Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

Proposed Syllabus Structure of T.E. (Mechanical Engineering) w.e.f. Academic Year 2013-14

Part-I

Subject No.	Subject	Contact Hours / Week				Examination Scheme						Remark
		L	T	P	Total	TH	CT	TW	P	Total	Duration of Theory Examination	
MED301	Design of Machine Elements-I	4		2	6	80	20			100	3	
MED302	Theory of Machines-II	4		2	6	80	20			100	3	
MED303	Metallurgy and Materials	4		2	6	80	20			100	3	
MED304	Fluid Mechanics and Machinery	4		2	6	80	20			100	3	
MED305	Industrial Management and Engineering Economics	4			4	80	20			100	3	
MED321	Lab-I Design of Machine Elements-I							25	25	50		
MED322	Lab-II Theory of Machines-II							50		50		
MED323	Lab-III Metallurgy and Materials							25		25		
MED324	Lab-IV Fluid Mechanics and Machinery							25	25	50		
BSH 331	Lab-V Communication Skills -II			2	2				50	50	01	Online Exam
MED326	Lab-VI Workshop-V			2	2			25		25		
	Total	**20**		**12**	**32**	**100**	**400**	**125**	**125**	**750**		

Part-II

Subject No.	Subject	Contact Hours / Week				Examination Scheme						Remarks
		L	T	P	Total	CT	TH	TW	P	Total	Duration of Theory Examination	
MED351	Design of Machine Elements-II	4		2	6	20	80			100	3	
MED352	Heat Transfer	4		2	6	20	80			100	3	
MED353	Industrial Hydraulics and Pneumatics	4		2	6	20	80			100	3	
MED354	Tool Engineering	4		2	6	20	80			100	4	
MED355	CAD / CAM / CAE	4		2	6	20	80			100	3	
MED356	Mechanical Measurements	2		2	4	10	40			50		Online Exam
MED371	Lab-VII Design of Machine Elements-II							25		25		
MED372	Lab-VIII Heat Transfer							25	25	50		
MED373	Lab-IX Industrial Hydraulics and Pneumatics							25		25		
MED374	Lab-X Tool Engineering							25	25	50		
MED375	Lab-XI CAD / CAM / CAE							25	25	50		
	Total	**22**		**12**	**34**	**110**	**440**	**125**	**75**	**750**		

L: Lecture hours per week T: Tutorial Hours per week P: Practical hours per week

TH: University Theory Examination TW: Term Work P: Practical / Oral Examination

MED301-DESIGN MACHINE ELEMENTS – I

Teaching Scheme
Lectures: 4 Hrs/Week

Examination Scheme
Theory Exam : 80 Marks (3 Hrs)
Class Test: 20 Marks

Objectives:

- Understand the meaning of design and design process.
- Predict effectively and accurately the reasons of failure and then correlate it to the theoretical knowledge.
- Developing the capability to analyze and select the various criteria of design.
- Developing creativity for designing the various types of fasteners including riveted joints and welding joints at various loading conditions.

Unit 1 : Fundamental Aspect of Design (7 Hrs)

1. The meaning of design, Engineering design, Phases of design, design classification, Aesthetic, Ergonomic & general design consideration, use of standards in design, preferred series.
   Material properties & selection of materials, BIS designation.
2. Types of loads and stresses. Stress strain diagram, Factor of safety, Direct stresses, bending stresses, Necessity of Theories of failure, Two dimensional stress condition, Different theories of failure and combined stresses. Design of C- clamp & C-frame.

Unit 2: (8 Hrs)

(A) **Design against static loading:** Design of Cotter joint single and double cotter joint. Design of knuckle joint. Design of lever.

(B) **Design of shaft, keys and coupling:** Shafts subjected to bending and torsion, types of keys and their design, design of rigid and flexible couplings.

Unit 3: Design of screw and fasteners (5 Hrs)

Design of bolted and threaded joints, design of power screws, introduction to re-circulating ball screw.

Unit 4: Design against fluctuating load (7 Hrs)

Stress concentration, fatigue failure, endurance limit, notch sensitivity, Goodman, Soderberg diagrams, and modified Goodman diagram, fatigue design under combined stresses.

Unit 5: Design of welded and Riveted joint: (6 Hrs)

(A) Types of welded joints, eccentrically loaded joints, welded joints subjected to bending moment.

(B) Types of riveted joints, , Types of failure of riveted joints, Strength equation. Caulking and Fullering of riveted, eccentrically loaded joints.

Unit 6: Design of Spring (7 Hrs)

Terminology and types of spring, Design of helical spring against static loading, A.M. Wahl correction factor, Design against fluctuating load, Surging and Buckling of spring, design of multi leaf spring, Nipping.

Section A: Unit 1, 2 and 3
Section B: Unit 4, 5 and 6

Reference Books

1. Shigley J.E. and Mischke C.R.,"Mechanical Engineering Design", McGraw Hill Publications Co. Ltd.
2. Bhandari V. B., "Introduction to Machine Design", Mc Graw Hill
3. Bhandari V.B., "Design of Machine Elements", Tata McGraw Hill Publ. Co. Ltd.
4. Spotts M.F. and Shoup T.E., " Design of Machine Elements", Prentice Hall International.
5. Black P.H. and O. Eugene Adams, "Machine Design", McGraw Hill Book Co. Ltd.
6. "Design Data", P.S.G. College of Technology, Coimbatore.
7. Juvinal R.C., "Fundamentals of Machine Components Design", John Wiley & Sons.
8. Hall A.S., Holowenko A.R. and Laughlin H.G., "Machine Design", Schaum's outline series, Mc Graw Hill.
9. Kulkarni S. G., Machine Design, Mc Graw Hill
10. Ganesh Babu K. and Srithar K., "Design of Machine Elements", Mc Graw Hill

Pattern of Question Paper

The units in the syllabus are divided in two equal sections. Question paper consists of two sections A and B. Section A includes first three units (1, 2, and 3) and Section B includes remaining three units (4, 5 and 6). Question paper should cover the entire syllabus.

For 80 marks Paper:

1. Five questions in each Section
2. Attempt any three questions from each Section.

MED302 -THEORY OF MACHINES-II

Teaching Scheme
Lectures: 4 Hrs/Week

Examination Scheme
Theory: 80 Marks (3 Hrs)
Class Test: 20 Marks

Objectives:

- Develop ability to come up with innovative ideas.
- To prepare the students for studying machine design and allied subjects.
- Select Suitable Drives and Mechanisms for a particular application.
- Understand the concept of Vibration.

Unit 1: Toothed Gears **(10 Hrs)**

Introduction, Gear terminology, types of gears and field of applications.

(A) **Spur Gears** :terminology of gearing, conjugate action, involute and cycloidal profile, path of contact, arc of contact, contact ratio, interference, undercutting, Methods to avoid interference and undercutting, Rack shift, Effect of center distance variation, friction between gear teeth, internal gears,

(B) **Helical and Herringbone gears**. Their relative merits and demerits over spur gear

(C) **Spiral Gears**- Spiral angle, shaft angle, centre distance & Efficiency of spiral gears.

(D) **Bevel Gears & Worm and worm gears :** Terminology, geometrical relationships,

(E) **Gear trains**: Types of gear trains.

Unit 2:Governor and Flywheel **(8 Hrs)**

A) Governors- Function, Inertia and centrifugal type governors, Different types of centrifugal governors (Watt, Porter, Proell and Hartnell only), Controlling force analysis, Governor effort and governor power, sensitivity, stability, Isochronism and hunting, Friction, Insensitiveness

B) Flywheel- Turning moment diagram, Fluctuation of energy and speed, Determination of flywheel size for different types of engines and machines.

Unit 3: Gyroscope **(4 Hrs)**

Introduction, Angular acceleration, Gyroscopic couple, Effect of gyroscopic couple on aeroplane, Naval ship, Stability of vehicles

Unit4: Friction Clutches **(4 Hrs)**

Types frictions, Friction laws, single plate& multiplate Cone clutch, Centrifugal clutch, Torque transmitting capacity, Clutch operating mechanisms.

Unit 5: Belt , Rope & chain Drives **(4 Hrs)**

Flat and Vee belt, Rope, Limiting tension ratio, Power transmitted, Centrifugal effect, Maximum power transmitted by belt, Slip, Creep and Initial tension.

kinematics of chain drives, angular velocity ratio, Construction of Bush and Roller chain, power transmitted by chain.

Unit 6: Vibration **(10 Hrs)**

Introduction, Cause, effects and terminology.

(A) **Single degree of freedom system:** undamped tree vibration. Development of differential equation of motion and its solution for different undamped systems. Computation of natural frequency.

(B) **Damped free vibrations**: differential equation of motion. Logarithmic decrement damping methods, Damped natural frequency of vibration (analysis of viscous damping only

(C) **Forced Vibrations:** vibration due to harmonic force excitation centric mass excitation, support excitation. Steady state response curves, phase lag angle. Motion and force transmissibility, seismic instruments

Section A: Unit 1, 2 and 3
Section B: Unit 4, 5 and 6

.

Reference Books

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, Mc Graw Hill
6. Kinematics of Machines-Dr. Sadhu Singh
7. Theory of Machines – Khurmi & Gupta
8. Theory of Machines – R. K. Bansal
9. Theory of Machines – V. P. Singh
10. Mechanical Vibrations by Grover G.K., Nemchand Publi.
11. Mechanical Vibrations by S.S.Rao, Pearson Education Publi
12. Mechanical Vibrations by V.P. Singh, Dhanpat Rai Publications.
13. Solved vibrations in Mechanical Vibrations, Schaums Series
14. Mechanical Vibrations by S Graham Kelly, Tata Mc Graw Hill
15. Mechanical Vibrations, Thammaiah Gowda, Jagadeesha T, D V Girish, Mc Graw Hill

Pattern of Question Paper

The units in the syllabus are divided in two equal sections. Question paper consists of two sections A and B. Section A includes first three units (1, 2, and 3) and Section B includes remaining three units (4, 5 and 6). Question paper should cover the entire syllabus.

For 80 marks Paper:

1. Five questions in each Section
2. Attempt any three questions from each Section.

MED303-METALLURGY AND MATERIALS

Teaching Scheme
Lectures: 4 Hrs/ Week.

Examination Scheme
Theory Examination: 80 Marks (3 Hrs)
Class Test: 20 Marks

Objectives:

1. To impart a fundamental knowledge about extraction of Steel & Cast Iron, their heat treatment process & industrial use.
2. To impart sound knowledge of different materials with their selection, properties for industrial application.

Unit 1: Structure of Materials and Strengthening Mechanism (7 Hrs)

Structure of Metals: Unit Cell, Space Lattice, types of Crystal structures, Miller Indices, Atomic Packing Factor, Coordination Number.

Solidification: Cooling curve for metals and alloys, Homogeneous & Heterogeneous Nucleation, Crystal growth, Grain boundaries, Equi-axised and Columnar Grain, Dendritic Pattern, Polymorphism.

Imperfections in Crystal: Point Defects, Line Defects, Surface and Bulk Defects.

Strengthening Mechanism : Introduction, Grain boundaries and deformation, strengthening from grain boundaries, Grain size measurement, Grain size reduction, solid solution strengthening/hardening, strengthening from fine particles, fiber strengthening, martensite strengthening, strain hardening, Bauschinger Effect.

Unit 2: Phase Diagram (6 Hrs)

Equilibrium Diagram: Importance of Equilibrium diagram, Gibbs's Phase Rule, Solid Solution & their types, Hume Rothery's rules, Types of phase diagram, Isomorphism, Eutectic, Peritectic and Eutectoid Reaction, Importance of lever rule.

Iron carbon equilibrium Diagram: Phases in the Fe–C system, Transformation Reactions, Critical Temperatures and their significance, The TTT diagram, CCT diagram.

Unit 3: Heat Treatment of Steels (10 Hrs)

Objective of heat treatment, types of heat treatment; **Annealing:** Stress Relieving, Full Annealing, Isothermal Annealing, Diffusion Annealing, Partial Annealing, Recrystallization Annealing, Process Annealing, Spherodising, **Normalizing**: Objective of Normalizing, Comparison of Normalizing v/s Annealing. **Hardening:** Hardening methods, Jominy End quench test, Hardening defects & Quench stresses Retained austenite, Sub-zero Treatment, **Tempering:** Objective of tempering, types, Temper brittleness, Temper Colors, Austempering, Martemparing, Patenting.

Surface and case hardening treatments: Carburizing, Nitriding, Surface hardening, etc.

Unit 4: Steel & Cast Irons (7 Hrs)

Steel: Classification of Steel, Specifications & their significance. (AISI, SAE Designation), Types of carbon steel: Low carbon steels, Medium Carbon steels, High carbon steels & their applications. **Alloy Steel**: classifications of alloying elements, effect of alloying elements on Fe-C, classifications of alloy steels: High strength low alloy steels (HSLA), Maraging steels, free cutting steel, tool steels & its classification. **Stainless Steels** – Introduction & its classification

as ferritic, martensitic and Austenitic stainless steel, sensitization of stainless steel, welds decay & its remedies. Characterization and its importance.
Classification of Cast Irons, effect of alloying element on microstructure of cast iron. Graphitization & its effect on properties of CI, White CI, Malleable CI, Nodular CI, Gray CI, their manufacture and applications, Microstructures of cast iron.

Unit 5: Non-Ferrous Alloys: (4 Hrs)
Copper Alloys: composition, properties & uses, copper and its alloys, - brasses, bronzes, bearing alloys. **Aluminum alloys:** composition, properties & uses, Classification of Al-alloys, Magnesium and its alloys, Titanium and its alloys.

Unit 6: Advanced Materials (6 Hrs)
Ceramic Materials: Ceramics and glasses, crystalline and non-crystalline ceramics, Structure of ceramics and glasses, Major mechanical and optical properties.
Composite Materials: Classification of Composites, Matrices and reinforcements, Fabrication methods of component manufacture of composites, Particle-Reinforced Materials, Fiber Reinforced Materials, Metal Ceramic Mixtures, Metal-Matrix Composites and Carbon-Carbon (C–C) composites. Examples and applications.
Nano Materials: Importance, Emergence of Nano–Technology, Bottom-Up and Top–down approaches, challenges in Nano –Technology, Applications.

Section A: Unit 1, 2 and 3
Section B: Unit 4, 5 and 6

Recommended Books

1. V.D. Kodgire, "Metallurgy and Material Sciences", Everest Publishing.
2. Donald R. Askeland, Pradeep P. Phule, "Essentials of Materials for Science and Engineering", Thomson-Engineering, 2006.
3. William D. Callister Jr., "Material Science & Engineering- An Introduction", Wiley India Pvt. Ltd. 6th Edition, 2006, New Delhi.
4. S. Avner, "Physical Metallurgy", McGraw Hill Publication.

Reference books

1. Charles P. Poole Jr. and Frank J. Owens, "Introduction to Nanotechnology", Wiley India, New Delhi, 2010
2. James S. Reed, "Introduction to the Principles of Ceramic Processing", John Wiley, 1995.
3. A.B. Strong, "Fundamentals of Composites Manufacturing- Materials, Methods and Applications", SME 1989.
4. R.A. Higgins, "Engineering Metallurgy".
5. Y.U. Lakhtin, "Engineering Physical Metallurgy and Heat Treatment".
6. ASM Handbook - Vol. 01 & 02, Properties and Selection (ferrous & Nonferrous metals)

Pattern of Question Paper

The units in the syllabus are divided in two equal sections. Question paper consists of two sections A and B. Section A includes first three units (1, 2, and 3) and Section B includes remaining three units (4, 5 and 6). Question paper should cover the entire syllabus.

For 80 marks Paper:
1. Five questions in each Section
2. Attempt any three questions from each Section.

MED304-FLUID MECHANICS AND MACHINERIES

Teaching Scheme
Lectures: 4 Hrs/ Week.

Examination Scheme
Theory Examination : 80 Marks (3 Hrs)
Class Test : 20 Marks

Objectives:

- To introduce the concepts of flow measurements and flow through pipes
- To introduce the concepts of momentum principles
- To impart the knowledge on pumps and turbines

Unit 1: Introduction to Fluid Mechanics (6 Hrs)

Introduction, , Ideal fluid and real fluid, Newtonian and non, Newtonian fluid, Compressible and incompressible fluid, properties of fluids, Viscosity and its unit, Surface tension, Compressibility, Capillarity.

Fluid Statics

Introduction, Pascal's law, Pressure in fluid at rest, Hydrostatics forces on immersed, Plane and curved surfaces, Center of pressure and resultant force, buoyant force and Center of buoyancy, Equilibrium of floating body, Metacentric height, Oscillation of, Floating bodies and engineering applications.

Unit 2: Fluid Dynamics (6 Hrs)

Introduction, Continuity equation in Cartesian and cylindrical coordinates, Euler's, Equation of motion, Bernoullies equation and its assumption, Practical application of Bernoulli's theorem, Momentum and energy correction factors, Engineering application of momentum equation as force exerted by flowing fluid on bends,

Unit 3: Dimensional Analysis and similarity (6 Hrs)

Dimensions of various physical quantities, Rayleigh's method, Buckingham's π (Pie)Theorem, Types of similarities, Distorted and non distorted models, Dimensionless numbers and their Significance.

Unit 4: Introduction to Computational Fluid Dynamics (2 Hrs)

Introduction, Need of CFD, CFD as research tool, governing equation of CFD, Application of CFD.

Unit 5: Impact of Jets (12 Hrs)

Introduction, Force exerted by jet on stationary vertical plate, Force exerted by a jet on plates, Stationary inclined plate, Force exerted by a jet on stationary curved plate, Force exerted by jet on moving (Flat vertical plate moving in the direction of jet & away from jet) ; Inclined plate Moving in the direction of the jet Curved plate moving in the direction of the jet.

Hydraulic Turbines

Introduction, Classification, Tangential flow impulse Turbine, Construction & working of Pelton wheel, Work done & efficiency of a pelton wheel, Definition of heads & efficiency, Design aspects of pelton wheel, Radial flow Reaction Turbine, Construction & working of Francis turbine, Design of a Francis turbine runner, axial flow reaction turbine, Propeller Turbine,

Kaplan Turbine, Runway speed, Draft Tube, Draft tube Theory, Types of draft tubes, Specific Speed, Unit Quantities, Performance Characteristics of Hydraulic Turbines, Cavitations.

Unit 6: Centrifugal Pumps (8 Hrs)

Introduction, Construction & Working of C. P. Work done by the impeller on water, Definition of Heads & efficiencies of C. P. Losses in C. P. Minimum Speed for Starting a C.P., Effect of Variation of Discharge on efficiency, Effect of no. of vanes of impeller on head & efficiency, Multistage C.P., Pumps in Series, Pumps in Parallel, Specific speed, Model testing & geometrically similar Pumps, Characteristics of C.P, NPSH, Cavitations, and Priming.

Fluid Systems

Introduction, Construction and working of hydraulic press, hydraulic accumulator, hydraulic Coupling, hydraulic intensifier, hydraulic torque converter, hydraulic crane.

Section A: Unit 1, 2 3 and 4
Section B: Unit 5 and 6

Recommended Books:

1. Fluid Mechanics & Hydraulic Machines by R.K.Bansal, Lakshmi Publication Pvt. Ltd. Co.
2. Fluid Mechanics & Hydraulic Machines by R.K.Rajput, S. Chand co. Publications
3. Fluid Mechanics & Fluid power Engineering by D.S. Kumar, S.K. Kataria & Sons Delhi.
4. Fluid Mechanics by Streeter V.L.& Wylie E.B., Tata McGraw-Hill International
5. Hydraulic Machines by Jagdish Lal, Metropolitan Book Co. Pvt. Ltd.
6. Hydraulics, Fluid Mechanics & Fluid Machines by Ramamurtham, Dhanpat Rai & Son's
7. Engineering Fluid Mechanics by K.L. Kumar, Eurasia Publishing House Pvt. Ltd.
8. Theory & applications of Fluid Mechanics by Subramanian K., Tata McGraw-Hill Publishing Co. Ltd.
9. Fluid Machines by Modi & Seth
10. Introduction to fluid mechanics by Robert W Fox, Wiley Publications
11. Computational Fluid Dynamics by Anderson

Pattern of Question Paper

The units in the syllabus are divided in two equal sections. Question paper consists of two sections A and B. Section A includes first three units (1, 2, 3 and 4) and Section B includes remaining three units (5 and 6). Question paper should cover the entire syllabus.

For 80 marks Paper:

1. Five questions in each Section
2. Attempt any three questions from each Section.

MED305 - INDUSTRIAL MANAGEMENT & ENGINEERING ECONOMICS

Teaching Scheme
Lectures: 4 Hrs/Week

Examination Scheme
Theory: 80 Marks (3 Hrs)
Class Test :20 Marks

Objectives:

- To understand concept of Management, Administration, Organization, costing and financial management.
- To engage and enhance critical skills by pursuit of specialist options via management and economics.

Unit 1: (8 Hrs)

A- Introduction to Management:

Nature and Characteristics of Management, Principles of management, functions of management, levels of management, a need for management, Management of Change, Management by objectives.

B. Recent trends in Management

Knowledge management-Classification, objectives, forces driving knowledge management, Knowledge cycle, benefits, Entrepreneurship Development-Definition, Functions of entrepreneur, various schemes for the Entrepreneurship Development, Six sigma, T.Q.M - Objectives, Dr. Deming and Cross by 14 points of T.Q.M., benefits of T.Q.M, Steps of implementing T.Q.M.

Unit 2: Business Organization (6 Hrs)

Forms of business organization, partnership, industrial proprietorship, joint Stock Company, co-operative enterprise, public sector undertaking, organizational structures, line organization, staff organization, committee organization, project organization, matrix organization

Unit 3: Human Resource Management (6 Hrs)

Scope and functions of Human resource management, recruitment, selection and induction, training development, method of training, job analysis: job specification and job description, succession planning, retirement /separation and its type, manpower planning, Trade union-definition, origin, objectives and functions of trade union.

.

Unit 4: (6 Hrs)

A. Costing and Financial Management

Costing Techniques: Elements of cost material cost, labour cost, Expenses, overhead cost, scope and importance of financial management.

B. Inventory Management

Inventory-definition, characteristics, types, meaning and nature of inventory, Inventory cost relationship, cost associated with inventory, Benefits of holding inventory, Risk and cost of holding inventory, Models of inventory, E.O.Q, A.B.C analysis, E.B.Q.

Unit 5: (6 Hrs)

A. Nature & Significance of Economics

Types of economic analysis - Micro and macro, kinds of economic decisions, economic principles for management decisions

B. Demand and supply analysis

Demand: Types of demand, Determination of demand, Demand function, law of demand
Supply: Determination of supply, supply function, law of supply, Perfect competition, Monopoly.

Unit 6: **(6 Hrs)**

Capital Budgeting and Depreciation

Reasons of Replacement, payback period method, net present value, discounted cash flow method, Profitability index method, internal rate of return (IIR) method, Types of Depreciation: Straight line method, written down method, Liquidation.

Section A: Unit 1, 2 and 3

Section B: Unit 4, 5 and 6

Reference Books

1. P. Subba Rao, "Personnel Human Resource Management", Himalaya.
2. Gary Dessler and Biu Varkkey, "Human Resource Management", Pearson.
3. Geethika, Piyali Ghosh and Purba Roy, "Managerial Economics", MC Graw Hill.
4. Koontz and O' Donnell, "Principles of Management".
5. James Stoner, "Management", PHI Publication.
6. Nandkumar Hukeri, "Industrial Engineering and Production Operation Management", Electrotech Publication.
7. Khan and Jain, "Financial Management", Tata MC Graw Hill.
8. Leland Blank and Anthony Tarquin, "Engineering Economy", Tata Mc Graw Hill

Pattern of Question Paper

The units in the syllabus are divided in two equal sections. Question paper consists of two sections A and B. Section A includes first three units (1, 2, and 3) and Section B includes remaining three units (4, 5 and 6). Question paper should cover the entire syllabus.

For 80 marks Paper:

1. Five questions in each Section
2. Attempt any three questions from each Section.

MED321 LAB-I DESIGN MACHINE ELEMENTS – I

Teaching Scheme
Practical: 2 Hrs/Week

Examination Scheme
Term Work- :25 Marks
Practical Exam-25 Marks

Term work

Term work shall consist of 'Three' design projects. Each design project shall consist of two imperial size sheets – one involving assembly drawing with a part list and overall dimensions and the other sheet involving drawings of individual components.

Manufacturing tolerances should be specified so as to make it working drawing. A design report giving all necessary calculations of the design of components and assembly should be submitted in a separate file.

Design project should be in the form of "Design of Mechanical System" comprising of Machine elements studied and topics covered in the syllabus. Design data book shall be used wherever necessary to achieve selection of standardized components.

- Design of cotter joint
- Design of Knuckle joint
- Design of coupling/ Power Screw.

Assignment Based on

- Welded joint and Riveted joint
- Fluctuating loads.

Practical Exam

- Practical examination is based on the practical work done during the course, Viva Voce based on syllabus.

MED322 LAB-II THEORY OF MACHINES-II

Teaching Scheme
Practical: 2 Hrs/Week

Examination Scheme
Term Work- :50 Marks

Term Work

At least eight out of the following experiments shall be conducted during the course record of the same shall be submitted by the candidate & term work

1. To generate involutes tooth profile with help of rack on gear blank.
2. Study of interference & undercutting
3. Study of governors
4. To determine Mass Moment of Inertia of uniform rod By using
   A] Compound pendulum B] Bifilar suspension
5. To determine Mass Moment of Inertia of disc By using
   A] Compound pendulum B] Trifilar suspension C] Single rotor system
6. Experiment on Longitudinal vibrations of helical springs
7. To determine of equivalent mass of spring mass for spring mass system
8. To determine of equivalent mass of spring mass for spring mass dashpot system
9. Determination of logarithmic decrement (Free Damped Vibrations)
10. Determination of Gyroscopic couple
11. Assignment on unit 4.
12. Assignment on unit 5.

MED323 LAB-III METALLURGY AND MATERIALS

Teaching Scheme
Practical: 2 Hrs/Week

Examination Scheme
Term Work- :25 Marks

Term Work

The term work shall consist of the experiments based on the above Syllabus as mentioned below

A set of 9 Experiments from following list

1. Study of Metallurgical Microscope and Image Analyzer.
2. Preparation of Specimen for metallographic examinations.
3. Preparation of Mounted samples with the help of mounting press / cold setting resins.
4. Study of microstructures of Steels and Cast Iron
5. Study of microstructures of Non Ferrous Metals.
6. Study of the effect of annealing and normalizing on properties of steels.
7. Tensile test on Mild Steel and Aluminum test specimen.
8. Measurement of hardness of hard and soft materials with the help of Brinell Testing Machine and Rockwell Testing Machine.
9. Heat treatment of high speed steels.
10. Study of mechanisms of quenching.
11. Characterization of ferrous alloys: Structure property co-relationship.

MED324 LAB-IV FLUID MECHANICS AND MACHINERY

Teaching Scheme
Practical: 2 Hrs/Week

Examination Scheme
Practical Exam:50 Marks

Term Work

The record of at least 10 experiments performed from following (Minimum five from fluid mechanics and five from hydraulics machines)

1. Red wood viscometer
2. Reynolds Experiment
3. Determination of metacentric height by experimental method
4. Measurement of flow by Venturimeter and orifice meter.
5. Verification of Bernoulli's theorem.
6. To find force exerted by liquid jet on horizontal plate.
7. Trial on Pelton wheel turbine test rig.
8. Trial on Francis Turbine test rig
9. Trial on Kaplan Turbine test rig.
10. Trial on centrifugal pump test rig.
11. Trial on gear pump test rig.
12. Visit to hydroelectric power plant.

Practical Examination

The Practical examination shall consist of performing an experiment based on practical work during the course, viva- voce based on the syllabus and term work.

The assessment will be based on

1. Performing an experiment
2. Viva-voce on the syllabus

BSH331 LAB-V COMMUNICATION SKILLS-II

Teaching Scheme
Practical: 2 Hrs/Week

Examination Scheme
Online Examination:50 Marks (1 Hr.)

Unit-I

- Fast calculation techniques, Number system, ratio ,proportion, variations averages,
- Simple interest ,compound interest, profit, loss
- Work and time speed and distance
- Set theory and vann diagram, permutation and combination
- Probability, alphanumeric series, logical deduction, reasoning, coding and decoding and blood relation
- Data interpretation

Unit-II

- The key components of non verbal communication i.e. eye contacts, body language, vocal tone and volume.
- Team work and team building, The basics of team intelligence, Diversity awareness, Gender issues
- Group discussion, unstructured group discussions and actual group discussions
- Presentation skills ,self confidence and decision making

Unit-III

- Adapting to corporate life
- Phone etiquettes, Email etiquettes, clothing etiquettes, Dinning table etiquettes
- Getting ready for an interviews, corporate dressing, writing reports and proposals, minutes writing.

Reference Books

1. Gopal Swamy Ramesh,Mahadevan Ramesh ,"The Ace of soft skills", Pearson Publication
2. Bansal Harison, "Spoken English"
3. Orient Blackswan, "English for Engineers and Technologist"
4. Jerry Wiessman , "Presenting to Win" Pretince Hall publications
5. Willium Sanborn Pfeiffer, T.V.S, Padamaja, "Technical Communication"
6. M. Tyra, "Magical book on Quikermaths" BSC Publishing Co. pvt.ltd.

MED326 LAB-VI WORKSHOP PRACTICE - V

Teaching Scheme
Practical: 2 Hrs/Week

Examination Scheme
Term Work- :25 Marks

Machine Shop

Preparation of blanks for the various jobs from the different types of available raw materials, on the lathe. Study the various single and multiple point tools, tool holding devices and the work-piece holding devices.

1) Study of various measuring instruments, gauges and their applications.
2) Preparation of one gear involving calculations for indexing. The side faces to be milled. The hole to be drilled and bored to the final size. Splines or a keyway to be cut by the slotting machine.
3) Prepare on block with various operations flat surface, steps, slot, etc on the shaper. Grind at least two faces of the job on the surface grinder, with required accuracy.
4) Study grinding of a tool or cutter on the tool and cutter grinder, accompanied with a demonstration on at least one job on multiple point tool, per batch.
5) Study of CNC machines and simple Programs of CNC.

Term work

The term work will comprise of the above stated jobs.

- A file containing the write-up of the study part of the experiments no.1, 2 and 6.
- A workshop diary containing details along with calculations wherever necessary.

Recommended books:

1. Hazra Chaudhury, Workshop Technology, Vol 2.
2. Raghuwanshi, Workshop Technology, Vol 2.

MED351-DESIGN MACHINE ELEMENTS – II

Teaching Scheme
Lectures: 4 Hrs/Week

Examination Scheme
Theory Examination : 80 Marks (3 Hrs)
Class Test: 20 Marks

Objectives:

- Analyze and evaluate forces and stresses within a gear system
- Select appropriate mechanical components using design principles.
- Developing the capability to analyze and select the various criteria of design.

Unit -1: Introduction to Gears (15 Hrs)

Design considerations of gears, material selection, types of gear failure.

(A) **Spur Gear:** Terminology, Gear tooth loads, force analysis, beam strength (Lewis equation) equation, dynamic tooth load (spott's & Bucking ham's equation) wear strength (Bucking ham's equation),

(B) **Helical Gears:** Terminology, Force analysis, Formative number of teeth in helical gears, beam & wear strength of helical gears, effective load & design of helical gear.

(C) **Bevel Gear :** Terminology , Force analysis, Formative number of teeth , Design of bevel gears based on beam and wear strength.

(D) **Worm Gears:** Terminology. Standard dimensions and recommendation of worm gearing, Force analysis, Formative number of teeth, Design of worm drive as per AGMA Recomandation

(E) **Gear train**- Introduction, Types of gear train, simple, compound, reverted and Epicyclic gear train.

Unit -2: Design of friction clutch (5 Hrs)

Introduction, types & friction materials, Design of single & multi-plate clutch, Design of cone clutch, Design of centrifugal clutch.

Unit -3: Design of belt (5 Hrs)

Introduction, types & materials.

(A) **Flat belt:** Length of belt (open & cross) , slip & creep belt , velocity ration, centrifugal tension . initial tension, ratio of limiting tension , stressess in belt, condition for maximum power

(B) **V-belt** : Construction of V-belt , ratio of limiting tension, selection of V-belt from manufacture catalogue

(C) **Chain & rope drive:** Introduction

Unit -4: Design of bearings (10 Hrs)

(A) **Introduction to Tribological consideration in design:** Friction, Wear, Lubrication.

(B) **Sliding contact bearing :** Basic theory, thick and thin film lubrication, Newton's law of viscosity, Petroff's equation , Sommerfield Number , Reynolds's equation, Raimondi and Boyd method relating bearing variables, Heat balance in journal bearings, Temperature rise.
Introduction to hydro static bearings.

(C) **Rolling Contact Bearing:** Types, static and dynamic load capacities, Stribeck's equation. Equivalent bearing load, load-life relationship, bearing life, load factor, Selection of bearing from manufactures catalogue.

(D) Design for variable load and speed, Bearings with probability of survival other than 90 %.

Unit -5: Design of brake **(5 Hrs)**

Introduction and types of brake, design of short shoe (single & double), design of long shoe (single & double), design of simple& differential band brake, design band & block brake & design internal expanding brake

Section A: Unit 1 and 2

Section B: Unit 3, 4 and 5

Reference Books

1. Shigley J.E. and Mischke C.R.,"Mechanical Engineering Design", McGraw Hill Publications Co. Ltd.
2. Bhandari V. B., "Introduction to Machine Design", Mc Graw Hill
3. Bhandari V.B., "Design of Machine Elements", Tata McGraw Hill Publ. Co. Ltd.
4. Spotts M.F. and Shoup T.E., " Design of Machine Elements", Prentice Hall International.
5. Black P.H. and O. Eugene Adams, "Machine Design", McGraw Hill Book Co. Ltd.
6. "Design Data", P.S.G. College of Technology, Coimbatore.
7. Juvinal R.C., "Fundamentals of Machine Components Design", John Wiley & Sons.
8. Hall A.S., Holowenko A.R. and Laughlin H.G., "Machine Design", Schaum's outline series, Mc Graw Hill.
9. Kulkarni S. G., Machine Design, Mc Graw Hill
10. Ganesh Babu K. and Srithar K., "Design of Machine Elements", Mc Graw Hill

Pattern of Question Paper

The units in the syllabus shall be divided in two equal sections. Question paper consists of two sections A and B. Section A includes first two units (1,2) and Section B includes remaining three units (3,4,5) . Question paper should cover the entire syllabus.

For 80 marks Paper:

1. Five questions in each Section
2. Attempt any three questions from each Section.

MED352-HEAT TRANSFER

Teaching Scheme:
Theory: 4 Hrs/ Week

Examination Scheme:
Theory Examination: 80 Marks (3 Hrs)
Class Test: 20 Marks

Objectives:

- Model basic heat transfer processes and identify modes
- Design and Predict heat exchanger performance
- Recognize basic convective heat transfer and apply appropriate methods for quantifying convection
- Determine radiation heat transfer

Unit 1: (**03 Hrs**)

A. Introduction

Modes and laws of heat transfer. Thermal conductivity and its variation with temperature for various engineering materials. Applications of heat transfer. Insulating materials. Derivation of generalized heat conduction equation and its reduction to Fourier, Laplace and Poisson's equation, thermal diffusivity. (Descriptive and simple numerical treatment)

B. One dimensional steady state heat conduction **(06 Hrs)**

Heat conduction through a plane wall, cylindrical and sphere. Heat conduction through a composite slab, cylinder and sphere. Effect of variable thermal conductivity. Electrical analogy in conduction. Critical radius of insulation, economic insulation, and thermal contact resistance. One dimensional steady state heat conduction with heat generation for plane wall, cylinder and sphere. (Descriptive and numerical treatment)

Unit 2: **(04 Hrs)**

A. Extended Surfaces

Types and applications of fins. Heat transfer through extended surfaces. Derivation of equations for temperature distribution and heat transfer through fins of constant cross-section area. Effectiveness and efficiency of a fin. Errors in the measurement of temperature in a thermo-well. (Descriptive and numerical treatment)

B. Unsteady state heat conduction **(03 Hrs)**

System with negligible internal resistance, Biot and Fourier numbers. Lumped heat capacity method. Use of Hiesler and Grober Charts. (Descriptive and numerical treatment)

Unit 3: Convection **(04 Hrs)**

A. **Convection**

Local and average convective coefficient. Hydrodynamic and thermal boundary layer. Laminar and turbulent flow over a flat plate and in a pipe. Friction factor, laminar and turbulent flow over a flat plate. Drag and drag co-efficient. (Descriptive and numerical treatment)

B. Free and Forced Convection **(06 Hrs)**

Dimensional analysis in free and forced convection. Physical significance of the dimensionless numbers related to free and forced convection. Empirical correlations for heat transfer in laminar and turbulent flow over a flat plate and in a circular pipe. Empirical correlations for free convection heat transfer over horizontal, vertical plate cylinder. (Descriptive and numerical treatment)

Unit 4: Condensation and Boiling (04 Hrs)

Modes of pool boiling, critical heat flux, burnout point, forced boiling. Film and drop wise condensation. (No numerical treatment)

Unit 5: Radiation Heat Transfer (05 Hrs)

Thermal radiation; definitions of various terms used in radiation heat transfer; Stefan-Boltzman law, Kirchoff's law, Planck's law and Wein's displacement law. Radiation heat exchange between two parallel infinite black surfaces, between two parallel infinite gray surfaces, effect of radiation shield, intensity of radiation and\solid angle, Lambert's law, radiation heat exchange between two finite surfaces-configuration factor or view factor. (Descriptive and numerical treatment)

Unit 6: Heat Exchangers (05 Hrs)

Heat exchangers classification, Fouling factor, overall heat transfer coefficient, heat exchanger analysis- use of log mean temperature difference (LMTD) for parallel and counter flow heat exchangers. LMTD correction factor, fouling factor. The effectiveness-NTU method for parallel and counter flow heat exchangers. Design considerations of heat exchanger. Introduction to heat pipe. (Descriptive and numerical treatment)

Section A: Unit 1, 2 and 3
Section B: Unit 4, 5 and 6

Reference Books

1. Yunus Cengel, Heat Transfer: A Practical Approach, 3rd edition (2007), Tata Mcgraw Hill.
2. Holman J. P., Heat Transfer, Tata Mcgraw Hill.
3. Sukhatme S. P., Heat Transfer, University Press.
4. Domkundwar, Heat and Mass Transfer, Dhanpat Rai & co.
5. Incropera & Dewit, Fundamentals of Heat & Mass Transfer, Wiley India Pvt . Ltd. New Dehli
6. Gupta and Prakash: Engineering Heat Transfer, New Chand and Bros., Roorkee (U.P.)
7. R.C. Sachdeva: Fundamentals of Engineering Heat and Mass Transfer, Wiley Eastern Ltd., India.
8. Frank Kreith: Principles of Heat Transfer, Harper and Row Publishers, New York.
9. Donald Q. Kern: Process Heat Transfer, TMH Publishing Company Ltd., New Delhi.
10. Heat transfer-A basic approach, Ozisik, Tata Mc Graw Hill 2002
11. Principles of heat transfer, Kreith Thomas Learning 2001
12. Heat transfer, P.K. Nag, Tata Mc Graw Hill 2002.
13. Rao Y. O.C, Heat Transfer, Orient Blackswan-University Press.

Pattern of Question Paper

The units in the syllabus are divided in two equal sections. Question paper consists of two sections A and B. Section A includes first three units (1, 2, and 3) and Section B includes remaining three units (4, 5 and 6). Question paper should cover the entire syllabus.

For 80 marks Paper:

1. Five questions in each Section
2. Attempt any three questions from each Section.

MED353- INDUSTRIAL HYDRAULICS AND PNEUMATICS

Teaching Scheme
Lectures: 4 Hrs/Week

Examination Scheme
Theory Examination : 80 Marks (4 Hrs)
Class Test: 20 Marks

Objectives:

- To develop Logical understanding of the subject.
- To develop skill so that students are able to apply Principles of Hydraulics and Pneumatics for the Industrial applications.
- To enhance the skill of the students in the automation design and application in the present day need of the industrial machines.

Unit 1: Introduction to Hydraulics and pneumatics (6 Hrs)

Fluid technology, fluid statics and fluid kinetics. Laws governing these systems, Pascal's law, Bernauli's equation. Force and work in fluid devices. Displacement actions.

Fluids used in Hydraulics and pneumatics. Essential properties of oils used in hydraulic systems. Oils used in hydraulic systems, oil additives. Air filter, regulator and lubricator unit.

Introduction of Hydraulic and pneumatic, basic circuits (in block diagram).

Unit 2: **Hydraulic and pneumatic symbols and the use of the symbols (6 Hrs)**

To study the ASME and DIN ISO standard symbols for hydraulics and pneumatics and their applications. Composite symbols. Use of symbols. General rules.

Unit 3: Hydraulic and pneumatic machines (pumps and actuators) (8 Hrs)

Construction, principle of working, applications of various hydraulic Pump and motors, pneumatic compressors and motors (linear, rotary, oscillating) their characteristics; Types: Piston cylinder, rotary vane, gear, lobe, gerotor, rotary piston, screw etc. Hydraulic sump, types and construction, air reservoir.

Unit4: Hydraulic and pneumatic controls. Accessories (6 Hrs)

Study of pneumatic and hydraulic control valves; Pressure control valves, flow control valves , direction control valves; study of all the types, different constructions, valve actuators, applications.

Study of the different piping, couplings, and pipe accessories used in hydraulic and pneumatic systems. Study of accessories in hydraulic and pneumatic systems; like accumulators, pressure boosters, , filters, seperators, air driers, heat exchangers. Seals-static, sliding and rotary, packings (types, material application).

Unit 5: Hydraulic and pneumatic circuits (8 Hrs)

Review of components of hydraulic and pneumatic system –pumps, motors, cylinders, different types of control valves –designation methods of actuation, power supply system, hoses, filters etc., circuit diagram with technical data. Study of the logics to develop a circuit. The placements of components. Details of drawing of pneumatic and hydraulic circuits. Designing and drawing of circuits.

Design of different circuits basic circuit, speed control circuit, force control circuit , various actuators . Special circuits like sequencing, counter balancing, unloading, variable operation circuit, circuit with air/hydraulic pilot operated valves. Typical industrial application circuits including synchronizing circuit, fail safe circuit, and two-hand safety circuit, machine applications like clamps, machine feed and other applications, material moving equipments, cranes, jacks, press etc.

Unit 6: Introduction to Electro-Hydraulics and Electro-Pneumatics (6 Hrs)

Review of components in electrical control of hydraulic and pneumatic systems, valve actuators used in these systems. Control switches, Limit switches, reed switches, proximity switches(capacitive, inductive & optical) , pressure switches, relays & contactors, solenoid operated direction control valves, symbols, performance data, ladder diagram, programmable logic controllers, input and output elements. Metering devices.. Advantages limitations and applications.

Note: All the units must be dealt with schematic representations and supported with the industrial need and the applications.

Section A: Unit 1, 2 and 3
Section B: Unit 4, 5 and 6

Reference Books

1. Hydraulics and Pneumatics Power for production, by Harry L. Stewart.(Industrial Press)
2. Hydraulics and Fluid Mechanics by Modi Seth. (Standard Book House)
3. Industrial Hydraulics manual by Sperry Vickers.
4. Oil Hydraulic Systems , by S.R.Mujumdar.(TMH)
5. Pneumatic Controls, by Joji P. (Wiley India Pvt Ltd)"
6. Pneumatic systems Principles and Maintenance, by S.R.Mujumdar(TMH)
7. ABC's of Hydraulic Circuits, by Harry L Stewart. (Taraporewala)
8. ABC's of Pneumatic Circuits, by Harry L Stewart. (Taraporewala)
9. Pneumatic Text Book, Hydraulic text book ,by Festo controls pvt ltd.,Bangalore.
10. Electro Pneumatics , Electro Hydraulics, by Festo controls pvt ltd.,Bangalore
11. Introduction to Mechatronics and Measurement Systems, by David G Alciatore, Michel Histand. (TMH)
12. Mechatronics by HMT.(TMH)

Pattern of Question Paper

The units in the syllabus are divided in two equal sections. Question paper consists of two sections A and B. Section A includes first three units (1, 2, and 3) and Section B includes remaining three units (4, 5 and 6). Question paper should cover the entire syllabus.

For 80 marks Paper:

1. Five questions in each Section
2. Attempt any three questions from each Section.

MED354-TOOL ENGINEERING

Teaching Scheme
Lectures: 4 Hrs/Week

Examination Scheme
Theory Examination : 80 Marks (4 Hrs)
Class Test: 20 Marks

Objectives:

- Enhancing imagination, visualization, design and interpretation skills
- To understand the standard practice followed in industries for tool design.
- To understand the methodology of communicating design and all the required information that will essential for tool manufacturing.

Unit 1: Theory of metal Cutting (10 Hrs)

Introduction, Mechanics of Machining - Geometry of single point cutting tool, Single point cutting tool Designation of cutting tools, ORS and ASA system, Importance of Tool angles, Mechanism of chip formation, Orthogonal and oblique cutting, Use chip breakers, Machining forces and Merchant's Circle

Diagram, Heat Generation and Cutting Temperature in Machining, Cutting fluid, Concept of machinability and its improvement, Failure of cutting tool and tool Life, Common use and advanced cutting tools materials.

Unit 2: Design of cutting tools (3 Hrs)

Introduction, types, geometry, nomenclature and design of Drills, milling cutters, Reamers, Taps & Broaches

Unit 3: Design of jigs & fixture (9 Hrs)

Introduction, process planning, need of fixtures, locating & clamping - principle of location, locating elements principle for clamping purposes, clamping devices, design principles common to jigs & fixtures. Drilling Jigs :- Design principles, drill bushes, design principles for drill bushings, Types of drilling jigs - Template jig, plate type jig, swinging leaf jig, Box type jig, channel type jig, Milling Fixtures: - Essential features of a milling fixtures, Design principles for milling fixtures, Indexing jig & fixtures, Turning fixtures, Automatic clamping devices**.**

Unit 4: Press tool Design (6 Hrs)

Introduction of Press operations, Press working equipment - Classification, Rating of a press, Press tool equipments, arrangement of guide posts. Press selection, press working terminology, Types of dies - Simple dies, inverted die, compound dies, combination dies, progressive dies, Transfer dies, multiple dies. Principle of metal cutting, strip layout, clearance, angular clearance, cutting forces, method of reducing cutting forces, Die block, Die block thickness, Die opening, Fastening of die block, back up plate, Punch, Methods of holding punches, Strippers. Stoppers, Stock stop, Stock guide, Knock outs, Pilots. Design of Blanking & Piercing die design - compound & progressive dies.

Unit 5: Bending Forming & Drawing dies (6 Hrs)

Bending - Bending Terminology, V- Bending, Air bending, bottoming dies, Wiping dies, spring back & its prevention, channel dies. Design Principles - Bend radius, Bend allowance, width of die opening, bending pressure.

Forming Dies- Introduction, Types - solid form dies, pad type form dies, and Embossing dies, coining dies, Bulging dies.

Drawing Dies - Introduction, Difference between bending, forming & drawing, Metal flow during drawing, Design consideration - Radius of draw die, Punch radius, Draw clearance, Drawing speed, Calculating blank size, Number of draws, Drawing pressure, Blank holding pressure.

Unit 6: Forging Die Design & mould Design (6 Hrs)

Forging Die Design: Introduction, Single impression dies, Multiple Impression dies, Forging design factors - Draft, fillet & corner radius, parting line, shrinkage & die wear, mismatch, finish allowances, webs & ribs Preliminary forging operation - fullering, edging, bending, flattering, blacking finishing, cutoff. Die design for machine forging - determination of stock size in closed & open die forging, materials & manufacture of forging dies.

Mould Design: Injection mould, mould base, design of simple two plate injection moulds, Mould Materials.

Section A: Unit 1, 2 and 3
Section B: Unit 4, 5 and 6

Recommended books:

1. Donladson, Lecain and Goold, "Tool design", Tata McGrawhill.
2. M.H.A. Kempster, "Introduction to Jigs and fixtures design".
3. P .H. Joshi, "Jigs & Fixtures".
4. Wilson, "Fundamentals of tool design", A.S.T.M.E.
5. P C Sharma, "A Textbook Of Production Engineering". S. Chand publishers.
6. A. B. Chattopadhyay, "Machining and Machine Tools"

Reference Books

1. Fundamentals of Metal Machining By Geoffery Boothroyd
2. Hoffman, "Introduction to Jigs and fixtures".
3. Dolyle, "Manufacturing processes and material for engineers".
4. G. Kuppuswamy, "Principles of metal cutting", university press.
5. Richard Kibbe, John E.Neely, Meyer, White, "Machine tool practices".
6. Production Technology-HMT –Tata McGraw-Hill Publishing Ltd.
7. Metal Cutting Theory & Cutting Tool Desing By V. Arshinov, g. Alekseev
8. Techniques of Press Working Sheet Metal by Earry Reed.

Pattern of Question Paper

The units in the syllabus are divided in two equal sections. Question paper consists of two sections A and B. Section A includes first three units (1, 2, and 3) and Section B includes remaining three units (4, 5 and 6). Question paper should cover the entire syllabus.

For 80 marks Paper:

1. Five questions in each Section
2. Attempt any three questions from each Section.

MED355- COMPUTER AIDED DESIGN/ COMPUTER AIDED MANUFACTURING/ COMPUTER AIDED ENGINEERING

Teaching Scheme
Lectures: 4 Hrs/Week

Examination Scheme
Theory Examination : 80 Marks (3 Hrs)
Class Test: 20 Marks

Objectives:

- To give an overview of CAD/CAM/CAE technology.
- To understand use of computers for product design and manufacturing.
- To develop 3D modeling skills required for product design.
- To develop programming skills required for NC manufacturing.

Unit 1: **(5 Hrs)**

Introduction – CAD, CAM, CAE; Product Life cycle Management – Concept, need and benefits, Product design process, and CAD, Principles of concurrent engineering, Manufacturing data base, Benefits of CAD

Unit 2: **(5 Hrs)**

Ground rules for graphics software. Software and hardware configuration of graphics system, Functions of graphics system, 2D and 3D transformations of geometric models like translation, scaling, rotation, reflection, shear; homogeneous representations, concatenated representation; Orthographic projections.

Unit 3: **3D Modelling** **(10 Hrs)**

Wire frame modelling, solid modelling, Modern solid modeling techniques, their need and advantages, feature based modeling, parametric modeling, constraint based modeling and hybrid solid modelers, Solid Representation: boundary representation, constructive solid geometry, sweep representations, primitive instancing, cell decomposition, Parametric and non parametric representation of Beizer curve, B-Spline curve, Kinds of Surfaces, Assembly modeling: Representation, mating conditions, representation schemes, generation of assembling sequences. An overview of modeling softwares like UG/NX, Solid Works, Autodesk Inventor, AutoCAD, PRO/E, CATIA.

Unit 4: Automation **(5 Hrs)**

Definition, Types, Advantages and Limitations of Automation, , Flexible Manufacturing System (FMS), Elements of FMS, Applications of FMS, Merits and Demerits in FMS, Computer Integrated Manufacturing (CIM), Group Technology, Merits and Demerits of Group Technology, Part classification and coding system, CAPP

Unit 5: NC Machine Tools **(9 Hrs)**

Basic components of NC, CNC and DNC system, Coordinate System, NC motion control systems, drive of NC systems, NC Part programming: Manual, APT, Post Processor, CNC controllers, Features and Advantages of CNC.

Unit 6:Robotics and Introduction to CAE (6 Hrs)

Physical configuration, basic robot motion, technical features of a robot, methods of robot programming, introduction to direct, and inverse kinematics, forward kinematics using transformation matrices, end effectors, industrial applications.

Introduction to CAE: Phases in CAE (Pre Processing, Analysis Solver & Post Processing), Applications of FEA in Mechanical Engineering, FEA Softwares.

Section A: Unit 1, 2 and 3

Section B: Unit 4, 5 and 6

Reference Books

1. CAD/CAM by M.P.Grover. and E.W.Zimmer, Prentice Hall of India Pvt. Ltd.
2. CAD/CAM – Principle Practice and Manufacturing Management, Chris McMahon and Jimmie Browne Addision Wesley England.
3. CAD/CAM Theory and Practice, Ibrahim Zeid ,TMH.
4. CAD/CAM Principles and Application, Rao P.N., - TMH.
5. Automation, Production Systems and Computer Integrated Manufacturing, Grover M.P.- Prentice Hall of India.
6. Mathematical Elements for Computer Graphics, Rogers, D.F. and Adams, A., McGraw Hill Inc.
7. CAD/CAM/CIM, P.Radhakrishnan, S.Subramanayan and V.Raju, New Age International
8. Computer Aided Manufacturing, P. N. Rao, N K Tewari and T K Kundra
9. Numerical Control Machines - P. S. Pabla, PHI Pub.
10. Numerical Control machine tools –Yoran Koran/ JosephBen, Khanna Publication.
11. Introduction to finite elements in engineering- Chandrupatla T.R and Belegunda A.D, PHI
12. The Finite Element method - O.C. Zienkiewicz, Tata McGraw Hill.
13. Robotics - Control, Sensing and Intelligence - K.S. fu, RC. Gonzalez, Lee

Pattern of Question Paper

The units in the syllabus are divided in two equal sections. Question paper consists of two sections A and B. Section A includes first three units (1, 2, and 3) and Section B includes remaining three units (4, 5 and 6). Question paper should cover the entire syllabus.

For 80 marks Paper:

1. Five questions in each Section.
2. Attempt any three questions from each Section.

MED356 - MECHANICAL MEASUREMENT

Teaching Scheme
Lectures: 2 Hrs/Week

Examination Scheme
Online Examination : 40 Marks (2 Hrs)
Class Test: 10 Marks

Objectives:

- To provide an overview of measurement techniques for measuring process parameters in industry.
- Familiarize students with theoretical response characteristics of transducers, instruments, and signal conditioning equipment used to measure these signals.
- Provide hands-on experience with such transducers and instruments.

Unit 1: Measurement and measurement systems (3 Hrs)
Significance, types, methods, classification, analog and digital mode, functions of Instrument and measurement, elements of generalized measurement system.

Unit 2: Static characteristics of instrument and measurement systems (3 Hrs)
Accuracy, static error, reproducibility, drift, sensitivity, errors in measurements, linearity, hysteresis, Threshold, bias, input and output impedance, loading effect.

Unit 3: Detector Transducers: (5 Hrs)
Classification of Transducers, Primary and secondary transducers, mechanical transducers, resistive transducers, inductive transducers, capacitive transducers, photoelectric transducers, Piezoelectric transducers, optical transducers.

Unit 4: Measurements - methods and devices (9 Hrs)

(A) Measurement of pressure and vacuum- methods and devices such as bourdon tubes, diaphragm guage, LVDT, Bellows, Piezo-electric pressure guage, vacuum gauges viz. Mclead guage, pirani guage, thermal conductivity gauge etc.

(B) Measurement of flow - methods and devices such as Rotameter, Gas flow meter, water meter etc.

(C) Measurement of temperature -methods and devices such as Thermometer, thermocouple, RTD, Thermistor, pyrometer etc.

(D) Measurement of speed, velocity and acceleration- methods and devices such as Tachometers, tachogenerators, stroboscopic methods, accelerometers, strain guage based & Piezoelectric accelerometers etc.

(E) Measurement of Force, Torque - methods and devices such as Load cells, torque sensors, strain gauges etc.

Recommended Books

1. Mechanical Measurement and Instrumentation-Dhanpat Rai & Sons Publication
2. Mechanical Measurement -Beckwith and Buck
3. Measurement System - Doeblin Ernest, TMH Publication
4. Mechanical Measurement - R.K. Jain
5. Pneumatics and Hydraulics - Harry L Stewart, Audel Series

MED371 LAB-VII DESIGN MACHINE ELEMENTS – II

Teaching Scheme
Practical: 2 Hrs/Week

Examination Scheme
Term Work- :25 Marks

Term Work

A) Total Three design project

A detail design report and A 2 Size sheet containing working drawing of details and assembly of project based on any relevant mechanical system consisting of

a) Gearbox design
b) clutch design .
c) Brake design

B) Assignments based on

a) Sliding contact bearing
b) Rolling contact bearing
c) Design of belt drives

MED372 LAB-VIII HEAT TRANSFER

Teaching Scheme
Practical: 2 Hrs/Week

Examination Scheme
Term Work- :25 Marks
Practical Exam-25 Marks

Practical/Term-work consists of the performance and record of the following Experiments (Any nine)

1. Determination of the thermal conductivity of a given metal rod.
2. Determination of the thermal conductivity of insulating powder.
3. Determination of the thermal conductivity of composite slab.
4. Determination of heat Transfer Coefficient in Natural Convection from Cylinder.
5. Determination of heat Transfer Coefficient in Forced Convection from Cylinder.
6. Determination of the critical heat flux.
7. Experimentation on drop-wise and film-wise condensation.
8. Trial on parallel and counter flow heat exchanger.
9. Determination of the emissivity of the given surface.
10. Determination of the Stefan-Boltzmann's constant.
11. Determination of thermal conductivity of a given liquid.
12. Study of design and analysis of heat pipe.

Note: - Practical examination shall consist of performing one of the experiment and producing the results followed by Viva. Performing experiment shall be allotted 15 marks and 10 marks for viva.

MED373 LAB-IX INDUSTRIAL HYDRAULICS AND PNEUMATICS

Teaching Scheme
Practical: 2 Hrs/Week

Examination Scheme
Term Work- :25 Marks

Practicals based on Hydraulic systems and pneumatic systems. Symbols must be studied and circuits must be drawn using symbols. Circuits must be designed, connected and tested on the Hydraulic and Pneumatic trainers and Electro hydraulic and electro pneumatic trainers., connected and tested on the trainers. On hand practice is expected to be given on the software's for circuit design.

1) Study of Construction and working Hydraulic pumps and motors and Pneumatic compressors, fluid storage and conditioning system. (reservoir and accessories, filter-seperator, regulator and lubricaion unit).
   Study of Hydraulic and Pneumatic valves. Pressure control, flow control and direction control valves. Study the construction and working on section models.
   Hydraulic and pneumatic piping and pipe accessories, quick disconnect couplings etc. pipe layout, factors of selection of pipes and layout..
   Study of solenoid valves, limit switches. Pressure, distance, flow rate measurement and electrical control.
2) Basic hydraulic circuit for the working of double acting cylinder and a hydraulic motor.
3) Basic pneumatic circuit for the working of single and double acting cylinder.
4) Speed control circuits. Different Metering methods Inlet & outlet flow control (meter-in & meter-out circuit)
5) Circuits for the Use of different direction control valves and valve actuation in single and double acting cylinder, and multi actuation circuit.
6) Hydraulic Counter-balancing circuit.
7) Hydraulic or Pneumatic Regenerative circuit.
8) Hydraulic or Pneumatic Sequencing circuit.
9) Hydraulic Unloading circuit.
10) Circuit with cam operated pilot valves operating a pilot operated 4way direction control valve or proximity/ limit switches, solenoid operated 4way direction control valve for auto reversing circuit.
11) Study of hydraulics and Pneumatics circuit, based on the industrial application. (at least one in each).

Term work will consist of a File/ Journal containing the detail write up of study and observation in each of the experiment. Write up of study experiment 1 and details of design of circuit diagram, working and findings of the experiments 2 to 11.

MED374 LAB-X TOOL ENGINEERING

Teaching Scheme
Practical: 2 Hrs/Week

Examination Scheme
Term Work- :25 Marks
Practical Exam-25 Marks

Term-Work: (First Angle projection to be adopted)

A. Practical work (Drawings to be drawn on A1 size drawing sheet)

Sheet 1. Drawing of nomenclature of single point cutting tool, milling cutter, drill, reamer, broach and tap.
Sheet 2. Detail drawings of different locating elements.
Sheet 3. Detail drawings of different clamping elements.
Sheet 4. Design and drawing of jig for given component.
Sheet 5. Design and drawing of milling fixture for given component or design and drawing of turning fixture for given component.
Sheet 6. Design and drawing of any one press tool (compound die / progressive die/Drawing Die)
Sheet 7. Design and drawing of forging die or simple Injection Mould

A. Industrial visit report.

Min 10 pages, individual report on industrial visit to study jig & fixtures/press tools/ forging die/ injection moulds.

Format: Name of organization / industry. Product information, Machines observed. Types of tool observed, Material of tool components. Sketches of process product and tool observed.

Practical Examination should be based on Viva-Voce on the above syllabus.

Text Books:

1. Donaldson, Lecain and Goold, "Tool design", Tata McGrawhill.
2. A.S.T.M.E. Fundamentals of the Tool Design, ASTME, Prentice-Hall of India Private Ltd., New Delhi, 1976
3. M.H.A. Kempster, "Introduction to Jigs and fixtures design".
4. P .H. Joshi, "Jigs & Fixtures".
5. P C Sharma, "A Textbook Of Production Engineering". S. Chand publishers.

Reference Books

1. Edward Hoffman, "Jigs and fixtures design".
2. Production Technology-HMT –Tata McGraw-Hill Publishing Ltd
3. Die Design Fundamentals by J.R. Paquin
4. Henrickson, Manual of Jigs and Fixtures Design, Industrial Press Inc., New York, 1973.

MED375 LAB-XI COMPUTER AIDED DESIGN/ COMPUTER AIDED MANUFACTURING/ COMPUTER AIDED ENGINEERING

Teaching Scheme
Practical: 2 Hrs/Week

Examination Scheme
Term Work- :25 Marks
Practical Exam-25 Marks

Term work

Performing minimum 8 experiments out of the following and preparing record of the experiments.

1. Creating a 2-D model on any drafting package and get its hardcopy output.
2. Creating of Solid models of any four components using any appropriate high end CAD software and get its hardcopy output.
3. Building two composite assemblies consisting of at least five components using any appropriate high end CAD software and get its hardcopy output.
4. Developing and executing a part program for contouring on NC milling machine.
5. Developing and executing a part program for NC lathe machine. .
6. Developing and executing a part program for point to point on NC drilling machine.
7. Analysis of a machine component using analysis (FEA) software.
8. Assignment on Unit 5.
9. Assignment on Unit 7.

Practical Examination

The Practical Examination will consist of performing an experiment based on practical work done during the course and viva voce based on the syllabus and term work. The practical examination will be assessed by two examiners, one will be the subject teacher and other examiner appointed by Dr. B.A.M.U. Aurangabad.