BABU BANARASI DAS UNIVERSITY LUCKNOW

SCHOOL OF ENGINEERING

Syllabus for

Bachelor of Technology

in

Mechanical Engineering

(Effective from the Academic Session 2012-13)

B. Tech. Mechanical Engineering 2nd Year

2nd -year											Semester-III
S. No.	Course Code	Subject	Periods			Evaluation Scheme				Subject Total	Credits
						Sessional exam.			ESE		
			L	T	P	CT	TA	Total			
					THEORY						
1.	BHU-301/ BHU-302	Industrial Psychology / Industrial Sociology	2	0	0	15	10	25	50	75	2
2	BAS-301	Mathematics-III	3	1	0	30	20	50	100	150	4
3.	BME301	Materials Science	3	1	0	30	20	50	100	150	4
4.	BME-302	Strength of Materials	3	1	0	30	20	50	100	150	4
5.	BME-303	Manufacturing Science- I	2	1	0	15	10	25	50	75	3
6.	BCE-302	Fluid Mechanics	3	1	0	30	20	50	100	150	4
					PRACTICAL/TRAINING/PROJECT						
7.	BME-351	Material Science & Testing Lab	0	0	2	10	10	20	30	50	1
8.	BME-352	Machine Drawing-I	0	0	3	10	10	20	30	50	1
9.	BME-353	Manufacturing Science- I Lab	0	0	2	10	10	20	30	50	1
10.	BCE-352	Fluid Mechanics Lab	0	0	2	10	10	20	30	50	1
11.	GP-301	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	**16**	**5**	**9**	**-**	**-**	**-**	**-**	**1000**	**26**

2nd -year											Semester-IV
S. No.	Course Code	Subject	Periods			Evaluation Scheme				Subject Total	Credits
						Sessional exam.			ESE		
			L	T	P	CT	TA	Total			
					THEORY						
1.	BHU-402/ BHU-401	Industrial Sociology / Industrial Psychology	2	0	0	15	10	25	50	75	2
2.	BME-401	Applied Thermodynamics	3	1	0	30	20	50	100	150	4
3.	BME-402	Manufacturing Science-II	3	1	0	30	20	50	100	150	4
4.	BME-403	Measurement Metrology & Control	3	1	0	30	20	50	100	150	4
5.	BAS-402	Numerical Techniques	2	1	0	15	10	25	50	75	3
6.	BCS-405	Programming in 'C'	3	1	0	30	20	50	100	150	4
					PRACTICAL/TRAINING/PROJECT						
7.	BME-451	Machine Drawing-II	0	0	3	10	10	20	30	50	1
8.	BME-452	Manufacturing Science-II Lab	0	0	2	10	10	20	30	50	1
9.	BME-453	Measurement & Metrology Lab	0	0	2	10	10	20	30	50	1
10.	BCS-455	'C'- Programming Lab	0	0	2	10	10	20	30	50	1
11.	GP-401	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	**16**	**5**	**9**	**-**	**-**	**-**	**-**	**1000**	**26**

BME- 301 : MATERIAL SCIENCE

Unit-1: Introduction : Historical perspective, importance of materials. Brief review of modern & atomic concepts in Physics and Chemistry.

Crystallography and Imperfections: Concept of unit cell space lattice, Bravais lattices, common crystal structures, Atomic packing factor and density. Miller indices. X-ray crystallography techniques. Imperfections, Defects & Dislocations in solids.

Unit-2: Mechanical properties and Testing: Stress strain diagram, Ductile & brittle material, Stress vs strength. Toughness, Hardness, Fracture, Fatigue and Creep. Testings such as Strength testings, Hardness testing, Impact testings, Fatigue testing Creep testing, Non-destructive testing (NDT)

Microstructural Exam : Microscope principle and methods. Preparation of samples and Microstructure exam and grain size determination. Comparative study of microstructure of various metals & alloys such as Mild steel, CI, Brass.

Phase Diagram and Equilibrium Diagram : Uniary and Binary diagrams, Phase rules. Types of equilibrium diagrams: Solid solution type, eutectic type and combination type.Iron-carbon equilibrium diagram.

Unit-3: Ferrous materials : Brief introduction of iron and steel making furnaces. Various types of carbon steels, alloy steels and cast irons, its properties and uses.

Heat Treatment: Various types of heat treatment such as Annealing, Normalizing, Quenching, Tempering and Case hardening. Time Temperature Transformation (TTT) diagrams.

Non-Ferrous metals and alloys : Non-ferrrous metals such as Cu, Al, Zn, Cr, Ni etc. and its applications. Various type Brass, Bronze, bearing materials, its properties and uses. Aluminum alloys such as Duralumin.

Unit-4: Magnetic properties : Concept of magnetism - Dia, para, ferro Hysteresis. Soft and hard magnetic materials, Magnetic storages.

Electric properties : Energy band concept of conductor, insulator and semi-conductor. Intrinsic & extrinsic semi-conductors. P-n junction and transistors. Basic devices and its application. Diffusion of Solid. Super conductivityand its applications. Messier effect. Type I & II superconductors. High Tc superconductors.

Unit-5: Ceramics: Structure types and properties and applications of ceramics. Mechanical/Electrical behavior and processing of Ceramics.

Plastics : Various types of polymers/plastics and its applications. Mechanical behavior and processing of plastics. Future of plastics.

Text/References:

1. W.D. Callister, Jr, - Material Science & Engineering Addition-Wesley Publication.
2 K.M.Gupta, Materials Science, Umesh Publication.
3. Van Vlash - Elements of Material Science & Engineering John Wiley & Sons.
4. V. Raghvan - Material Science, Prentice Hall.
5. Narula - Material Science, TMH.
6. Srivastava, Srinivasan - Science of Materials Engineering, NewAge Publication..

BME- 302 STRENGTH OF MATERIALS

Unit-1: Compound stress and strains: Introduction, state of plane stress, Principal stress and strain, Mohr's stress circle.
Theory of failure, Castinglion's Theorem, Impact load: Generalized Hook's Law. Theories of Failure. Castigliano's Theorem. Impact load & stresses.

Unit-2: Stresses in Beams: Review of pure Bending**.** Direct and shear stresses in beams due to transverse and axial loads, composite beams.
Deflection of Beams: Equation of elastic curve, cantilever and simply supported beams, Macaulay's method, area moment method, fixed and continuous beams.
Torsion: Review of Torsion, combined bending & torsion of solid & hollow shafts.

Unit-3 : Helical and Leaf Springs: deflection of springs by energy method, helical springs under axial load and under axial twist (respectively for circular and square cross sections) axial load and twisting moment acting simultaneously both for open and closed coiled springs, laminated springs.
Columns and Struts: Combined bending and direct stress, middle third and middle quarter rules. Struts with different end conditions. Euler's theory and experimental results, Ranking Gardon Formulae.
Unit-4: Thin cylinders & spheres: Hoop and axial stresses and strain. Volumetric strain.
Thick cylinders: Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures, Compound cylinders. Stresses due to interference fits.

Unit-5: Curved Beams: Bending of beams with large initial curvature, position of neutral axis for rectangular, trapezoidal and circular cross sections, stress in crane hooks, stress in circular rings subjected to tension or compression.
Unsymmetrical Bending: Properties of beam cross-section, slope of neutral axis, stress and deflection in unsymmetrical bending, determination of shear center and flexural axis(for symmetry about both axis and about one axis) for I-section and channel- section.

Text/References:

1. Mechanics of Materials by Pytel, CL-Engineering; 2 edition
2. Strength of Materials by Ryder, Macmillan Publishers India Ltd
3. Strength of Materials by Timoshenko and & Yσungs, TMH Publication
4. Mechanics of Materials by Bear Jhonson, The Macmillan Company

BME- 303: MANUFACTURING SCIENCE-I

Unit-1: Introduction: Importance o f manufacturing. Economic & technological considerations in manufacturing. Classification of manufacturing processes. Materials & manufacturing processes for common items.
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.

Unit-2: Analysis of wire / strip drawing and maximum reduction. Tube drawing, Extrusion and its application. Rolling and rolled section, condition for rolling force and power in rolling. Defects in metal forming processes.

Unit-3: 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.
Powder Metallurgy : Powder metallurgy manufacturing process. The need, process, advantage and applications.

Unit-4: Casting (Foundry): 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, CO_2 casting.
Jigs & Fixtures: Locating & Clamping devices & principles. Jigs and Fixtures and its applications.

Text/References:

1. Manufacturing Science by Ghosh and Mallik, Prentice Hall PTR
2. Production Engg. Science by P.C. Pandey, Standard Publishers Distributors
3. Production Technology by R.K. Jain, Khanna Publishers
4. Manufacturing Technology by P.N. Rao., TMH
5. Materials and Manufacturing by Paul Degarmo, Prentice Hall
6. Manufacturing Science by KM Moeed, Umesh Publication
7. Manufacturing Engineering & Technology by Kalpaksjian, Pearson Pub.

BME- 351 : MATERIALS SCIENCE AND TESTING LAB

(A). Material Science Lab Experiments: (Say, min 5 **experiments** out of the following)

1. Making a plastic mould for small metallic specimen.
2. Specimen preparation for micro structural examination-cutting, grinding, polishing, etching.
3. Grain Size determination of a given specimen.
4. Comparative study of microstructures of different given specimens (mild steel, gray C.I., brass, copper etc.)
5. Heat treatment experiments such as annealing, normalizing, quenching, case hardening and comparison of hardness before and after.
6. Material identification of, say, 50 common items kept in a box.
7. Faradays law of electrolysis experiment.
8. Study of corrosion and its effects.
9. Study of microstructure of welded component and HAZ. Macro & MicroExamination.
10. Suitable experiment on Magnetic/ Electrical/Electronic materials.

(B). Material Testing Lab Experiments: (Say, min 5 **experiments** out of the following)

1. Strength testing of a given mild steel specimen on UTM with full details and s-e plot on the machine.
2. Shear bend tests on UTM.
3. Impact testing on impact testing machine like Charpy, Izod or both.
4. Hardness testing of given specimen using Rockwell and Vickers/Brinell testing machines.
5. Spring index testing on spring testing machine.
6. Fatigue testing on fatigue testing machine.
7. Creep testing on creep testing machine.
8. Deflection of beam experiment, comparison of actual measurement of deflection with dial gauge to the calculated one, and or evaluation of young's modulus of beam.
9. Torsion testing of a rod on torsion testing machine.
10. Study of non-destructive testing methods like magnetic flaw detector, ultrasonic flaw detector, eddy current testing machine, dye penetrates tests.

BME – 352: MACHINE DRAWING-I LAB

Introduction (1 drawing sheet) Graphics Language, Classification of drawings, Principles of drawing, IS codes for machine drawing, scales, types of lines, section lines, Dimensioning
Orthographic Projections (1 drawing sheet) Principle of first angle and third angle projection, drawing of machine elements in first angle projection, selection of views, sectional views
Screwed fasteners (2 drawing sheet) thread nomenclature, Forms of thread, Thread series, designation, Representation of threads, Bolted joints, Locking arrangement of nuts
Keys and Cotters and Pin joint (1 drawing sheet) Types of keys, Cotter joint or Knuckle joint
Shaft Couplings (1 drawing sheet) Introduction, Rigid coupling or Flexible coupling
Riveted joints (1 drawing sheet) Introduction, rivets and riveting, Types of rivet heads, Types of riveted joints, Boiler joint
Assembly Drawing (1 drawing sheet) Introduction, Engine parts-stuffing box, cross head.

Text/References:

1. Machine Drawing-KL Narayana, P Kannaiah, KV Reddy-New Age
2. Machine Drawing-PS Gill-SK Kataria & sons
3. Machine Drawing-N. Siddeshswar, P Kannaiah, VVS Shastry, Tata McGraw Hill
4. Engineering drawing Practice for School and Colleges, SP46-1988 (BIS)

Babu Banarasi Das University

BME-353: MANUFACTURING SCIENCE-I LAB

Say, min 8 **experiments** out of the following

1. Design of pattern for a desired casting (containing hole)
2. Pattern making
3. Making a mould (with core) and casting.
4. Sand testings (at least one such as grain fineness number determination)
5. Injection moulding with plastics
6. Forging hand forging processes
7. Forging - power hammer study & operation
8. Tube bending with the use of sand and on tube bending m/c.
9. Press work experiment such as blanking/piercing, washer, making etc.
10. Wire drawing/extrusion on soft material.
11. Rolling-experiment.
12. Bending & spring back.
13. Powder metallurgy experiment.
14. Jigs & Fixture experiment.
15. Any other suitable experiment on manufacturing science / process / technique.

BME-401 APPLIED THERMODYNAMICS

Unit-1: Thermodynamic relations: Mathematical conditions for exact differentials. Maxwell Relations, Clapeyron Equation, Joule-Thompson coefficient and Inversion curve. Coefficient of volume expansion, Adiabatic & Isothermal compressibility.
Fuels and Combustion: Combustion analysis, Heating Values, Air requirement, Air/Fuel ratio, Standard heat of Reaction and effect of temperature on standard heat of reaction, heat of formation, Adiabatic flame temperature.

Unit-2: 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.
Condenser: Classification of condenser, Air leakage, Condenser performance parameters

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

Unit-4: Vapour Power cycles: Carnot vapour power cycle, Effect of pressure & temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heaters, Binary vapor cycle, combined cycles, Cogeneration.
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, Impulse reaction Turbines, state point locus, Comparison with steam engines, Losses in steam turbines, Governing of turbines.
Unit-5: 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.
Jet Propulsion: Introduction to the principles of jet propulsion, Turbojet and turboprop engines & their processes, Principle of rocket propulsion, Introduction to Rocket Engine.

Text/References:

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 Pub.
3. Thermal Engg. By P.L. Ballaney, Khanna Publisher
4. Theory of Steam Turbine by W.J. Kearton, London, New York [etc.] Sir I. Pitman & Sons
5. Steam & Gas Turbine by R.Yadav, CPH Allahabad
6. Thermal Engg. By R.K. Rajput, Laxmi Publication
7. Gas Turbine, by V. Ganeshan, Tata Mc Graw Hill Publishers.
8. Gas turbine Theory & Practice, by Cohen & Rogers, Addison Weslay Long man

BME-402 : MANUFACTURING SCIENCE-II

Unit-1: 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. 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-2: Machine Tools- Lathe :Principle, construction, types, operations, turret/capstan/ Automatic, Tool layout. **Shaper, slotter, planer** : Construction, operations & drives. **Milling** : Construction, Milling cutters, up & down milling. Dividing head & ndexing. Max chip thickness & power required. **Drilling and boring** : Drilling, boring, reaming tools. Geometry of twist drills. **Grinding & Super finishing:** 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. Super finishing **:** Honing, lapping, polishing.

Unit-3: Standardization & Interchangeability, Limits, Fits & Tolerance and Surface- roughness: Introduction to Standardization & Interchangeability Limits, Fits, Tolerances and IS standards, Limit-gauges, and surface-roughness.

Unit-4: 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 .

Unit-5: Introduction to Un-conventional 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.

Text/References:

1. Manufacturing science by Ghosh and Mallik, Prentice Hall PTR
2. Fundamentals of Metal Cutting and Machine tools by Boothroyd, Scripta Book Co.
3. Production Technology by R.K. Jain, Khanna Publication
4. Production Technology - H.M.T.
5. Production Engineering Science by P.C. Pandey, Standard Publishers Distributors
6. Modern Machining Processes by P.C. Pandey & H.S. Shan, Tata McGraw-Hill
7. Manufacturing science by Degarmo, Wiley
8. Fundamentals of metal cutting & machine tools - Juneja & Shekhon, Wiley
9. Process & materials of manufacturing – Lindburg, Allyn and Bacon,
10. Advanced Machining Process - VK Jain

BME -403: MEASUREMENT METROLOGY & CONTROL

Unit-1: Mechanical Measurements

Introduction: Introduction to measurement and measuring instruments, Generalized measuring system and functional elements, units of measurement, static and dynamic performance characteristics of measurement devices, calibration, concept of error, sources of error, statistical analysis of errors. **Sensors and Transducers:** Types of sensors, types of transducers and their characteristics. **Signal transmission and processing:** Devices and systems. Signal Display & Recording Devices.

Unit-2: Time related measurements: Counters, stroboscope, frequency measurement by direct comparison. Measurement of displacement. **Measurement of pressure:** Gravitational, directing acting, elastic and indirect type pressure transducers. Measurement of very low pressures. **Strain measurement:**Types of strain gauges and their working, strain gauge circuits, temperature compensation. Strain rosettes, calibration. **Measurements of force and torque:** Different types of load cells, elastic transducers, pneumalic & hydraulic systems. **Temperature measurement:** Thermometers, bimetallic thermocouples, thermistors and pyrometers. **Vibration:** Seismic instruments, vibration pickups and decibel meters, vibrometers accelerometers.

Unit-3: Metrology

Metrology and Inspection : Standards of linear measurement, line and end standards. Limit fits and tolerances. Interchangeability and standardization. Linear and angular measurements devices and systems Comparators: Sigma, Johansson's Microkrator. Limit gauges classification, Taylor's Principle of Gauge Design.

Unit-4: Measurement of geometric forms like straightness, flatness, roundness. Tool makers microscope, profile project autocollimator.
Interferometry: principle and use of interferometry, optical flat. Measurement of screw threads and gears. **Surface texture:** quantitative evaluation of surface roughness and its measurement. **Measurement and Inspection:** Dimensional inspection – Tolerance, Limit gauging, comparators, Surface roughness, Feature inspection.

Unit-5: Introduction: Concept of automatic control- open loop & closed loop system Servomechanisms. Block diagrams, transfer functions. Applications of Laplace transform in control system.
Representation of control components & systems: Translation and rotational mechanical components, series and parallel combinations, cascade system, analogous system.
Controllers: Brief introduction of Pneumatic, hydraulic, & electric controllers

Text/References:

1. Beckwith Thomas G., Mechanical Measurements, Narosa Publishing House, N. Delhi.
2. Doeblein E.O., “Measurement Systems, Application Design”, McGraw Hill, 1990.
3. Kumar D.S., “Mechanical Measurements and Control”, Metropolitan, N. Delhi.
4. Hume K.J., “Engineering Metrology”, MacDonald and Co. 1963
5. Gupta, I.C., “Engineering Metrology”, Dhanpat Rai & Sons, New Delhi, 1994
6. Sirohi, “Mechanical Measurement” New Age Publishers
7. Jain, R.K., “Engineering Metrology” Khanna Publishers
8. Jain, R.K., “Mechanical Measurement” Khanna Publishers

BME 451: MACHINE DRAWING-II LAB

Review of Orthographic Projections (1 drawing sheet)
Orthographic Projection of solids in First angle of projection, missing lines views, interpretation of views
Part and Assembly Drawing (2 drawing sheet)
Assembly drawing of eccentric, lathe tail stock, air valve, screw jack, connecting rod, safety valve etc.

Specification of Materials (1 drawing sheet)
Engineering materials, representation, Code designation of steel, copper, aluminum etc.

Limits, Tolerance and Fits (1 drawing sheet)
Limit system, Tolerances, Method of placing limit dimensions, Fits-types
Surface Roughness (1 drawing sheet)
Introduction, nomenclature, machining symbols, indication of surface roughness
Production Drawing (1drawing sheet)
Types, Examples of simple machine elements like helical gear, bevel gear, crank, connecting rod, belt pulley, piston etc.
Computer Aided Drafting (2 drawings)
Introduction, input, output devices, introduction to software like AutoCAD, ProE, basic commands and development of 2D and 3D drawings of simple parts

Text/References:

1. Machine Drawing - KL Narayana, P Kannaiah, KV Reddy - New Age
2. Machine Drawing - PS Gill - SK Kataria & sons
3. Machine Drawing -N. Siddeshswar, P Kannaiah, VVS Shastry -Tata McGraw Hill
4. Engineering Drawing - RK Dhawan - S. Chand
5. AutoCAD-S. Vshal - Dhanpat Rai
6. Engineering Graphics - BK Goel & PK Goel - SK Kataria
7. Computer Aided Engineering Graphics - Rajashekhar Patil - New Age
8. Engineering Drawing - Dhananjay A Jolhe - Tata McGraw Hill
9. Engineering Drawing - CM Agrawal - Tata McGraw Hill
10. Machine Drawing – Ajeet Singh – The Mc Graw Hill Companies

BME-452: MANUFACTURING SCIENCE -II – LAB

Say, min 8 **experiments** out of the following

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.

BME 453: MEASUREMENT & METROLOGY LAB

Say, min 8 **experiments** out of the following

1. Study & working of simple measuring instruments- Vernier calipers, micrometer, tachometer.
2. Measurement of effective diameter of a screw thread using 3 wire method.
3. Measurement of angle using sinebar & slip gauges. Study of limit gauges.
4. Study & angular measurement using level protector
5. Adjustment of spark plug gap using feeler gauges.
6. Study of dial indicator & its constructional details.
7. Use of dial indicator to check a shape run use.
8. Study and understanding of limits, fits & tolerances
9. Study of Pressure & Temperature measuring equipment.
12. Strain gauge measurement.
13. Speed measurement using stroboscope.
14. Flow measurement experiment
15. Vibration/work measuring experiment.
16. Experiment on Dynamometers

BABU BANARASI DAS UNIVERSITY
LUCKNOW

SCHOOL OF ENGINEERING

Syllabus for

Bachelor of Technology

in

Mechanical Engineering

(Effective from the Academic Session 2013-2014)

B. Tech. Mechanical Engineering

III Year V SEM

S. No.	Course Code	SUBJECT	PERIODS			Evaluation Scheme				Subject Total	Credits
						SESSIONAL EXAM.			ESE		
			L	T	P	CT	TA	Total			
THEORY											
1.	BHU-501	Engineering and Managerial Economics	3	1	0	30	20	50	100	150	4
2.	BEE-505	Electrical Machines	2	1	0	15	10	25	50	75	3
3.	BME-501	Machine Design-I	2	1	0	15	10	25	50	75	3
4.	BME-502	Theory of Machines-I	3	1	0	30	20	50	100	150	4
5.	BME-503	Heat & Mass Transfer	3	1	0	30	20	50	100	150	4
6.	BME-504	I.C.Engines & Compressors	3	1	0	30	20	50	100	150	4
PRACTICAL/TRAINING/PROJECT											
7.	BME-551	Machine Design-I Lab	0	0	2	10	10	20	30	50	1
8.	BME 553	Heat & Mass Transfer Lab	0	0	3	10	10	20	30	50	1
9.	BEE 555	Electrical Machines & Automatic control Lab	0	1	2	10	10	20	30	50	2
10.	BME 558	Seminar	0	0	3	-	50	-	-	50	1
11.	GP 501	General Proficiency	-	-	-	-	-	50	-	50	1
Total			16	7	10	-	-	-	-	1000	28

B. Tech. Mechanical Engineering
III Year VI SEM

S. No.	Course Code	SUBJECT	PERIODS			Evaluation Scheme				Subject Total	Credits
						SESSIONAL EXAM.			ESE		
			L	T	P	CT	TA	Total			
THEORY											
1.	BHU-601	Industrial Management	3	1	0	30	20	50	100	150	4
2.	BME-011 to BME-014	Professional Elective-I	3	1	0	30	20	50	100	150	4
3.	BME-601	Theory of Machine- II	2	1	0	15	10	25	50	75	3
4.	BME-602	Refrigeration & Air-conditioning	3	1	0	30	20	50	100	150	4
5.	BME-603	Machine Design-II	3	1	0	30	20	50	100	150	4
6.	BME-604	Advanced Welding Technology	2	1	0	15	10	25	50	75	3
PRACTICAL/TRAINING/PROJECT											
7.	BME-651	Theory of Machines Lab Lab	0	0	3	10	10	20	30	50	1
8.	BME-652	Refrigeration & Air Conditioning Lab	0	0	2	10	10	20	30	50	1
9.	BME-653	Fluid Machinery Lab	0	1	2	10	10	20	30	50	2
10.	BME-658	Seminar	0	0	2	10	10	20	30	50	1
11.	GP-601	General Proficiency	-	-	-	-	-	50	-	50	1
Total			16	7	9	-	-	-	-	1000	28

- **Industrial Training, of 4 – 6 weeks after VI semester will be evaluated in VII semester**

PROFESSIONAL ELECTIVE - I

1	BME-011	Fluid Machinery
2	BME-012	Unconventional Manufacturing Processes
3	BME-013	Product Development & Design
4	BME-014	Reliability Engineering

B. Tech. Mechanical Engineering
YEAR IV, SEMESTER VII

S. No.	Course Code	SUBJECT	PERIODS			Evaluation Scheme				Subject Total	Credits
						SESSIONAL EXAM.			ESE		
			L	T	P	CT	TA	Total			
THEORY											
1.	BME-701	Computer Aided Design	3	1	0	30	20	50	100	150	4
2.	BME-702	Automobile Engineering	3	1	0	30	20	50	100	150	4
3.	OE-01-06	Open Elective-I	3	1	0	30	20	50	100	150	4
4.	BME-015-018	Professional Elective - II	3	1	0	30	20	50	100	150	4
5.	BME-019-022	Professional Elective – III	3	1	0	30	20	50	100	150	4
PRACTICAL/TRAINING/PROJECT											
6.	BME-751	CAD/CAM Lab	0	1	2	*10*	*10*	*20*	*30*	50	2
7.	BME-752	Automobile Lab	0	0	2	*10*	*10*	*20*	*30*	50	1
8.	BME-757	Industrial Training Evaluation	0	0	2		*50*	*50*	-	50	1
9.	BME-759	Mini Project	0	0	3	-	*50*	*50*	-	50	2
10.	GP-701	General Proficiency	-	-	-	-	-	*50*	-	50	1
Total			15	6	9	-	-	-	-	1000	27

PROFESSIONAL ELECTIVE II:

BME-015	Computer Aided Manufacturing
BME -016	Advanced Fluid Mechanics
BME -017	Advanced Dynamics of Machines
BME -018	Management Information System

PROFESSIONAL ELECTIVE III:

BME -019	Thermal Turbo Machines
BME -020	Mechanical System Design
BME -021	Industrial Ergonomics
BME -022	Concurrent Engineering

B. Tech. Mechanical Engineering
YEAR IV, SEMESTER VIII

S. No.	Course Code	SUBJECT	PERIODS			Evaluation Scheme				Subje ct Total	Credits
						SESSIONAL EXAM.			ESE		
			L	T	P	CT	TA	Tota l			
THEORY											
1.	BME-801	Power Plant Engineering	3	1	0	30	20	50	100	150	4
2.	OE-21-25	Open Elective- II	3	1	0	30	20	50	100	150	3
3.	BME-023-026	Professional Elective -I V	3	1	0	30	20	50	100	150	4
PRACTICAL/TRAINING/PROJECT											
4.	BME-858	Seminar	-	-	-	-	50	50	-	50	1
5.	BME-859	Project	0	0	12	-	150	150	300	450	12
6.	GP-801	General Proficiency	-	-	-	-	-	50	-	50	1
Total			9	3	12	-	-	-	-	1000	25

PROFESSIONAL ELECTIVE -IV

BME-023	Maintenance Engineering & Management
BME-024	Design of Thermal Systems
BME-025	Advanced Synthesis of Mechanisms
BME-026	Six Sigma Methods & Applications

BME-501: 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 against Static Load: Modes of failure, Factor of safety, Stresses due to bending and torsion, Theory of failure.

UNIT II

Design against 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, 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, 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

Text/References:

1. Mechanical Engineering Design – Joseph E. Shigely, McGraw Hill Publications
2. Design of Machine Memebers-Alex Valance and VI Doughtie, McGraw Hill Co.
3. Machine design-M.F. Spott, Prentice Hall India
4. Machine Design-Maleev and Hartman, CBS
5. Machine design -Black & Adams, Mc Graw Hill
6. Machine Design-Sharma and Agrawal, S.K. Katara & Sons
7. Design of Machine Elements-V.B. Bhandari, Tata McGraw Hill Co.

BME 502: THEORY OF MACHINES - I

UNIT I

Introduction: Links-types, Kinematics pairs-classification, Constraints-types, Degrees of freedom of planar mechanism, Grubler's equation, linkage mechanisms, inversions of four bar chain, slider crank chain and double slider crank chain.

Velocity in Mechanisms: 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 & location of instantaneous centers, Kennedy's theorem, Velocities in four bar mechanism & slider crank mechanism.

UNIT II

Acceleration in Mechanisms: Acceleration of a point on a link, Acceleration diagram, Coriolis component of acceleration, Crank and slotted lever mechanism, Klein's construction for Slider Crank mechanism and Four Bar mechanism.

Mechanisms with Lower Pair: Pantograph, Exact straight line motion mechanisms-Peaucellier's, Hart and Scott Russell mechanisms, Approximate straight line motion mechanisms–Grass-Hopper, Watt and Tchebicheff mechanisms, Analysis of Hooke's joint, Davis and Ackermann steering gear mechanisms.

UNIT III

FRICTION:

Laws of friction, Friction on inclined plane, Efficiency on inclined plane, Friction in journal bearing-friction circle, Pivots and collar friction-uniform pressure and uniform wear, Belt and pulley drive, Length of open and cross belt drive, Ratio of driving tensions for flat belt drive, centrifugal tension, condition for maximum power transmission, V belt drive

Brakes & Dynamometers: Shoe brake, Band brake, Band and Block brake, and Absorption and transmission type dynamometers

UNIT IV

CAMS:

Cams and Followers - Classification & terminology, Cam profile by graphical methods with knife edge and radial roller follower for uniform velocity, simple harmonic and parabolic motion of followers, Analytical methods of cam design – tangent cam with roller follower and circular cams with flat faced follower.

UNIT V

Gears & Gear Trains: Classification & terminology, law of gearing, tooth forms & comparisons, Systems of gear teeth, Length of path of contact, contact ratio, interference & under cutting 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.

Text/References:

1. Theory of Machines - Thomas Bevan
2. Theory of Machines and Mechanisms- Shigley
3. Theory of Machines and Mechanisms-Ghosh & Mallik
4. Theory of Machines and Mechanisms- Rao & Dukkipati
5. Theory of Machines-S.S. Rattan
6. Kinematics of Machines-Dr. Sadhu singh
7. Mechanics of Machines – V. Ramamurti
8. Theory of Machines – Khurmi & Gupta
9. Theory of Machines – R. K. Bansal
10. Theory of Machines – V. P. Singh
11. Theory of Machines – Malhotra & Gupta

BME-503:HEAT & MASS TRANSFER

UNIT-I

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.

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

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.

UNIT-II

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-III

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.

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-IV

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.

UNIT-V

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 g a s e s .

Introduction To Mass Transfer: Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion though a stagnant gas film.

Books:

1. Elements of Heat transfer by Bayazitouglu & 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 Vijay Gupta, New Age International (P) Ltd. Publishers
7. Heat Transfer, by Y.V.C. Rao, University Press.
8. Heat Transfer, by R. Yadav, Central Publishing House, Allahabad.

BME-504: I C ENGINES & COMPRESSORS

Unit-I

Introduction to I.C Engines: Engine classification, Air standard cycles, Otto cycle, Diesel cycle, Dual cycle, Comparison of Otto, Diesel and Dual cycles, Stirling cycle, Ericsson cycles, Actual cycle analysis, Two and four stroke engines, SI and CI engines, Valve timing diagram, Rotary engines, stratified charge engine.

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-II

SI Engines: Combustion in SI engine, Flame speed, Ignition delay, abnormal combustion and it's control, combustion chamber design for SI engines. Carburetion, Mixture requirements, Carburetor types, Theory of carburetor, MPFI. Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition.

Unit–III

CI Engine: Combustion in CI engines, Ignition delay, Knock and it's control, Combustion chamber design of CI engines. Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings.Scavenging in 2 Stroke engines, pollution and it's control.

Unit-IV

Engine Cooling: Different cooling systems, Radiators and cooling fans.

Lubrication: Engine friction, Lubrication principle, Type of lubrication, Lubrication oils, Crankcase ventilation.

Supercharging: Effect of altitude on power output, Types of supercharging.

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.

Text/References:

1. Fundamentals of Internal Combustion Engine by Gill, Smith,Ziurs, Oxford & IBH Publishing CO
2. IC Engines, by Rogowsky, International Book Co.
3. A Course in International 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 Mc Graw Hill Publishers.
6. I.C Engine, by R. Yadav, Central Publishing House, Allahabad
7. Reciprocating and Rotary Compressors, by Chlumsky, SNTI Publications, Czechoslovakia
8. Turbines, Compressors and Fans, by S.M.Yahya, Tata Mc Graw Hill

BME-551: MACHINE DESIGN-I Lab

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

BME-553: HEAT & MASS TRANSFER – Lab

Minimum 10 experiment of the following

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

BME-601: THEORY OF MACHINES-II

UNIT I

Static & Dynamic Force Analysis: Static equilibrium of two/three force members, Static equilibrium of member with two forces and torque, Static force analysis of linkages, D'Alembert's principle, Equivalent offset inertia force, Dynamic force analysis of four link mechanism and slider crank mechanism, Engine force analysis-Piston and crank effort.

Turning Moment & Flywheel: Turning moment on crankshaft, Turning moment diagrams-single cylinder double acting steam engine, four stroke IC engine and multi-cylinder steam engine, Fluctuation of energy, Flywheel

UNIT II

Balancing of Machines: Static and dynamic balancing, Balancing of several masses in the same plane and different planes, Balancing of reciprocating masses, Balancing of primary force in reciprocating engine, Partial balancing of two

cylinder locomotives, Variation of tractive force, swaying couple, hammer blow.

UNIT III

Governors:

Terminology, Centrifugal governors-Watt governor, Dead weight governors-Porter & Proell governor, Spring controlled governor-Hartnell governor, Sensitivity, Stability, Hunting, Isochronism, Effort and Power of governor, Controlling force diagrams for Porter governor and spring controlled governors.

UNIT IV

Gyroscopic Motion: Principles, Gyroscopic torque, Effect of gyroscopic couple on the stability of aero planes & automobiles.

Mechanical Vibrations: Types of vibrations, Degrees of freedom, Single degree free & damped vibrations.

Text/References:

1. Theory of Machines - Thomas Bevan
2. Theory of Machines and Mechanisms- Shigley
3. Theory of Machines and Mechanisms-Ghosh & Mallik
4. Theory of Machines and Mechanisms- Rao & Dukkipati
5. Theory of Machines - S.S. Rattan
6. Theory of Machines – R.K. Bansal
7. Mechanics of Machines – V. Ramamurti
8. Theory of Machines – Khurmi & Gupta
9. Theory of Machines – P.L. Ballaney
10. Theory of Machines – V. P. Singh

BME 602: REFRIGERATION & AIR CONDITIONING

Unit-I

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 refrigation system. Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART).

Unit-II

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 vapor compression refrigeration cycle, Multistage vapour compression system requirement, Removal of flash gas, Intercooling, Cascade system.

Unit-III

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.

Refrigerants: Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants and CFC free refrigerants.

Unit-IV

Air Conditioning: Introduction to air conditioning, Psychometric properties and their definitions, Psychometric chart, Different Psychometric processes, 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).

Unit-V

Refrigeration Equipment & Application: Elementary knowledge of refrigeration & air conditioning equipments e.g compressors, condensers, evaporators & expansion devices, Air washers, Cooling, towers & humidifying efficiency, Food preservation, Cold storage, Refrigerates Freezers, Ice plant, Water coolers, Basic difference between comfort and industrial air conditioning.

Text/References:

1. Refrigeration and Air conditioning, by Manohar Prasad, New Age International (P) Ltd.Pub.
2. Refrigeration and Air conditioning by C.P Arora.
3. Refrigeration and Air conditioning by Arora & Domkundwar.
4. Refrigeration and Air conditioning by stoecker & Jones.
5. Refrigeration and Air conditioning by Roy J. Dossat.
6. Refrigeration and Air conditioning by P.L. Baloney.
7. Thermal Environment Engg. by Kuhen, Ramsey & Thelked.

BME-603: MACHINE DESIGN-II

UNIT I

Spur Gears

Tooth forms, System of gear teeth, contact ratio, Standard proportions of gear systems, Interferencein 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, Beam strength and wear strength of helical gears, herringbone gears, crossed helical gears, Design of helical gears.

UNIT II

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.

Bevel Gears: Terminology, Proportions for Bevel gears. Design of right angle bevel gears.

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, piston ring and gudgeon pin; Design of connecting rod; Design of centre crankshaft.

Text/References:

1. Mechanical Engineering Design – Joseph E. Shigely, McGraw Hill Publications
2. Design of Machine Memebers-Alex Valance and VI Doughtie, McGraw Hill Co.
3. Machine design-M.F. Spott, Prentice Hall India
4. Machine Design-Maleev and Hartman, CBS
5. Machine design -Black & Adams, Mc Graw Hill
6. Machine Design-Sharma and Agrawal, S.K. Katara & Sons
7. Design of Machine Elements-V.B. Bhandari, Tata McGraw Hill Co.

BME-604 : ADVANCED WELDING TECHNOLOGY

Unit-I

Introduction : Importance and application of welding, classification of welding process. Selection of welding process.
Brief review of conventional welding process : Gas welding, Arc welding, MIG, TIG welding. Resistance welding. Electroslag welding, Friction welding etc. Welding of MS.CI, Al, and Stainless steel & Maurer/Schaefflar Diagram. Soldering & Brazing.

Unit-II

Advanced welding Techniques- Principle and working and application of advanced welding techniques such as Plasma Arc welding, Laser beam welding, Electron beam welding, Ultrasonic welding etc. Explosive welding/ cladding, Underwater welding.

Unit-III

Weld Design: Welding machines/equipments and its characteristics and arc-stability, Weld defects and distortion and its remedies, Inspection/testing of welds, Weld Design, Welding of pipe-lines and pressure vessels. Life predication.

Unit-IV

Thermal and Metallurgical consideration.: Thermal considerations for welding, temperature distribution, Analytical/Empirical analysis/formulae, heating & cooling curves. Metallurgical considerationof weld, HAZ and Parent metal, micro & macro structure.Solidification of weld and properties.

Text/References:

Welding Hand Book

BME-651: THEORY OF MACHINES LAB

Note: Eight experiments out of the following are to be conducted

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

BME-652 : REFRIGERATION & AIR CONDITIONING LAB

Note: Eight experiments out of the following are to be conducted

1. Experiment on refrigeration test rig and calculation of various performance parameters.
2. To study different types of expansion devices used in refrigeration system.

3. To study 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 Desert coolers.
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. Experiment on Ice-plant.

BME-653: FLUID MACHINERY LAB

Note: Eight experiments out of the following are to be conducted

1. Impact of Jet experiment.
2. Turbine experiment on Pelton wheel.
3. Turbine experiment on Francis turbine.
4. Turbine 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 detailed visit of any water pumping station/plant
11. Experiment on Compressor.
12. Experiment for measurement of drag and lift on aerofoil in wind tunnel

BME -701: COMPUTER AIDED DESIGN (CAD)

UNIT-I

Introduction:

Introduction to CAD/CAED/CAE, Elements of CAD, Essential requirements of CAD, Concepts of integrated CAD/CAM, Necessity & its importance, Engineering Applications Computer Graphics-I CAD/CAM systems, Graphics Input devices-cursor control Devices, Digitizers, Keyboard terminals, Image scanner, Speech control devices and Touch, panels, Graphics display devices-Cathode Ray Tube, Random & Raster scan display, Colour CRT monitors, Direct View Storage Tubes, Flat Panel display, Hard copy printers and plotters

UNIT-II

Computer Graphics-II

Graphics standards, Graphics Software, Software Configuration, Graphics Functions, Output primitives- Bresenham's line drawing algorithm and Bresenham's circle generating algorithm

Geometric Transformations:

World/device Coordinate Representation, Windowing and clipping, 2 D Geometric transformations-Translation, Scaling, Shearing, Rotation & Reflection Matrix representation, Composite transformation, 3 D transformations, multiple transformation

UNIT-III

Curves:

Curves representation, Properties of curve design and representation, Interpolation vs approximation, Parametric representation of analytic curves, Parametric continuity conditions, Parametric representation of synthetic curves Hermite cubic splines-Blending function formulation and its properties, Bezier curves-Blending function formulation and its properties, Composite Bezier curves, B-spline curves and its properties, Periodic and non-periodic B-spline curves

UNIT-IV

3D Graphics:

Polygon surfaces-Polygon mesh representations, Quadric and Superquadric surfaces and blobby objects; Solid modeling-Solid entities, Fundamentals of Solid modeling-Set theory, regularized set operations; Half spaces, Boundary representation, Constructive solid geometry, Sweep representation, Color models Application commands for AutoCAD & ProE software

UNIT-V

Numerical Methods:

Introduction, Errors in numbers, Binary representation of numbers, Root findingBisection method,Newton Raphson method,Curve fitting-Least square method,Numerical differentiation-Newton's interpolation, Numerical Integration-Trapezoidal And Simpson method.

Finite Element Method:

Introduction, Principles of Finite elements modeling, Stiffness matrix/displacement matrix, Stiffness matrix for spring system, bar & beam elements, bar elements in 2D space (truss element)

Text/References:

1. Computer Graphics Hearn & Baker Prentice Hall of India
2. Computer Aided Engineering Design Anupam Saxena & B. Sahay Anamaya Publishers
3. CAD/CAM HP Groover & EW Zimmers, Jr. Prentice Hall India Ltd.
4. CAD/CAM Theory and Practice Ibrahim Zeid & R Sivasubramaniam McGraw Hill
5. Computer Aided Design RK Srivastava Umesh Publications
6. Mathematical Elements for Computer Graphics DF Rogers & JA Adams McGraw Hill
7. Finite Element Method SS Rao
8. FE Analysis Theory and Programming CS Krishnamoorthy Tata McGraw Hill
9. Numerical Method for Engg Computation MK Jain, SRK Iyenger & R K JainWiley Eastern Limited

BME -702 AUTOMOBILE ENGINEERING

Unit-I

Power Unit and Gear Box:

Principles of Design of main components. Valve mechanism. Power and Torque characteristics. Rolling, air and gradient resistance. Tractive effort.Gear Box. Gear ratio determination. Design of Gear box.

Unit-II

Transmission System:

Requirements. Clutches. Toque converters. Over Drive and free wheel, Universal joint. Differential Gear Mechanism of Rear Axle. Automatic transmission, Steering and Front Axle. Castor Angle, wheel camber & Toe-in, Toe-out etc.. Steering geometry. Ackerman mechanism, Understeer and Oversteer.

Unit-III

Braking System:

General requirements, Road, tyre adhesion, weight transfer, Braking ratio. Mechanical brakes, Hydraulic brakes. Vacuum and air brakes. Thermal aspects.

Chasis and Suspension System: Loads on the frame. Strength and stiffness. Various suspension systems.

Unit-IV

Electrical System : Types of starting motors, generator & regulators, lighting system, Ignition system, Horn, Battery etc.

Fuel Supply System: Diesel & Petrol vehicle system such as Fuel Injection Pump, Injector & Fuel Pump, Carburetor etc. MPFI.

Unit-V

Automobile Air Conditioning: Requirements, Cooling & heating systems.

Cooling & Lubrication System: Different type of cooling system and lubrication system.

Maintenance system: Preventive maintenance, break down maintenance and over hauling.

Text/References:

1. Automotive Engineering- Hietner
2. Automobile Engineering - Kripal Singh.
3. Automobile Engineering - Narang.
4. Automotive Mechanics- Crouse
5. Automobile Engineering - Newton and Steeds.

BME-751: CAD/CAM LAB

Total TEN Experiments are to carried out. FIVE Experiments each from CAD and CAM.

A. CAD Experiments

1. Line Drawing or Circle Drawing experiment: Writing and validation of computer program.
2. Geometric Transformation algorithm experiment for translation/rotation/scaling: Writing and validation of computer program.
3. Design of machine component or other system experiment: Writing and validation of computer program.
4. Understanding and use of any 3-D Modeling Software commands.
5. Pro/E/Idea etc. Experiment: Solid modeling of a machine component
6. Writing a small program for FEM for 2 spring system and validation of program or using a fem Package
7. Root findings or curve fitting experiment: Writing and validation of computer program.
8. Numerical differentiation or numerical integration experiment: Writing and validation of computer program.

B. CAM Experiments

1. To study the characteristic features of CNC machine
2. Part Programming (in word address format) experiment for turning operation (including operations such as grooving and threading) and running on CNC machine
3. Part Programming (in word address format or ATP) experiment for drilling operation (point to point) and running on CNC machine

4. Part Programming (in word address format or ATP) experiment for milling operation (contouring) and running on CNC machine
5. Experiment on Robot and programs
6. Experiment on Transfer line/Material handling
7. Experiment on difference between ordinary and NC machine, study or retrofitting
8. Experiment on study of system devices such as motors and feed back devices
9. Experiment on Mecatronics and controls

BME-752: AUTOMOBILE LAB

Experiments : Say minimum 10 experiments out of following in depth and details.
1. Performance Analysis of Four stroke S.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
2. Determination of Indicated H.P. of I.C. Engine by Morse Test.
3. Performance Analysis of Four stroke C.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
4. Study & experiment on Valve mechanism.
5. Study & experiment on Gear Box.
6. Study & experiment on Differential Gear Mechanism of Rear Axle.
7. Study & experiment on Steering Mechanism.
8. Study & experiment on Automobile Braking System.
9. Study & experiment on Chassis and Suspension System.
10. Study & experiment on Ignition system of I.C. Engine.
11. Study & experiment on Fuel Supply System of S.I. Engines- Carburetor, Fuel Injection Pump and MPFI.
12. Study & experiment on Fuel Supply System of C.I. Engines- Injector & Fuel Pump.
13. Study & experiment on Air Conditioning System of an Automobile.
14. Comparative study of technical specifications of common small cars (such as Maruti Swift, Hyundai i20, Cheverlet Aveo, Tata Indica, Ford Fusion etc.
15. Comparative study & technical features of common scooters & motorcycles available in India.
16. Visit of an Automobile factory.
17. Visit to a Modern Automobile Workshop.
18. Experiment on Engine Tuning.
19. Experiment on Exhaust Gas Analysis of an I.C. Engine.

BME-801: POWER PLANT ENGINEERING

Unit-I

Introduction

Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion calculations. Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant units. Power plant economics and selection Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit; depreciation and replacement, theory of rates. Economics of plan selection.

Unit-II

Steam power plant

General layout of steam power plant, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories, Different systems such as coal handling system, pulverizers and coal burners, combustion system, draft, ash handling system, Dust collection system,Feed water treatment and condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, feed heating, reheating , flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency, Site selection of a steam power plant.

Unit-III

Diesel power plant

General layout, Components of Diesel power plant, Performance of diesel power plant, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant, Comparative study of diesel power plant with steam power plant.

Gas turbine power plant

Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants, Site selection of gas turbine power plant

Unit-IV

Nuclear power plant

Principles of nuclear energy, Lay out of nuclear power plant, Basic components of nuclear reactions, nuclear power station, Nuclear waste disposal, Site selection of nuclear power plants. Hydro electric station Hydrology, Principles of working, applications, site selection, classification and arrangements, hydro-electric plants, run off size of plant and choice of units, operation and maintenance, hydro systems, interconnected systems.

Non Conventional Power Plants

Introduction to non-conventional power plants (Solar, wind, geothermal, tidal) etc.

Unit-V

Electrical system Generators and generator cooling, transformers and their cooling, bus bar, etc.

Instrumentation Purpose, classification, selection and application, recorders and their use, listing of various control rooms.

Pollution Pollution due to power generation References

Text/References:

1. “Power Plant Engineering” F.T. Morse, Affiliated East-West Press Pvt. Ltd, New Delhi/Madras.
2. “Power Plant Engineering” Mahesh Verma, Metropolitan Book Company Pvt. Ltd. New Delhi.

BME-011 : FLUID MACHINERY

Unit-I

Introduction:

Classification of Fluid Machines & Devices, Application of momentum and momentum equation to flow through hydraulic machinery, Euler’s fundamental equation.Impact of jet: Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat *&* curve), Effect of inclination of jet with the surface.

Hydraulic Turbines: 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, Cavitation 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, Model testing, Cavitation & separation and their control, Performance characteristics.

Unit-IV

Positive Displacement Pumps: Reciprocating pump theory, Slip and coefficient of discharges, Indicator diagram, Effect and acceleration, Work saved by fitting air vessels, Comparison of centrifugal and reciprocating pumps, Positive rotary pumps, Gear and Vane pumps, Performance characteristics.

Unit-V

Other Machines: Hydraulic accumulator, Special duty pumps, Intensifier, Hydraulic press, Lift and cranes, Theory of hydraulic coupling and torque converters, Performance characteristics. Water Lifting Devices : Hydraulic ram, Jet pumps, Air lift pumps.

Text/References:

Hydraulic Machines by Jagdish Lal, Metropolitan book co. pvt ltd.
Hydraulic Machines: Theory & Design, V.P.Vasandhani, Khanna Pub.
Applied Hydraulics by Addison
Hydraulic Machines by R K Rajput, S.Chand & co Ltd.
Hydraulic Machines by D S Kumar

BME -012 : UNCONVENTIONAL MANUFACTURING PROCESSES

Unit-I

Introduction: Limitations of conventional manufacturing processes, need of unconventional manufacturing processes & its classification and its future possibilities.

Unit-II

Unconventional Machining Process: Principle and working and applications of unconventional machining process such as Electro-Discharge machining, Electro-chemical machining, ultrasonic machining, Abrasive jet machining etc.

Unit-III

Unconventional Machining Process (continued) : Principle and working and application of unconventional machining processes such as Laser beam machining, Electron beam machining, Ultrasonic machining etc. (these can also be used for welding).

Unit-IV

Unconventional welding processes: Explosive welding, Cladding etc. Under water welding, Metalizing, Plasma are welding/cutting etc.

Unit-V

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: Brief description of Diffusion and Photo- Lithography process for electronic-device manufacturing.

Text/References:

1. Modern Machining Processes – P.C. Pandey
2. Unconventional Machining – V.K. Jain

BME -013 : PRODUCT DEVELOPMENT AND DESIGN

Unit-I

Introduction to Product Design

Introduction to PDD, Applications, Relevance, Product Definition, Scope, Terminology. Design definitions, the role and nature of design, old and new design methods, Design by evolution. Examples such evolution of bicycle, safety razor etc. Need based development, technology based developments. Physical reliability & Economic feasibility of design concepts.

Unit-II

Morphology of Design

Divergent, transformation and convergent phases of product design. Identification of need, Analysis of need. Design for what? Design criteria, functional aspects. Aesthetics, ergonomics, form (structure). Shape, size, color. Mental blocks, Removal of blocks, Ideation Techniques. Creativity, Checklist.

Unit-III

Transformations

Brainstorming & Synectics. Morphological techniques. Utility concept, Utility value, Utility index. Decision making under multiple criteria. Economic aspects of design. Fixed and variable costs. Break-even analysis.

Unit-IV

Reliability

Reliability considerations, Bath tub curve, Reliability of systems in series and parallel. Failure rate, MTTF and MTBF. Optimum spares from reliability consideration. Design of displays and controls, Man-Machine interface, Compatibility of displays and controls. Ergonomic aspects. Anthropometric data and its importance in design. Applications of Computers in product design.

Unit-V

Product Appraisal

Information and literature search, patents, standards and codes. Environment and safety considerations. Existing techniques such as work-study, SQC etc. which could be used to improve method & quality of product. Innovation versus Invention. Technological Forecasting.

Text/References:

1. Product Design & Manufacturing - A.K.Chitab & R.C.Gupta, PHI (EEE).
2. The Technology of Creation Thinking - R.P. Crewford – Prentice Hall
3. The Art of Thought – Grohem Walls – Bruce & Co., New York
4. Product Design & Decision Theory - M.K. Starr - Prentice Hall
5. Engg . Product Design -C .D. Cain, Bussiness Books.
6. Industrial design for Engineers –W .H. Mayall, Itiffe.
   Design Methods – seeds of human futures – J. Christopher Jones, John Wiley & Sons.
7. Human Factor Engg. – Mccormick E.J., Mc GrawHill.
8. Engineering: An Introduction to Creative profession – G.C. Beakley Hw leach, Macmillan.
9. Industrial Design In Engineering – A marriage of Techniques – Charles H . Flurscheim, The Design Council - London.
10. Quality Control & Reliability Analysis – Bijendra Singh, Khanna Publications.

BME-014 : RELIABILITY ENGINEERING

Unit-I

Introduction:

Definition of reliability, types of failures, definition and factors influencing system effectiveness, various parameters of system effectiveness.

Unit-II

Reliability Mathematics:

Definition of probability, laws of probability, conditional probability, Bay's theorem; various distributions; data collection, recovery of data, data analysis Procedures, empirical reliability calculations.

Unit-III

Reliability:

Types of system- series, parallel, series parallel, stand by and complex; development of logic diagram, methods of reliability evaluation; cut set and tieset methods, matrix methods event trees and fault trees methods, reliability evaluation using probability distributions, Markov method, frequency and duration method.

Unit-IV

Reliability Improvements:

Methods of reliability improvement, component redundancy, system redundancy, types of redundancies-series, parallel, series - parallel, stand by and hybrid, effect of maintenance.

Unit-V

Reliability Testing:

Life testing, requirements, methods, test planning, data reporting system, data reduction and analysis, reliability test standards.

Text/References:

1. R.Billintan & R.N. Allan,"Reliability Evaluation of Engineering and Systems", Plenum Press.
2. K.C. Kapoor & L.R. Lamberson,"Reliability in Engineering and Design", John Wiely and Sons.
3. S.K. Sinha & B.K. Kale,"Life Testing and Reliability Estimation", Wiely Eastern Ltd.
4. M.L. Shooman, "Probabilistic Reliability, An Engineering Approach", McGraw Hill.
5. G.H.Sandler,"System Reliability Engineering", Prentice Hall.

BME-015: COMPUTER AIDED MANUFACTURING (CAM)

Unit-I

Automation

Introduction to CAM; Automated Manufacturing system; Need of automation, Basic elements of automation, Levels of automation, Automation Strategies, Advantages & disadvantages of automation, Historical development and future trends.

Features of NC Machines-

Fundamental of Numerical Control, elements of NC machine tools, classification of NC machine tools, Advantages, suitability and limitations of NC machine tools, Application of NC system, Methods for improving Accuracy considering the factors such as tool deflection and chatter and Productivity.

Unit-II

NC Part Programming-

(a) Manual (word address format) programming. Examples Drilling, Turning and Milling; Canned cycles, Subroutine, and Macro.

(b) APT programming. Geometry, Motion and Additional statements, Macro- statement.

Unit-III

System Devices

Introduction to DC motors, stepping motors, feed back devices such as encoder, counting devices, digital to analog converter and vice versa.

Interpolators

Digital differential Integrator-Principle of operation, exponential decelarion; DDA Hardware Interpolator- Linear, Circular; DDA Software Interpolator.

Control of NC Systems

Open and closed loops. Control of point to point systems- Incremental open loop control, Incremental close loop, Absolute close loop; Control loop in contouring systems; Adaptive control.

Unit-IV

Computer Integrated Manufacturing system

Group Technology, Flexible Manufacturing System, CIM, CAD/CAM, Computer aided process planning-Retrieval and Generative, Concept of Mechatronics, Computer aided Inspection.

Unit-V

Robotics

Types and generations of Robots, Structure and operation of Robot, Robot applications. Economics, Robot programming methods. VAL and AML with examples.

Intelligent Manufacturing Introduction to Artificial Intelligence for Intelligent manufacturing.

Text/References:

1. Automation, Production Systems and Computer Integrated Manufacturing by Mikell P.Groover
2. Computer Aided Manufacturing by Kundra and Rao
3. Computer control of Manufacturing systems by Koren
4. NC Machine Tools by S.J. Martin.
5. NC Machines by Koren
6. CAD/CAM by Groover.

BME-016 : ADVANCED FLUID MECHANICS

Unit-I

Review of kinematics of fluid motion, method of describing fluid motion, translation, rate of deformation, the material derivatives, acceleration, vorticity in cartesian & polar coordinates, Reynolds transport theorem, Stress at a point, velocity profile, wall shear stress.

Unit-II

Non-viscous incompressible flow- Equation of continuity, Euler's equation of motion, Bernoulli's equation, circulation and its theorem, stress function, velocity potential, irrotational flow, two dimensional source, sink, source-sink pair, doublet vortex, superposition of source-sink with rectilinear flow, Rankine body, Superposition of rectilinear flow and doublet, flow around a spinning circular cylinder, Magnus effect, lift & Drag, Skin friction. Lift of aerofoils.

Unit-III

Boundary layer Concept-Introduction to boundary layer formation, Novier-stokes equation, Boundary layer thickness, momentum thickness, energy thickness, Boundary layer equations, Momentum-Integral equation - Von Korman, Blasius solution of boundary layer on a flat plate without pressure gradient, Flow with very small Reynolds number, Hogen poisseuille flow, Plane Couette flow, Hydrodynamic theory of lubrication.

Unit-IV

Compressible flow- Propagation of pressure change, sound velocity, elastic waves, Mach number, Mach cone, isentropic flow relations in terms of sonic velocity and mach number, Stagnation properties, Regions of flow, Energy equation, Effect of Mach number on compressibility. Propagation of infinitesimal waves, Non-steep finite pressure wave and steep finite pressure waves, Expansion waves Isentropic flow with variable area, Mach number variation and its effect on Flow through nozzles and diffusers. Area ratio, impulse function, Use of Gas/Air tables.

Unit-V

Flow with normal shock waves- Development of shock wave, rarefaction wave, governing equations, Prandtle-Meyer relation. Thermodynamic properties across shock.
Wind tunnels.

Flow in constant area duct with friction-Fanno curves, Fanno flow equations, Solution of fanno flow equations. Variation of flow properties. Tables & charts for Fanno flow.

Flow in constant area duct with heat transfer- Rayleigh line, Fundamental equations, Rayleigh flow relation, Variation of flow properties. Tables & Charts for Rayleigh flow.

Text/References:

1. Fluid Mechanics by White.
2. Fluid Mechanics by Streeter
3. Fluid Mechanics by Som & Biswas
4. Fluid Mechanics by K.L. Kumar
5. Fluid Mechanics by A.K. Jain
6. Fluid Mechanics by Robert W. Fox & Alan T. Mc Donald, Wiley Students Edition
7. Fundamentals of Compressible flow by S.M. Yahya
8. Gas Dynamics by Z. Hussain
9. Viscous fluid flow by White
10. Computational Fluid Dynamics by Anderson
11. Gas Dynamics by E. Radhakrishnan
12. Fluid Mechanics by Kundu & Cohen, Academic Press, Elsevier

BME-017: ADVANCED DYNAMICS OF MACHINES

Unit-I

Dynamic Analysis of Mechanisms and Machines: Introduction, Motion of Rigid Body under a System of Forces, Principle of Virtual Work, D'Alembert's Principle and Dynamic Equilibrium, Dynamic Force Analysis, Stresses in Moving Members, Motion Analysis, Equivalent Force and Mass Method.

Unit-II

Dynamics of Direct Acting Engine Mechanisms: Introduction, Piston Motion, Turning Moment on Crank-Shaft, Dynamically Equivalent Link, Approximate Expression for Turning Moment, Correction to the Approximate Expression, Turning Moment Diagram, Fluctuation of Crank-Shaft Speed, Flywheel Analysis.

Unit-III

Balancing of Inertia Force and Moments in Machines: Introduction, Balancing of Rotating Masses, Two-Plane Balancing, Determination of Balancing Masses, Balancing of Internal Combustion Engines.

Unit-IV

Gyroscopic action in Machines: Introduction, Motion of a Rigid Body in Three- Dimensions, Principal Axes, Angular Velocity and Momentum about Principal Axes, Euler's Equation of Motion, Euler's Modified Equation, Simple Precession of a Symmetrical Gyroscope in Angular Precession, Gyroscopic Effects in Machines, Gyroscopic Stabilization.

Unit-V

Dynamics of Rotating Shafts: Introduction, Critical Speed, Shaft with an Unbalanced Disc at Mid-Span, Generalized Forces, Lagrange's Equation of Motion, Gyroscopic Effect on Critical Speed.

Text/References:

1. Theory of Mechanisms and Machines by Amitabh Ghosh and Ashok Kumar Malik, Affiliated East- West Press Pvt. Ltd, New Delhi.
2. Theory of Machines and Mechanisms by Joseph Edward Shigley and John Joseph Uicker, J.R. International Student Edition, Mc-Graw Hill International Company.

BME-018: MANAGEMENT INFORMATION SYSTEM

Unit-I

Organisation & Types, Decision Making, Data & information, Characteristics & Classification of information, Cost & value of information, Various channels of information & MIS.

Unit-II

Foundation of Information System : Introduction to Information System in Business Fundamentals of Information System, Solving Business Problems with Information System, Concept of Balanced MIS, Effectiveness & Efficiency Criteria. Tool and Techniques of MIS- dataflow diagram, flow chart etc.

Unit-III

Business application of information technology, electronic commerce, Internet, Intranet, Extranet & Enterprise Solutions, Information System for Business Operations, Information system for managerial Decision Support, Information System for Strategic Advantage.

Unit-IV

Managing Information Technology, Enterprise & Global Management, Security & Ethical Challenges, Planning & Implementing Change.Reports: Various types of MIS reports, GUI & Other Presentation tools.

Unit-V

Advancedconcepts ininformatio system: Enterprise Resource Planning: introduction, various modules like Human Resources, Finance, Accounting, Production & Logistics. Supply Chain Management, CRM, Procurement Management System Object Oriented modeling case studies.

Text/References:

1. O.Brian, "Introduction to Information System", Mc-Graw Hill.
2. O.Brian, "Management Information System", TMH.
3. Alter, "Information Systems : A Management Perspective", Addison Wesley.
4. Arora & Bhatia, "Information Systems for Managers", Excel
5. Bansal, "Information System Analysis & Design", TMH.
6. Jawadegar, "Management Information System", TMH.
7. Murdick, "Information System for Modern Management", PHI.
8. Alexis Leon, "Enterprise Resource Planning", TMH.

BME-019: THERMAL TURBO MACHINES

Unit-I

Brief history of turbo machinery, introduction to blowers, pumps, compressors, steam & gas turbines, turbojet, Review of laws of thermodynamics & SFEE in reference to turbo machinery, Energy transfer in turbo machines, Euler's equation, Definition of various efficiencies, Preheat factor, Reheat factor, Blade classification, Blade terminology, Cascade testing, Velocity diagrams for axial and radial turbomachinery and pumps.

Unit-II

Centrifugal compressors- Principle of operation, work done and pressure rise, Velcoity diagram for centrifugal compressor, Slip factor, Stage pressure rise, Loading coefficient, Diffuser, degree of reaction, Effect of impeller blade profile, Pre-whirl and inlet guide vanes, Centrifugal Compressor characteristic curves.

Unit-III

Axial flow compressor- Principle of operation and working, Energy transfer, Velocity diagram for axial compressor, Factors affecting stage pressure ratio, Blockage in compressor annulus, Degree of reaction, 3-D flow, Design process, blade design, calculation of stage performance, Axial compressor performance characteristic curves.

Axial flow turbines-Elementary theory of axial flow turbine, Energy transfer, Velocity diagram, Types of blades, Vortex theory, Choice of blade profile, pitch and chord, Estimation of stage performance, Characteristic curves.

Unit-IV

Steam turbines- Constructional details, working of steam turbine.

Pumps : Classification of Pumps, Main components, indicator diagram and modification due to piston acceleration, Performance characteristics, Cavitation and its control, Miscellaneous types of pumps.

Radial flow turbines: Elementary theory of radial flow turbines, Enthalpy- Entropy diagram, State losses, Estimation of stage performance, Performance characteristics.

Unit-V

Gas Turbine Starting & Control Systems: Starting ignition system, Combustion system types, Safety limits & control.

Turbine Blade coding: Different cooling techniques, Types of coolants, Comparative evaluation of different cooling techniques.

Mechanical Design consideration: Overall design choices, Material selection, Design with traditional materials.

Text/References:

1. Gas turbine theory : Cohen & Rogers, Addison Weslay Longman Ltd.
2. Design of high efficiency turbomachinery and gas turbines, David Gordon Wilson, Theodosios Korakianitis, Prentice Hall International.
3. Turbomachinery : S.M. Yahya.
4. Turbine, Compressors and Fans, S.M. Yahya, Tata Mc Graw Hill.
5. Gas Turbine- Ganeshan, Tata Mc Graw Hill.

BME-020 : MECHANICAL SYSTEM DESIGN

Unit-I

Engineering process and System Approach

Basic concepts of systems, Attributes characterizing a system, system types, Application of system concepts in Engineering, Advantages of system approach, Problems concerning systems, Concurrent engineering, A case study-Viscous lubrication system in wire drawing.

Problem Formulation

Nature of engineering problems, Need statement, hierarchical nature of systems, hierarchical nature of problem environment, problem scope and constraint, A case study: heating duct insulation system, high speed belt drive system

Unit-II

System Theories : System Analysis, Black box approach, state theory approach, component integration approach, Decision process approach, A case study- automobile instrumentation panel system.

System modeling: Need of modeling, Model types and purpose, linear systems, mathematical modeling, concepts, A case study compound bar system

Unit-III

Graph Modeling and Analysis: Graph Modeling and analysis process, path problem, Network flow problem, A case study: Material handling system

Optimization Concepts : Optimization processes, Selection of goals and objectives-criteria, methods of optimization, analytical, combinational, subjective. A case study: aluminium extrusion system.

Unit-IV

System Evaluation

Feasibility assessment, planning horizon, time value of money, Financial analysis, A case study: Manufacture of maize starch system

Calculus Method for Optimization

Model with one decision variable, model with two decision variables, model with equality constraints, model with inequality constraints, A case study: Optimization of an insulation system.

Unit-V

Decision Analysis

Elements of a decision problem, decision making, under certainty, uncertainty risk and conflict probability, density function, Expected monetary value, Utility value, Baye's theorem, A case study: Installation of machinery

System Simulation: Simulation concepts, simulation models, computer application in simulation, spread sheet simulation, Simulation process, problem definition, input model construction and solution, limitation of simulation approach, a case study: Inventory control in production plant.

Text/References:

1. Design and Planning of Engineering systems-DD Reredith, KV Wong, RW Woodhead, and RR Worthman, Prentice Hall Inc., Eaglewood Cliffs, New Jerse
2. Design Engineering-JR Dixon, TMH, New Delhi
3. An Introduction to Engineering Design Method-V Gupta and PN Murthy, TMH, New Delhi
4. Engineering Design-Robert Matousck, Blackie and son ltd. Glasgow
5. Optimization Techniques-SS Rao
6. System Analysis and Project Management-Devid I Cleland, William R King, McGraw Hill.

BME-021 : INDUSTRIAL ERGONOMICS

Unit-I

Introduction: Importance applications and principles of occupational ergonomics.

Physiological Principles: Muscular work, Nervous control of movements, Improving working efficiency. Optimal use of muscle strength. /Guidelines for work layout.

Skilled work: Acquiring skill, control of skilled movements. Design of tools and equipments for skilled work.

Unit-II

Heavy work: Energy consumption, Efficiency, Heart rate as a measure of workload.

Work-station Design: Anthropometric data, Reach and clearance dimensions. Percentiles to be accommodated.

Unit-III

Working Heights: Comfortable working postures. Room to grasp or move things, and operate controls. Sedentary work. Its advantages,disadvantages and limitation. Sedentary workplace design. Design of VDT workstations, Design of Key board.

Handling Lads: The Human spine, back troubles associated with industrial work, Intervertebral disc, disc pressure, slip of disc, Bio-mechanical models of lower back. Recommendations for handling loads.

Man-Machine System: Display equipment, Controls, Relation between control and display instruments, Mental activity, Fatigue, Occupational stress, Job design inmonotonous task.

Unit-IV

Human Visual System: Accommodation, Aperture of the pupil, Adaptation of reline, eye movements Visual capacity, Visual strain, Physiology of reading.

Ergonomic Principles of Lighting: Light sources, measurement, physiological requirements of artificial lighting, arrangement of light. Light for fine work and for VDT offices.

Unit-V

Noise and Violation: Sound perception, Noise load, damage to hearing, physiological and psychological effects of noise. Protection against noise, Vibrations and their effect on performance.

Working Environment: Thermo-regulation in human body, comfort indoors, Air quality and its dryness, Air pollution and ventilation. Heat in industry Recommendations for comfort indoors. Daylight, colours and music for pleasant work environment.

Text/References:

1. Fitting the task to the Man, E. Gandjean, Taylor and Francis.
2. A guide to Ergonomics of Manufacturing, Helander, M., East-West Press.
3. Human Factor in Engineering and Design, Sanders, M.S., and Mc Cormik, E.J., Mc Graw.Hill

BME-022: CONCURRENT ENGINEERING

Unit-I

Introduction: Background and challenges faced by modern production environment, sequential Engineering process, Concurrent engineering definition and requirement, meaning of concurrent objectives of CE, benefits of CE, Life cycle design of products, life cycle costs.

Support for CE: Classes of support for CE activity, CE organizational, structure CE, team composition and duties, Computer based Support, CE Implementation Process.

Unit-II

Design Product for Customer Industrial Design, Quality Function Deployment, house of quality, Translation process of quality function deployment (QFD).

Modeling of Concurrent Engineering Design: Compatibility approach, Compatibility index, implementation of the Compatibility

model, integrating the compatibility Concerns.

Unit-III

Design for Manufacture (DFM)

Introduction, role of DFM is CE, DFM methods, e.g. value engineering, DFM guidelines, design for assembly, creative design methods, product family themes, design axioms,
Taguchi design methods, Computer based approach to DFM. Evaluation of manufacturability and assemblability.

Unit-IV

Quality by Design

Quality engineering & methodology for robust product design, parameter and Tolerance design, Quality loss function and signal to noise ratio for designing the quality, experimental approach.

Unit-V

Design for X-ability

Design for reliability, life cycle serviceability design, design for maintainability, design for economics, decomposition in concurrent design, concurrent design case studies.

Text/References:

1. Concurrent Engineering Kusiak John Wiley
2. Concurrent Engineering Menon Chapman & hall

BME-023 : MAINTENANCE ENGINEERING & MANAGEMENT

Unit-I

Introduction, operating life cycle, reliability, Failure data analysis, failure rate curve, hazard models, elements in series, parallel, mix, logic diagrams, improving reliability,
redundancy-element, unit, standby, maintainability, availability, reliability and maintainability trade off.

Unit-II

Maintenance Strategies: Break down maintenance, planned maintenance, strategies, preventive maintenance, design out maintenance, planned lubrication, total productive maintenance, zero break down, preventive inspection of equipment used in emergency.

Unit-III

Replacement planning maintain or replace decision, replacement of items that deteriorate identical equipment, replacement of items that fail without deterioration individual, group replacement, replacement in anticipation of failure.

Unit-IV

Break down maintenance planning, assignment model, waiting time models expected waiting time, minimum cost service rate, PERT.

Unit-V

Maintenance Management, production maintenance system, objectives and functions, forms, policy, planning, organization, economics of maintenance, manpower planning, materials planning, spare parts planning and control, evaluation of maintenance management.

Text/References:

1. Management of systems – R.N. Nauhria & R. Prakash.
2. Operations Research – Wangner.

BME-024 : DESIGN OF THERMAL SYSTEMS

Unit-I

Psychrometry of Air Conditioning Processes, Design Conditions & Load Calculations Psychrometric Processes in Air Conditioning Equipments, Analysis of Air Conditioning systems for summer & winter conditions, inside & out side design conditions for comfort, Industrial Air Conditioning.

Unit-II

Cooling & Heating Load calculations- Heat transfer through building structures, solar heat gain, Infiltration & ventilation air, Internal heat gain, Occupancy & Product load, Room sensible heat factor, Effective sensible heat factor & Grand sensible heat factor, capacity of the plant.

Design & Selection of Air conditioning Apparatus

Heat & moisture transfer in Air conditioning apparatus, Enthalpy potential, Analysis of Coil & Spray Equipments Design of Cooling & Dehumidifying coils, Design of Air Washer & Cooling Towers.

Unit-III

Analysis of Complete Vapour Compression System – Design and Balancing of System Components. Type of Refrigerant Compressors, Condensers, Evaporators & Expansion devices used in Vapour Compression Refrigeration Cycles, Design and Selection of individual components and their performance characteristics, Use of P-H charts for different Refrigerants in performance predication of the cycle. Analysis of the complete vapour-compression-system and determination of 'Balance Points' using Graphical and Analytical methods, system simulation. Layout & selection of Refrigerant, water and Brine pipings for the designed system. Selection of Refrigeration and Air conditioning Controls for the system.

Unit-IV

Design of Turbomachines:

Principles of Design of turbo machines, Design of axial flow turbine stage, Design of axial flow compressor stage, Design of centrifugal compressor.

Design of Heat Exchanger :

Study of design aspects, fluid flow and heat transfer characteristics, Material requirement of heat exchange equipments, Liquid – to liquid and Liquid – to – gas heat exchange systems, Familiarity with use of design related standards and codes, Design of Heat exchanger.

Unit-V

Optimization of design of thermal systems like condenser, evaporator, cooling tower for minimum cost and maximum performance, Development of computer program for design, Environmental consideration in design of thermal systems, Analysis of thermal systems using FEM.

Text/References:

1. Refrigeration & Air Conditioning - By C.P. Arora
2. Refrigeration & Air Conditioning - By Manohar Prasad
3. Principles of Refrigeration (S.I.Units) - By Roy J.Dossat
4. Air Conditioning Engineering - By W,P.Jones
5. Heating, Ventilating and Air Conditioning - By Mc Quistion, Parker & Spitler
6. Refrigeration & Air Conditioning Data Book – Manohar Prasad
7. Ashrae hand Book – Fundamentals
8. Refrigeration & Air Conditioning-Stoecker & Jones
9. Refrigeration & Air condioning – By P.L.Ballaney

BME-025 : ADVANCED SYNTHESIS OF MECHANISM

Unit-I

Introduction:

Mechanisms, Classifications, Relative & absolute motion, degree of freedom, 4-bar mechanisms-planar & spatial mechanisms, Inversion and equivalent linkage, Transmission deviation and pressure angles Kinematic analysis of Planer motion **Relative velocity and velocity difference, Instantaneous centre, Poles and centrodes, Relative acceleration, acceleration difference**

Unit-II

Kinematic Synthesis:Type, number and dimensional synthesis, spacing of accuracy points, Chebyshev polynomials

Four bar coupler point curves:

Four bar linkage, Equation of coupler curves, Double points and symmetry, Robert hebyshev theorem, Approximate and exact straight line mechanisms

Unit-III

Geometrical Method of Synthesis:

Poles and relative poles of four bar linkage, Poles and relative poles of slider crank mechanism, Synthesis with three accuracy points, Pole triangle, Four position synthesis, Examples

Unit-IV

Algebraic Methods of Synthesis-I:

Displacement equation of four bar linkage, Crank and follower synthesis with three accuracy points, Four bar function generator with three accuracy points, Crank and follower synthesis: angular velocities and accelerations

Unit-V

Algebraic Methods of Synthesis-II:

Synthesis of slider crank mechanism with three accuracy points, Synthesis of slider crank mechanism with four accuracy points, Five accuracy points synthesis of crank and follower mechanism, Analysis of mechanical errors in linkage, Mechanical error in four
bar linkage

Text/References:

1. Kinematic Synthesis of Linkages RS Hartenberg and J Denavit McGraw Hill, NewYork
2. Kinematic and Linkage Design AS Hall Jr Prentice Hall India Ltd.
3. Mechanism and Machine Theory Amitabh Ghosh and AK Mallick
4. Mechanism Design: Analysis & Synthesis Erdman & Sandor Prentice Hall of India

BME-026: Six Sigma Methods & Application

Unit-I

Quality Perception; Quality in Manufacturing, Quality in Service Sector; Differences between Conventional and Six Sigma concept of quality; Six Sigma success stories. Statistical foundation and methods of quality improvement. Descriptive statistics: Data Type, Mean, Median, Mode, Range, Variation, Standard Deviation, Skewness, Kurtosis. Probability Distribution: Normal, Binomial, Poisson distribution

Unit-II

Basics of Six Sigma: Concept of Six Sigma, Defects, DPMO, DPU, Attacks on X'S, Customer focus, Six Sigma for manufacturing, Six Sigma for service. Z score, Understanding Six Sigma organization, Leadership council, Project sponsors and champions, Master Black Belt, Black Belt, Green Belts.

Unit-III

Methodology of Six Sigma, DMAIC, DFSS, Models of Implementation of Six Sigma, Selection of Six Sigma Projects.

Unit-IV

Six Sigma Tools: Project Charter, Process mapping, Measurement system analysis, Hypothesis Testing, Quality Function deployment, Failure mode effect analysis, Design of Experiments.

Unit-V

Sustenance of Six Sigma, Communication plan, Company culture, Reinforcement and control, Introduction to softwares for Six Sigma, Understanding Minitab, Graphical analysis of Minitab plots.

Text/References:

1. Six Sigma: SPC and TQM in manufacturing and service, Geoff Tennant, Gower Publishing Co.
2. Six Sigma for managers, Greg Brue, TMH
3. What is Six Sigma, Pete Pande, TMH
4. The Six Sigma Way, Peter S. Pande, TMH Team Field book
5. The Six Sigma way, Peter S. Pande, TMH

OE06: QUALITY MANAGEMENT

Unit-I

Quality Concepts: Evolution of Quality control, concept change, TQM Modern concept, Quality concept in design, Review off design, Evolution of proto type.

Control on Purchased Product: Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure.

Manufacturing Quality: Methods and Techniques for manufacture, Inspection and control of product, Quality in sales and services, Guarantee, analysis of claims.

Unit-II

Quality Management: Organization structure and design, Quality function, decentralization, Designing and fitting organization for different types products and company, Economics of quality value and contribution, Quality cost, optimizing quality cost, seduction programme.

Human Factor in Quality: Attitude of top management, co-operation, of groups, operators attitude, responsibility, causes of operators error and corrective methods.

Unit-III

Control Charts: Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts.

Attributes of Control Charts: Defects, construction and analysis off-chart, improvement by control chart, variable sample size, construction and analysis of C-chart.

Unit-IV

Defects Diagnosis and Prevention: Defect study, identification and analysis of defects, corrective measure, factors affecting reliability, MTTF, calculation of reliability, Building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

Unit-V

IS0-9000 and its concept of Quality Management: ISO 9000 series, Taguchi method, JIT in some details.

Text/References:

1. Lt. Gen. H.LaI, "Total Quality management", Wiley Eastern Limited, 1990. .
2. Greg Bounds. “Beyond Total Quality Management”. McGraw Hill, 1994.
3. Menon, H.G, "TQM in New Product manufacturing", McGraw Hill 1992

OE-25: PRODUCT DEVLOPEMENT

Unit-I

Concept of product, definition and scope. Applications, Relevance, Product Definition, Scope, Terminology. Design definitions, the role and nature of design, old and new design methods, Design by evolution. Need based development, technology based developments.

Unit-II

Morphology of Design, Divergent, transformation and convergent phases of product design. Identification of need, Analysis of need. Aesthetics, ergonomics, form (structure). Shape, size, color. Mental blocks, Removal of blocks, Ideation Techniques. Creativity, Checklist.

Unit-III

Transformations , Brainstorming & Synectics. Morphological techniques. Utility concept, Utility value, Utility index. Decision making under multiple criteria. Economic aspects of design. Fixed and variable costs. Break-even analysis.

Unit-IV

Reliability considerations, Bath tub curve, Reliability of systems in series and parallel. Failure rate, MTTF and MTBF. Optimum spares from reliability consideration.

Unit-V

Patents, standards and codes. Environment and safety considerations. Existing techniques such as work-study, SQC etc. which could be used to improve method & quality of product. Innovation versus Invention. Technological Forecasting.

Text/References:

1. Product Design & Manufacturing - A.K.Chitab & R.C.Gupta, PHI (EEE).
2. The Technology of Creation Thinking - R.P. Crewford – Prentice Hall
3. The Art of Thought – Grohem Walls – Bruce & Co., New York
4. Product Design & Decision Theory - M.K. Starr - Prentice Hall
5. Engg . Product Design -C .D. Cain, Bussiness Books.
6. Industrial design for Engineers –W .H. Mayall, Itiffe.
   Design Methods – seeds of human futures – J. Christopher Jones, John Wiley & Sons.
7. Human Factor Engg. – Mccormick E.J., Mc GrawHill.
8. Engineering: An Introduction to Creative profession – G.C. Beakley Hw leach, Macmillan.
9. Industrial Design In Engineering – A marriage of Techniques – Charles H . Flurscheim, The Design Council - London.
10. Quality Control & Reliability Analysis – Bijendra Singh, Khanna Publications.