on piston, Turning moment diagrams for single cylinder double acting steam engine, four stroke IC engine and multi-cylinder engines, Fluctuation of speed, Flywheel.

### **Unit II**

**Gyroscope:** Space motion of rigid bodies, angular momentum, gyroscopic couples, gyroscopic stabilization, ship stabilization, stability of four wheel and two wheel vehicles moving on curved paths.

**Mech. Vibrations:** Types of Vibration, Degrees of freedom. Longitudinal Vibration: Single degree free and damped vibration. Forced vibration of single degree under harmonic excitation. Vibration isolation. Whirling of shaft and critical speed.

### **Unit III**

**Balancing:** Introduction, static balance, dynamic balance, balancing of rotating masses, two plane balancing, graphical and analytical methods, balancing of reciprocating masses, balancing of single cylinder engine, balancing of multi cylinder inline engines.

#### **Unit IV**

**Governors:** Introduction, types of governors, characteristics of centrifugal governors, gravity controlled and spring controlled centrifugal governors, hunting of centrifugal governors, inertia governors. Effort and Power of governor, Controlling force diagrams for Porter governor and spring controlled governors.

#### **Unit V**

**Brakes and dynamometers:** Introduction, Law of friction and types of lubrication, types of brakes, effect of braking on rear and front wheels of a four wheeler, dynamometers, belt transmission dynamometer, torsion dynamometer, hydraulic dynamometer

#### **Text/Reference Books:**

1. Kinematics and dynamics of machinery: Wilson and Sadler, Third edition, Pearson.
2. Theory of Mechanisms and Machines: Amitabha Ghosh and Ashok kumar Mallik, Third Edition Affiliated East-West Press.
3. Theory of Machines and Mechanisms: Joseph Edward Shirley and John Joseph Quicker, Jr. Oxford University Press

## **BTME-63 REFRIGERATION & AIR CONDITIONING**

#### **Unit-1**

**Refrigeration:** Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration, Refrigeration effect & C.O.P.

#### **Air Refrigeration cycle:**

Open and closed air refrigeration cycles, Reversed Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system. Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART).

#### **Unit-2**

#### **Vapour Compression System:**

Single stage system, Analysis of vapour compression cycle, Use of T-S and P-H charts, Effect of change in suction and discharge pressures on C.O.P, Effect of sub cooling of condensate & superheating of refrigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle, Multistage vapour compression system requirement, Removal of flash gas, Intercooling, Different configuration of multistage system, Cascade system.

#### **Unit-3**

#### **Vapour Absorption system;**

Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature – concentration diagram & Enthalpy – concentration diagram, Adiabatic mixing of two streams, Ammonia – Water vapour absorption system, Lithium- Bromide water vapour absorption system, Comparison. Three fluid system.

#### **Refrigerants:**

Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants and CFC free refrigerants. Ozone layer depletion and global warming considerations of refrigerants

#### **Unit-4**

#### **Air Conditioning:**

Introduction to air conditioning, Psychometric properties and their definitions, Psychometric chart, Different Psychometric processes, Thermal analysis of human body, Effective temperature and comfort chart, Cooling and heating load calculations, Selection of inside & outside design conditions, Heat transfer through walls & roofs, Infiltration & ventilation, Internal heat gain, Sensible heat factor ( SHF ),By pass factor, Grand Sensible heat factor ( GSHF), Apparatus dew point (ADP). Air Washers, Cooling towers & humidifying efficiency.

## **Unit-5**

### **Refrigeration Equipment & Application:**

Elementary knowledge of refrigeration & air conditioning equipmentse.g compressors, condensers, evaporators & expansion devices, Food preservation, Cold storage, Refrigerates Freezers, Ice plant, Water coolers, Elementary knowledge of transmission and distribution of air through ducts and fans, Basic difference between comfort and industrial air conditioning.

### **Books:**

1. Refrigeration and Air conditioning by C.P Arora, McGraw-Hill
2. Refrigeration and Air conditioning, by Manohar Prasad, New Age International (P) Ltd.Pub.
3. Refrigeration and Air conditioning by R. C. Arora, PHI

## **BTME-64 FLUID MACHINERY**

### **UNIT-I**

#### **Introduction: Impulse of Jet and Impulse Turbines:**

Classification of Fluid Machines & Devices, Application of momentum and moment of momentum equation to flow through hydraulic machinery, Euler's fundamental equation. Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat & curve), Classification of turbines, Impulse turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Governing of Pelton wheel

### **UNIT-II**

**Reaction Turbines:** Francis and Kaplan turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Degree of reaction, Draft tube, Cavitations in turbines, Principles of similarity, Unit and specific speed, Performance characteristics, Selection of water turbines.

### **UNIT-III**

#### **Centrifugal Pumps:**

Classifications of centrifugal pumps, Vector diagram, Work done by impellor, Efficiencies of centrifugal pumps, Specific speed, Cavitations & separation, Performance characteristics.

### **UNIT-IV**

#### **Positive Displacement and other Pumps:**

Reciprocating pump theory, Slip, Indicator diagram, Effect of acceleration, air vessels, Comparison of centrifugal and reciprocating pumps, Performance characteristics. Hydraulic ram, Jet pumps, Air lift pumps.

### **BOOKS:**

1. Hydraulic Machines by JagdishLal, Metropolitan book co. pvt ltd.
2. Hydraulic Machines by K Subramanian, Tata McGraw Hill
3. Fluid Mechanics and Machinery by C.S.P.Ojha, R. Berndtsson, P.N. Chandramouli, Oxford University Press

## **BTME-65 UNCONVENTIONAL MANUFACTURING PROCESSES**

### **UNIT-I**

Introduction, Limitations of conventional manufacturing processes, Need for unconventional manufacturing processes, its classification and future possibilities, Hybrid processes Unconventional Machining Process based on material removal by abrasion, Principle and working and applications Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet machining and Ultrasonic Machining.

### **UNIT-II**

Thermoelectric unconventional methods, Principle, working and applications of Plasma Arc Machining, Laser Beam Machining, Electron Beam Machining etc Working principle and applications of Electric Discharge Machining, EDM machines, EDM process characteristics, Wire electric discharge machining

### **UNIT-III**

Electro-chemical machining processes, ECM, its working principle, advantages and applications, Electro-chemical grinding, Electro-chemical debarring, Chemical machining. Unconventional welding processes: Explosive welding, Cladding etc., Under water welding, Metalizing, Plasma arc welding/cutting etc.

### **UNIT-IV**

Unconventional Forming processes: Principle, working and applications of High energy forming processes such as Explosive Forming, Electromagnetic forming, Electro-discharge forming, water hammer forming, explosive compaction etc. Electronic-device Manufacturing, Diffusion and Photo- Lithography process for electronic-device manufacturing.

### **Books and references:**

1. Modern Machining Processes – P.C. Pandey
2. Advanced Machining Processes, V.K. Jain, Allied Publishers.
3. Handbook of Manufacturing Processes, James G Bralla, Industrial Press.

## **BTMB-61 : INDUSTRIAL MANAGEMENT**

**Unit-I** Introduction: Concept, Development, application and scope of Industrial Management. Productivity: Definition, measurement, productivity index, types of production system, Industrial Ownership.

**Unit-II** Management Function: Principle of Management – Time and motion study, work simplification – process charts and flow diagrams, Production Planning.

**Unit-III** Inventory Control: Inventory, Cost, Deterministic Models, Introduction to supply chain management.

**Unit-IV** Quality Control: Process control, SQC, Control charts, Single, Double and Sequential Sampling, Introduction to TQM.

## **BTME-61P MACHINE DESIGN-II Lab**

**A. Computer and Language :** students are required to learn the basics of computer language such as C and C++ so that they should be able to write the computer programme (*3practical turns*)

**B. Writing Computer programme for conventional design:** Students are required to write computer program and validate it for the design of machine components done in theory subject (*5practical turns*)

**C. Mini Project:** Each student will be given a real life problem for the complete design of a subsystem/system using either manual calculation with the help of design handbook or through computer programme, if needed. This will be done as home assignment to be submitted at the end of the semester.

## **BTME-62P THEORY OF MACHINES LAB**

Minimum eight experiments out of the following:

1. Study of simple linkage models/mechanisms
2. Study of inversions of four bar linkage
3. Study of inversions of single/double slider crank mechanisms
4. Experiment on Gears tooth profile, interference etc.
5. Experiment on Gear trains
6. Experiment on longitudinal vibration
7. Experiment on transverse vibration
8. Experiments on dead weight type governor
9. Experiment on spring controlled governor
10. Experiment on critical speed of shaft
11. Experiment on gyroscope
12. Experiment on static/dynamic balancing
13. Experiment on Brake
14. Experiment on clutch

## **BTME-63P REFRIGERATION & AIR CONDITIONING Lab**

Minimum eight experiments out of the following:

1. Experiment on refrigeration test rig and calculation of various performance parameters.
2. Study of different types of expansion devices used in refrigeration system.
3. Study of different types of evaporators used in refrigeration systems.
4. To study basic components of air-conditioning system.
5. Experiment on air-conditioning test rig & calculation of various performance parameters.
6. Experiment on air washers
7. Study of window air conditioner.
8. Study & determination of volumetric efficiency of compressor.
9. Visit of a central air conditioning plant and its detailed study.
10. Visit of cold-storage and its detailed study.
11. Experiment on Ice-plant.
12. Experiment on two stage Reciprocating compressor for determination of volumetric efficiency , PV diagram and effect of intercooling.
13. Study of Hermetically sealed compressor.
14. Experiment on Desert coolers.

## **BTME-64P FLUID MACHINERY Lab**

**Minimum ten experiments out of the following along with study of the machines and processes**

1. Impact of Jet experiment.
2. Experiment on Pelton wheel.
3. Experiment on Francis turbine.
4. Experiment on Kaplan turbine.
5. Experiment on Reciprocating pump.
6. Experiment on centrifugal pump.
7. Experiment on Hydraulic Jack/Press
8. Experiment on Hydraulic Brake
9. Experiment on Hydraulic Ram
10. Study through visit of any water pumping station/plant
11. Any other suitable experiment/test rig such as comparison & performance of different types of pumps and turbines.
12. Experiment on Compressor
13. Experiment for measurement of drag and lift on aerofoil in wind tunnel