DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CIRCULAR NO.SU/Engg./B.E.IIIrd Yr./64/2018

It is hereby informed to all concerned that, the syllabi prepared by the Board of Studies & recommended by the Dean, Faulty of Science & Technology the **Academic Council at its meeting held on 30 June & 02 July 2018 has accepted the following syllabi in accordance with Choice Based Credits & Grading System for all Branches Third Year Engineering & Second Year of Bachelor of Architecture** under the Faulty of Science & Technology as enclosed herewith:-

Sr.No.	Syllabi as per CBC & GS
[1]	Third Year B.E.[Civil Engineering],
[2]	Third Year B.E [Mechanical Engineering],
[3]	Third Year B.E [EE/EEE/Electrical, Electronics & Power,],
[4]	Third Year B.E [Chemical Engineering],
[5]	Third Year B.E [Instrumentation Engineering],
[6]	Third Year B.E [E&TC/E&C/IE/ECT],
[7]	Third Year B.E [CSE/IT].
[8]	Second Year of Bachelor of Architecture.

This is effective from the Academic Year 2018-2019 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.SU/2018/10497-03
Date:- 03-07-2018.

6/7/18

Deputy Registrar,
Syllabus Section

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Copy forwarded with compliments to :-

1] The Principals, affiliated concerned Colleges, Dr. Babasaheb Ambedkar Marathwada University.

2] The Director, University Network & Information Centre, UNIC, with **a request to upload this Circular on University Website.**

Copy to :-

1] The Director, Board of Examinations & Evaluation,
2] The Section Officer, [Engineering Unit] Examination Branch,
3] The Section officer, [Eligibility Unit],
4] The Programmer [Computer Unit-1] Examinations,
5] The Programmer [Computer Unit-2] Examinations,
6] The In-charge, [E-Suvidha Kendra],
7] The Public Relation Officer,
8] The Record Keeper,

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD.

Curriculum under Choice Based Credit & Grading System

Revised Syllabus of

Bachelor of Engineering

Third Year

Mechanical Engineering

Under the Faculty of Science & Technolog

[Effective from the Academic Year 2018-19 & onwards

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

FACULTY OF SCIENCE AND TECHNOLOGY

Syllabus Structure 2018-19

Third Year of Bachelor of Engineering (Mechanical Engineering)

Subject Code	Semester : V	Contact Hrs / Week			Examination Scheme					Credit Structure			Duration of Theory Exam
	Subject	L	P	Total	CT	TH	TW	P	Total	T	P	Total	
MED301	Design of Machine Elements-I	4		4	20	80			100	4		4	3 Hours
MED302	Materials and Metallurgy	4		4	20	80			100	4		4	3 Hours
MED303	Fluid Mechanics and Machines	4		4	20	80			100	4		4	3 Hours
MED304	Theory of Machine - II	4		4	20	80			100	4		4	3 Hours
MED305	Modern Management Techniques	4		4	20	80			100	4		4	3 Hours
BSH305	Communication Skill- II	2		2		50			50	2		2	1 Hour
MED321	Lab-I: Design of Machine Elements-I		2	2			25	25	50		1	1	
MED322	Lab-II: Materials and Metallurgy		2	2			25	25	50		1	1	
MED323	Lab-III: Fluid Mechanics and Machines		2	2			25	25	50		1	1	
MED324	Lab-IV: Theory of Machine - II		2	2			25	25	50		1	1	
Total		**22**	**8**	**30**	**100**	**450**	**100**	**100**	**750**	**22**	**4**	**26**	
Subject Code	**Semester : VI**	**Contact Hrs / Week**			**Examination Scheme**					**Credit Structure**			**Duration of Theory Exam**
	Subject	**L**	**P**	**Total**	**CT**	**TH**	**TW**	**P**	**Total**	**T**	**P**	**Total**	
MED351	Design of Machine Elements - II	4		4	20	80			100	4		4	3 Hours
MED352	Heat Transfer	4		4	20	80			100	4		4	3 Hours
MED353	Tool Engineering	4		4	20	80			100	4		4	3 Hours
MED354	CAD/CAM	4		4	20	80			100	4		4	3 Hours
MED355	Elective-I	4		4	20	80			100	4		4	3 Hours
MED371	Lab-V: Design of Machine Elements - II		2	2			25	25	50		1	1	
MED372	Lab-VI: Heat Transfer		2	2			25	25	50		1	1	
MED373	Lab-VII: Tool Engineering		2	2			25	25	50		1	1	
MED374	Lab-VIII: CAD/CAM		2	2				50	50		2	2	
	Mini Project		2	2			25	25	50		1	1	
Total		**20**	**10**	**30**	**100**	**400**	**100**	**150**	**750**	**20**	**6**	**26**	

Elective – I: 1. Industrial Hydraulic & Pneumatics, 2. Machine Tool Design, 3. Industrial Product Design, 4. Robotics & Automation, 5. Advanced Thermodynamics

DESIGN MACHINE ELEMENTS – I

Teaching Scheme
Lectures: 4 Hrs/Week
Credit: 4

Examination Scheme
Theory Exam: 80 Marks (3 Hrs)
Class Test: 20 Marks (1 Hr)

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: Design of Various Joints, shaft keys and Couplings (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", McGraw 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, McGraw Hill.
9. Kulkarni S. G., Machine Design, McGraw Hill
10. Ganesh Babu K. and Srithar K., "Design of Machine Elements", McGraw 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. Question no. 1 and 6 are compulsory for 10 marks each which contains short answer questions of 02 marks each
3. From remaining four questions, attempt any two questions from each section

MATERIALS AND METALLURGY

Teaching Scheme
Lectures: 4 Hrs/Week
Credit: 4

Examination Scheme
Theory Exam: 80 Marks (3 Hrs)
Class Test: 20 Marks (1 Hr)

Objectives:

- To impart a fundamental knowledge about ferrous and nonferrous materials & their industrial use.
- To impart sound knowledge of different materials with their selection, properties and basics heat treatments.
- Learn the methods how materials study can be done.

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

Properties: Basic mechanical properties such has Hardness, Toughness, Tensile strength, Stiffness, Fatigue strength, Creep strength, Ductility, malleability.

Structure of Metals: Unit Cell, Space Lattice, types of Crystal structures, Miller Indices, Solidification: Atomic Packing Factor, Coordination Number. Cooling curve for metals and alloys, Homogeneous & Heterogeneous Nucleation, Crystal growth, Grain boundaries, Equi-axised and Columnar Grain, Dendritic Imperfections in Crystal: Pattern, Polymorphism.

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, eutectoid, Peritectic Iron carbon equilibrium Diagram , Importance of lever rule. : 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: and its types, Normalizing: Objective of Normalizing, Comparison of Normalizing v/s Annealing. Hardening: Hardening methods, Jominy End quench test, Hardening defects , Retained austenite, Sub-zero Treatment, Tempering: Objective of tempering, types, Temper brittleness, Temper Colors, Austempering, Surface and case hardening treatments: Carburizing, Martemparing, Patenting. Nitriding, Surface hardening, etc.

Unit 4: Steel & Cast Irons Steel (7 Hrs)

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 FeC, classifications of alloy steels: High strength low alloy steels (HSLA), Maraging steels, free cutting steel, tool steels & its

classification. Stainless Steels – Introduction & its classification 8 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,

Unit 6: Advanced Materials (6 Hrs)

Magnesium and its alloys, Titanium and its alloys. Ceramic Materials: Ceramics and glasses, 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 Nano Materials: (C–C) composites. Examples and applications. 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. Question no. 1 and 6 are compulsory for 10 marks each which contains short answer questions of 02 marks each
3. From remaining four questions, attempt any two questions from each section

FLUID MECHANICS AND MACHINES

Teaching Scheme
Lectures: 4 Hrs/Week
Credit: 4

Examination Scheme
Theory Exam: 80 Marks (3 Hrs)
Class Test: 20 Marks (1 Hr)

Objectives:

- Define fluid, define and calculate various properties of fluid
- Calculate hydrostatic forces on the plane & curved surfaces and explain stability of floating bodies
- Explain various types of flow. Calculate acceleration of fluid particles
- Apply Bernoulli's equation and Navier-Stokes equation to simple problems in fluid mechanics
- Explain laminar and turbulent flows on flat plates and through pipes
- Explain and use dimensional analysis to simple problems in fluid mechanics
- Explain hydraulic turbines and centrifugal pumps

Unit 1: Basics of Fluid Mechanics and Fluid Statics (10 Hrs)

Definition of fluids, Properties of fluids, Ideal and real fluids, Newtonian and non-Newtonian, compressible and incompressible, viscosity and its units, surface tension and capillarity, Pressure in fluids at rest, Pascal's law, Manometry.

Fluid Statics: Hydrostatics force on immersed plane and curved surfaces, center of pressure, buoyancy, stability of floating bodies, Meta centre and Meta centric height, engineering application

Unit 2: Fluid Kinematics (4 Hrs)

Description of fluid motion, Velocity of fluid particle, acceleration of fluid particle Types of fluid flow, Types of flow lines, Continuity equation(in Cartesian and polar co ordinate), Circulation and Vorticity, Velocity potential and stream function, Relation between velocity potential and stream function

Unit 3: Fluid Dynamics (4 Hrs)

Euler's equation of motion, Bernoulli's equation & its assumptions, practical applications of Bernoulli's theorem, Momentum equation & its applications of momentum equations as force on pipe bend

Unit 4: Dimensional analysis and model testing (4 Hrs)

Dimensions of different fluid parameters, Buckingham's Pie theorem, calculations of dimensionless groups, physical meaning of important dimensionless groups of fluid mechanics model ana1ysis and types of similarities, practical applications of dimensional analysis for model testing.

Unit 5: Boundary Layer Theory (4 Hrs)

Introduction to boundary layer, definition and characteristics, boundary layer thickness, displacement thickness, energy thickness, momentum thickness, Von- Karman momentum equation, laminar boundary layer, turbulent boundary layer, total drag due to laminar and turbulent boundary layers, boundary layer separation and its control.

Unit 6: Hydraulic Machines **(14 hrs)**

Impact of Jet: Force of jet impinging normal to a fixed plate, force of a jet on an inclined fixed plate, force on hinged plates, force on moving plate, force on series of moving plates, force of on jet impinging on fixed curved vane, force on moving curved vane.

Hydraulic Turbines: Introduction, Classification, Working principle and design of Pelton wheel, Francis turbine, Kaplan turbine, Draft tube and performance of turbines

Centrifugal pumps: Introduction, Types of pumps, Types of casings, Work supplied to Centrifugal pump, Manometric Head, Efficiencies of Centrifugal pump, Power required to drive centrifugal pump, Increase in water pressure, Minimum starting speed of centrifugal pump, Multi-stage centrifugal pump, performance of centrifugal pumps

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

Reference Books:

1. Fluid Mechanics and Hydraulic Machines - S.K. Agrawal. IMH Publication
2. Fluid mechanics and Hydraulic Machinery, Dr. R.K Bansal, Laxmi Publication
3. Hydraulic Machines - Dr. JagdishLaL
4. Fluid Mechanics and Hydraulic Machines - Modi and Seth.
5. Reversible Axial Flow pump turbine - Dr. K.K. Sudevan
6. Fluid Mechanics and, Hydraulic Machines, Subrayamanam, TMH Publication
7. Fluid Mechanics - Shames.
8. Fluid Mechanics - Streeter and Wylie.
9. Fluidic logic & Control - Dr. Subirkar.

Pattern of the Question Paper:

The units in the syllabus are divided in two equal sections. Question Paper shall consist of two sections A and B. Section A questions shall be set on first 3 units (1, 2 and 3) and sections B questions shall be set on remaining 3 units (4, 5 and 6). Question paper should cover the entire syllabus.

For 80 marks Paper:

1. Five questions in each Section
2. Question no. 1 and 6 are compulsory for 10 marks each which contains short answer questions of 02 marks each
3. From remaining four questions, attempt any two questions from each section

THEORY OF MACHINE – II

Teaching Scheme
Lectures: 4 Hrs/Week
Credit: 4

Examination Scheme
Theory Exam: 80 Marks (3 Hrs)
Class Test: 20 Marks (1 Hr)

Objectives:

- To design gear trains and flywheel for simple application.
- To analyze mechanisms of control-governors and gyroscope and their applications.
- To select Suitable Drives and Mechanisms for a particular application.
- To understand the concept of Vibration

Unit 1: Toothed Gears-1 **(6 Hrs)**

Introduction, Gear terminology, types of gears and field of applications. Spur Gears: Law of gearing, conjugate action, involute and cycloidal profile, path of contact, arc of contact, contact ratio, interference, undercutting, Methods to avoid Interference and undercutting, Minimum Numbers of teeth for interference free motion, Static force analysis

Unit 2: Toothed Gear-2 **(6 Hrs)**

(A) Helical and Herringbone gears. Their relative merits and demerits over spur gear, Static force analysis

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

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

(D) Gear trains: Introduction, its Classification, Types of gear trains, Kinematic and dynamic analysis of the simple gear trains, compound gear trains, Epicyclic gear trains, Reverted gear trains.

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

Introduction, Angular acceleration, gyroscopic couple, Effect of gyroscopic couple on aero plane, naval ship, Stability of vehicles

Unit4: Governor and Flywheel **(6 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 5: Belt, Rope & chain Drives **(4 Hrs)**

Flat and V-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

Text Books:

1. Theory of Machines by S.S. Rattan Tata McGraw-Hill Education
2. Theory of Machines – Khurmi & Gupta
3. Theory of Machines and Mechanisms -- P. L. Ballaney Khanna Publishers
4. Mechanical Vibrations -- G. K Grover, Nem Chand and Bros Publications.
5. Mechanical Vibrations -- V.P. Singh, Dhanpat Rai Publications.

Reference Books:

1. Theory of Machines – Thomas Bevan, Pearson Education India
2. Theory of Machines and Mechanisms-Ghosh & Mallik, Affiliated East-West Press
3. Mechanism and Machine Theory - 6. Rao J.S and Dukkipati R.V., Wiley-Eastern Ltd., New Delhi.
4. Kinematics of Machines-Dr. Sadhu Singh, Pearson Education India
5. Theory of Machines and Mechanisms-- Uicker J.J.,Pennock G.R.,Shigley J.E. ,Oxford University Press.
6. Theory of Machines – V. P. Singh, Dhanpat Rai Publishing Company (P) Limited
7. Mechanical Vibrations -- S.S.Rao, Pearson Education Publications
8. Mechanical Vibrations -- S Graham Kelly, Schaum'soutline Series, Tata McGraw-Hill Education
9. Mechanical Vibrations – Thammaiah Gowda, Jagadeesha T, D V Girish, Tata McGraw-Hill Education
10. Mechanism And Machine Theory -- Ashok .G. Ambekar,, PHI Learning Private Limited
11. Kinematics & Dynamics Of Machinery by R.L. Norton Tata McGraw-Hill Education

Pattern of the Question Paper:

The units in the syllabus are divided in two equal sections. Question Paper shall consist of two sections A and B. Section A questions shall be set on first 3 units (1, 2 and 3) and sections B questions shall be set on remaining 3 units (4, 5 and 6). Question paper should cover the entire syllabus.

For 80 marks Paper:

1. Five questions in each Section
2. Question no. 1 and 6 are compulsory for 10 marks each which contains short answer questions of 02 marks each
3. From remaining four questions, attempt any two questions from each section

MODERN MANAGEMENT TECHNIQUES

Teaching Scheme
Lectures: 4 Hrs/Week
Credit: 4

Examination Scheme
Theory Exam: 80 Marks (3 Hrs)
Class Test: 20 Marks (1 Hr)

Objectives:

- To comprehend quality management techniques and its practices
- To get acquainted with the new dimensions or concepts in modern management theory and practices
- To develop managerial skills/techniques for practicing new management techniques.

Unit 1: Introduction to Management (6Hrs)

Management principles and characteristics, Importance of management, Functions of management, Management as a decision making process.

Introduction to Total Quality Management, Basic approach for TQM, Dimensions of Quality, New and Old Quality Cultures. Problem solving Tools- Seven Old and New Quality tools.

Unit 2: Methods of Engineering (6Hrs)

Methods Engineering: KAIZEN, POKAYOKE, Workplace layout & Work station design, Single Minute Exchange of Dies (SMED).

Just in Time: Basic Elements of JIT, Role of set-up time and lot size in JIT, Benefits of JIT, JIT implementation issues.

KANBAN: Definition and principles, Types of Kanban systems – Withdraval Kanban, Production ordering Kanban, One and two card Kanban, implementation steps.

Unit 3: Lean Manufacturing (8Hrs)

Lean Manufacturing: Basic definitions of terms - lean production, value, waste, value steam, Toyota production system (TPS) and 4P model (Philosophy, process people and problem solving), lean principles, eight Muda (wastes).

Value Stream Mapping: Definitions of the basic terms, Phases of the value stream analysis implementation, Creation of the value stream map (steps).

Unit 4: Principles of Management (8Hrs)

5S: Definition, Principles and description of 5S, Implementation of 5S using PDCA cycle.

Six Sigma: Evolution of Six Sigma, Sigma levels, DMAIC process, Process capability, Phases of Six Sigma.

Quality Function Deployment (QFD):- Introduction, Voice of Customer, House of Quality, QFD Process, Merits and Demerits.

Unit 5: Total Productive Maintenance (5Hrs)

Total Productive Maintenance: Introduction, Definition, Types of maintenance, Reliability centered maintenance (RCM), eight TPM Pillars, Measure of TPM efficiency – overall equipment efficiency (OEE), six big losses, the five TPM development activities, the twelve steps of TPM.

Unit 6: Creativity and Innovation (7Hrs)

Creativity and Innovation: Definition, Characteristics, Significance, Role of management.

Types of thinking: Vertical Thinking, Parallel Thinking, Practical Thinking Techniques, Six thinking hats, Concept of Lateral Thinking.

Quality of Work Life (QWL): - Definition, Features, Elements/Factors, Positive Effect/Outcomes, Managerial role for improving QWL, Relationship between QWL and Work Life Balance (WLB).

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

References:

1. Total Quality Management by Dr. Gunmala Suri and Dr. Puja Sharma, Wiley Pub.
2. Industrial Engineering & Production Management by Maratand Telsang, S.Chand Pub.
3. Total Quality Management by Dale Besterfield, Carol Besterfield-Michna, Glen Besterfield, and Mary Besterfield-Sacre, Prentice Hall.
4. Competitive Manufacturing Management by John M.Nicholas, Tata McGraw Hill.
5. Just-In Time by M G Korgaonkar, Macmillan Publishers India.
6. Six Thinking Hats by Edward De Bono.
7. Lean Manufacturing: Tools, Techniques, and How to Use Them by William M Feld, CRC Press.
8. Principles of Management by Ramesh B Rudani, McGraw Hill.

Pattern of the Question Paper:

The units in the syllabus are divided in two equal sections. Question Paper shall consist of two sections A and B. Section A questions shall be set on first 3 units (1, 2 and 3) and sections B questions shall be set on remaining 3 units (4, 5 and 6). Question paper should cover the entire syllabus.

For 80 marks Paper:

1. Five questions in each Section
2. Question no. 1 and 6 are compulsory for 10 marks each which contains short answer questions of 02 marks each
3. From remaining four questions, attempt any two questions from each section

COMMUNICAION SKILLS –II

Teaching Scheme
Theory: 2Hrs/Week
Credit: 2

Examination Scheme
Online Examination: 50 Marks (1Hr)

Course Objective: To Understand the Significance of Communication Skills and Develop the Participants' Competency to effectively Employ Verbal and Nonverbal Communication Skills in Professional and Personal life.

Unit: 1 **(8 Hrs)**

- Communication: Its Meaning and Nature, Social Aspect, Ingredients, Features and Process.
- Importance and Purpose of Communication: Factors Responsible for Growing Importance of Communication, Significance of Internal and External Communication.
- Functions of Communication: Information, Control, Motivation, Conflict and Negotiation, Emotional Expression.
- Dimensions of Communications: Downward communication, Upward Communication, Barriers / Problems in Downward and Upward Communication.
- Channels of Communication: Formal and Informal.
- Means of Communication: Importance of verbalization, the living and Dynamic Nature of English Language. Words and Dictionaries, Understanding difference between colloquial, Slang and Formal Language, Corporate Language, Business /Trade vocabulary.

Unit: 2 **(26 Hrs)**

- Verbal communication: Oral, Introduction, Formal against Informal communication, Advantages and Disadvantages. Vocal Tone and Volume. Pitch Variation, Speed and Pauses.
- Verbal communication: Written, Introduction, Salient Features, Advantages and Disadvantages of written communication.
- Non Verbal Communication: Body language, Introduction, Importance, Reflection of Thoughts, Facial Expressions, Eye contact, Gestures and Body Posture, Effective Use of Body Language, Advantages and Limitations.
- Culture and Communication: Introduction, Understanding Cultural Diversity, Implication of Verbal and Non- Verbal Communication.

Unit: 3 **(6 Hrs)**

- Barriers and Breakdown in Communication: Lack of planning, Semantic Problems, Cultural, Soci-Psychological.
- Guidelines for Effective Communication: Clarity of Purpose, Common Set of Symbols, Feedback, Conciseness.
- Adapting to Corporate Life, Mannerism and Office/ Corporate Etiquettes.
- Phone Etiquettes, Clothing Etiquettes, Dining Table Etiquettes, Corporate Dressing.

- Getting ready for an Interviews, Objectives of Interview, and Types of Interviews, Stages of Interview, Understanding Resume, Bio-data and Curriculum Vitae.

Reference Books:

1. Gopal Swamy Ramesh, Mahadevan Ramesh, “The Ace of Soft Skills”, Pearson Publication.
2. Sinha K.K, “Business Communication”, Galgotia Publishing Company.
3. Peter Simon “Communication Skills”, Reader’s Delight.
4. Meenakshi Raman& Sangeeta Sharma, “Technical Communication- Principles and Practice”, Oxford University Press.
5. Shirley Taylor, “Communication for Business- A Practical Approach”, Person Education.

Exam Pattern: ***Online Exam for 50 Marks which will contain fifty objective questions.***

LAB - I: DESIGN MACHINE ELEMENTS – I

Teaching Scheme
Practical: 2 Hrs/Week
Credit: 1

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

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.

LAB – II: MATERIALS AND METALLURGY

Teaching Scheme
Practical: 2 Hrs/Week
Credit: 1

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

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

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. Experiment to study the effect of annealing, normalizing and hardening on properties of steels.
7. Measurement of hardness of hard and soft materials with the help of Brinell Testing Machine and Rockwell Testing Machine.
8. Study of mechanisms of quenching.
9. Study of hardenability by Jominy End Quench Method.
10. Industrial visit to heat treatment plant.

Term work:
The term work shall consist of Performing / Studying above mentioned experiments. The candidate shall submit the report of each experiment and the assignments.

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.

LAB– III: FLUID MECHANICS AND MACHINES

Teaching Scheme
Practical: 2 Hrs/Week
Credit: 1

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

Performing minimum seven experiments (five from fluid mechanics and two from hydraulic machines) out of the following and preparing record of the experiments.

1. Determination of viscosity by using Red wood Viscometer.
2. Study and performance on different types of pressure measuring devices
3. Determination of metacentric height of a floating body.
4. To perform Reynolds experiment.
5. Verification of Bernoulli's Theorem
6. Measurement of flow by orifice and venturimeter.
7. Trial on any one hydraulic turbine e.g. Pelton wheel, Francis, Kaplan turbine
8. Trial on Centrifugal pump.
9. Trial on Gear pump.

Term work:
The term work shall consist of Performing / Studying above mentioned experiments. The candidate shall submit the report of each experiment and the assignments.

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.

LAB – IV: THEORY OF MACHINES-II

Teaching Scheme
Practical: 2 Hrs/Week
Credit: 1

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

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

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
5. Compound pendulum b] Bifilar suspension
6. To determine Mass Moment of Inertia of disc By using
7. Compound pendulum b] Trifilar suspension
8. To determine Mass Moment of Inertia of disc By using Single rotor system
9. Experiment on Longitudinal vibrations of helical springs
10. To determine of equivalent mass of spring mass for spring mass system
11. Determination of logarithmic decrement (Free Damped Vibrations)
12. Determination of Gyroscopic couple
13. Assignment on Flywheels.
14. Assignment on unit 5.

Term work:
The term work shall consist of Performing / Studying above mentioned experiments. The candidate shall submit the report of each experiment and the assignments.

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.

DESIGN MACHINE ELEMENTS – II

Teaching Scheme
Lectures: 4 Hrs/Week
Credit: 4

Examination Scheme
Theory Examination: 80 Marks (3 Hrs)
Class Test: 20 Marks (1 Hr)

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 (Lewisequation) 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 bevelgears 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 Epicyclicgear 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, centrifugaltension . 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 frommanufacture 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'sequation. 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 MischkeC.R.,"Mechanical Engineering Design", McGraw Hill Publications Co. Ltd.
2. Bhandari V. B., "Introduction to Machine Design", McGraw 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, McGraw Hill.
9. Kulkarni S. G., Machine Design, McGraw Hill
10. Ganesh Babu K. and Srithar K., "Design of Machine Elements", McGraw 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 and 2) and Section B includes remaining three units (3, 4, and 5). Question paper should cover the entire syllabus.

For 80 marks Paper:

1. Five questions in each Section
2. Question no. 1 and 6 are compulsory for 10 marks each which contains short answer questions of 02 marks each
3. From remaining four questions, attempt any two questions from each section

HEAT TRANSFER

Teaching Scheme
Lectures: 4 Hrs/Week
Credit: 4

Examination Scheme
Theory Examination: 80 Marks (3 Hrs)
Class Test: 20 Marks (1 Hr)

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: Conduction (7Hrs)

Modes and laws of heat transfer. Thermal conductivity and its variation with temperature.Insulating materials.Generalized heat conduction equation.Fourier, Laplace and Poisson's equation.Thermal diffusivity.1D, 2D steady state heat conduction - 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, 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: Extended Surfaces (7Hrs)

Types and applications of fins. Heat transfer through extended surfaces. Derivation of equationsfor 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.**Unsteady state heat conduction-** System with negligible internal resistance, Biot and Fourier numbers. Lumped heat capacitymethod. Use of Hiesler and Grober Charts. (Descriptive and numerical treatment)

Unit 3: Convection (8Hrs)

Local and average convective coefficient. Hydrodynamic and thermal boundary layer.Laminarand turbulent flow over a flat plate and in a pipe.Friction factor, laminar and turbulent flow overa flat plate.Drag and drag co-efficient.**Free and Forced Convection -**Dimensional analysis in free and forced convection. Physical significance of the dimensionlessnumbers related to free and forced convection. Empirical correlations for heat transfer in laminarand turbulent flow over a flat plate and in a circular pipe. (Descriptive and numericaltreatment)

Unit 4: Condensation and Boiling (6Hrs)

Modes of pool boiling, critical heat flux, burnout point, forced boiling. Film and drop wisecondensation. (Descriptive and numericaltreatment)

Unit 5: Radiation Heat Transfer (6Hrs)

Introduction to radiative heat transfer, Stefan-Boltzmanlaw, Kirchoff's law, Planck's law and Wein's displacement law. Radiation heat exchangebetween two parallel infinite black surfaces, between two parallel infinite gray surfaces, effect ofradiation shield, intensity of radiation and\solid angle, Lambert's law, radiation heat exchangebetween two finite surfaces-configuration factor or view factor. (Descriptive and numerical treatment)

Unit 6: Heat Exchangers (6Hrs)

Heat exchangers classification, Fouling factor, overall heat transfer coefficient, heat exchangeranalysis-log mean temperature difference (LMTD) for parallel and counter flow heatexchangers. LMTD correction factor, fouling factor. The effectiveness-NTU method for paralleland counter flow heat exchangers. (Descriptive and numerical treatment)

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

Reference Books:

1. Holman J. P., Heat Transfer, Tata Mcgraw Hill
2. YunusCengel, Heat Transfer: A Practical Approach, Tata Mcgraw Hill
3. Domkundwar, Heat and Mass Transfer, DhanpatRai& co.
4. Incropera&Dewit, Fundamentals of Heat & Mass Transfer, Wiley India Pvt . Ltd.
5. R.C. Sachdeva: Fundamentals of Engineering Heat and Mass Transfer, Wiley Eastern Ltd.,India
6. Frank Kreith: Principles of Heat Transfer, Harper and Row Publishers, New York.
7. Heat transfer-A basic approach, Ozisik, Tata McGraw Hill
8. Heat transfer, P.K. Nag, Tata McGraw 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:

4. Five questions in each Section
5. Question no. 1 and 6 are compulsory for 10 marks each which contains short answer questions of 02 marks each
6. From remaining four questions, attempt any two questions from each section

TOOL ENGINEERING

Teaching Scheme
Lectures: 4 Hrs/Week
Credit: 4

Examination Scheme
Theory Examination: 80 Marks (4 Hrs)
Class Test: 20 Marks (1 Hr)

Objectives:

- Enhancing imagination, visualization, design and interpretation skills for cutting tools
- 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, Heat Generation and Cutting Temperature in forces and Merchant's Circle Diagram. Machining, Cutting fluid, Concept of machinability and its improvement, Failure of cutting tool and tool Life, Common use and advanced cutting tools materials.Study of various cutting tool insers (carbide and CBN), their coatings and importance.

Unit 2: Design of cutting tools advanced cutting tools materials. (6 Hrs)

Introduction, types, geometry, nomenclature and design of Drills, milling cutters, Reamers, Taps and broaches.

Unit 3: Design of jigs & fixture (12 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 (06 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 Bending, Compound & progressive dies.

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

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, Drawing Dies coining dies, Bulging dies. - Introduction, Difference between bending, forming & drawing, Design consideration - Radius of draw die, Punch radius, Draw clearance, Drawing speed, Calculating blank size, Number of draws, Drawing pressure

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.

COMPUTER AIDED DESIGN / COMPUTER AIDED MANUFACTURING (CAD/CAM)

Teaching Scheme
Lectures: 4 Hrs/Week
Credit: 4

Examination Scheme
Theory Examination: 80 Marks (3 Hrs)
Class Test: 20 Marks (1 Hr)

Objectives:

- To give an overview of CAD/CAM 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 CNC manufacturing
- To understand the need and use of robotics and rapid prototyping

Unit 1: Introduction to CAD/CAM (5 Hrs)

Definition and history of CAD/CAM; PLM Flow chart for CAD and CAM; Concurrent engineering used for Product Development; CAD/CAM applications like CAAP (Computer Aided Assembly Planning), CAI (Computer Aided Inspection), RP (Rapid Prototyping) and CAPP (Computer Aided Process Planning)

Unit 2: Hardware and Transformations (6 Hrs)

Hardware configuration required for graphics software, Functions of graphics system, Ground rules for selection of graphics software; 2D transformations of geometric models like translation, Scaling, Rotation, Reflection and Shear; Composite transformations: Homogeneous and Concatenated representation; 3D Projections: Orthographic, Axonometric, Oblique and Perspective projections (Numericals on 2D Transformations)

Unit 3: 3D Modeling Techniques (9 Hrs)

Wire frame, Surface and Solid modeling; Modern solid modeling techniques, feature based modeling, parametric modeling, constraint based modeling; Solid Representation: boundary representation, constructive solid geometry, sweep representations, primitive instancing, cell decomposition, Parametric representation of Beizer curve, B-Spline curve; Introduction of Surfaces like Beizer, B-Spline; Capabilities of modeling software like Creo, CATIA, Solid Works, UG/NX

Unit 4: CNC Machine Tools (9 Hrs)

Basic components of NC, CNC and DNC system, NC motion control systems, drive of NC systems; Coordinate System of CNC Lathe Machine, CNC Drilling and CNC Milling Machine; Tool Compensations in CNC Drilling, Lathe and Milling Machines; Different CNC Machining Centers like three, four and five axes; ISO codes (G & M Codes), CNC Part Programming like Manual and APT; Automatic Tool Changer (ATC) Arrangement in CNC

Unit 5: Manufacturing 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 6: Robotics and Rapid Prototyping (6 Hrs)

Robotics: Physical configuration, basic robot motion, technical features of a robot, methods of robot programming, end effectors, industrial applications

Rapid Prototyping: Stereolithography, Selective Laser Sintering, Laminated Object Manufacturing, Fusion Deposition Modeling, Solid Ground Curing and 3D Printing

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

Reference Books:

1. CAD/CAM – 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. Robotics - Control, Sensing and Intelligence – K.S. fu, RC. Gonzalez, Lee
12. Rapid Prototyping – M. Adithan, Atlantic Book House

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. Question no. 1 and 6 are compulsory for 10 marks each which contains short answer questions of 02 marks each
3. From remaining four questions, attempt any two questions from each section

ELECTIVE 1 - INDUSTRIAL HYDRAULICS AND PNEUMATICS

Teaching Scheme
Lectures: 4 Hrs/Week
Credit: 4

Examination Scheme
Theory Examination: 80 Marks (3 Hrs)
Class Test: 20 Marks (1 hr)

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.

Unit 4: 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.

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. Question no. 1 and 6 are compulsory for 10 marks each which contains short answer questions of

02 marks each

3. From remaining four questions, attempt any two questions from each section

ELECTIVE 1 – MACHINE TOOL DESIGN

Teaching Scheme
Lectures: 4 Hrs/Week
Credit: 4

Examination Scheme
Theory Examination: 80 Marks (3 Hrs)
Class Test: 20 Marks (1 hr)

Objective:

- Students are expected to understand & analyze the fundamentals of Machine Tool Design.

Unit 1: Introduction **(4 Hrs)**

General requirements to machine tools, Machine tool design recommendations, Classification of motions to shape surface, Machine tool drives for rectilinear motion, Periodic motion, reversing motion etc.

Unit 2: **Kinematics of Machine Tools** **(4 Hrs)**

Kinematics or gearing diagram of Lathe, drilling Machine, Milling Machine etc. Main drive and feed drive, principles specification of Machine tool.

Unit 3: Design of Kinematics Scheme **(4 Hrs)**

Methods to determine transmission ratios for drives. Development of Kinematics scheme, minimum of transmission groups, Determination of number of teeth on gears..

Unit4: Speed and Feed Boxes **(8 Hrs)**

General requirement Design of gear trains, speed boxes types, speed changing devices Feed boxes characteristics of feed mechanism, types of Rapid traverse mechanisms, variable devices.

Unit 5: Spindle Design And Spindle Bearings **(6 Hrs)**

Main requirement, Materials and details of spindle design, Spindle bearings, bearings, types of bearings and their selections, Bearing Materials BED

Unit 6: Columns, Tables And Ways **(4 Hrs)**

Materials, typical constructions and design.

Unit 7: Machine Tools Control Systems **(4 Hrs)**

Requirement of control system selection and construction of control systems Mechanical control system, predilection control, remote control safety devices.

Unit 8: Machine Tool Dynamics **(4 Hrs)**

Dynamic performance, dynamic and elastic system of Machine, tools. Dynamics of cutting forces, tool chatter.

Unit 9: Recent Trends **(2 Hrs)**

A review of recent practices used in Machine Tool Technology effect of development on manufacturing process, modular design concept.

Section A: Unit 1, 2, 3 and 4
Section B: Unit 5, 6, 7, 8 and 9

Reference Books:

1. Machine Tools Design - Sen and Bhattacharya, CBS Publishers
2. Machine Tool Design - N.K. Mehta, Tata Mc Graw Hill.
3. Machine Tool Design - N. Acherkan, Mir Publishers
4. Design of machine tools - S.K. Basu and D.K. Pal, Oxford and IBH
5. Principles of Machine Tool - Bhattacharya and S. G. Sen, New central book agency Calcutta
6. Design Principles of Metal Cutting Machine Tools - F. Koenigsberger, The Macmillan Company New York
7. Numerical control and computer Aided Manufacturing - T. kundra, Rao, Tiwari N.K., Tata Mc Graw Hill
8. NC Machine Tools - Martin S.J., ELBS

Pattern of Question Paper:

The units in the syllabus are divided in two 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 five units (5, 6, 7, 8 and 9). Question paper should cover the entire syllabus.

For 80 marks Paper:

1. Five questions in each Section
2. Question no. 1 and 6 are compulsory for 10 marks each which contains short answer questions of 02 marks each
3. From remaining four questions, attempt any two questions from each section

ELECTIVE - I INDUSTRIAL PRODUCT DESIGN

Teaching Scheme
Lectures: 4 Hrs/Week
Credit: 4

Examination Scheme
Theory Examination: 80 Marks (3 Hrs)
Class Test: 20 Marks (1 Hr)

Objectives:

- Students are expected to understand the basics of product design.
- Students are able to understand the product development process.

Unit 1: Introduction **(5 hrs)**

Characteristics of successful product development, Who designs and develops products? Duration and cost of Product development.

Unit 2: Development Process **(9 hrs)**

The Product Development Process, Concept development- The front end process, Adapting the Generic Product development process, Product development process flow, The Tyco Product Development process.

Unit 3: Opportunity Identification **(6 hrs)**

What is an opportunity? Opportunity identification process, Five steps of product Planning, Identifying customer needs

Unit 4: Product Specifications **(8 hrs)**

What are specifications? When are specifications established? Establishing Product Specifications, Setting the final specifications, Concept generation- The activity of concept generation-steps 1 to 5, **Concept Selection**: Concept selection, Methods for choosing concept, Benefits, Concept Screening, Concept Testing.

Unit 5: Product Architecture **(5 hrs)**

What is Product Architecture**?** Implications of the Architecture, Establishing the architecture, Delayed differentiation, Platform planning, Related system Level Design Issues

Unit 6: Industrial Design **(7 hrs)**

What is Industrial design? Assessing the need for Industrial Design, The impact of industrial design, The industrial design process, Management of the industrial design process, Assessing the quality of industrial design..

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

Reference Books:

1. Product Design and Development- Karl T Ulrich, Steven D Eppinger, McGraw Hill
2. The basics of Product Design Development- Phil Baker, Press Delivers Elements-Financial Times
3. Product Design- Mike Baxter, CRC Press
4. Concurrent Engineering in Product Design and Development- ImadMoustapha, New Age International

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. Question no. 1 and 6 are compulsory for 10 marks each which contains short answer questions of 02 marks each
3. From remaining four questions, attempt any two questions from each section

ELECTIVE - I ROBOTICS AND AUTOMATION

Teaching Scheme
Lectures: 4 Hrs/Week
Credit: 4

Examination Scheme
Theory Examination: 80 Marks (3 Hrs)
Class Test: 20 Marks (1 Hr)

Objective:

- Students are expected to understand the basics of Robotics and Automation.

Unit 1: Introduction (6 hrs)

Definition and History of Robots, Automation and Robotics, Robot anatomy, Robot classification – Drive technologies, work envelope, geometries, motion control methods, Robot specifications – Pay load, reach, precision , accuracy and repeatability.

Unit 2: Robot Kinematics (6 hrs)

Matrix representations of coordinate transformation, Transformation about reference frame and moving frame. Forward and Inverse kinematics. RPY and Euler's angle. Homogeneous coordinate transformation and examples.

Unit 3: Trajectory Planning (8 hrs)

Introduction, General considerations in path description and generation, Joint space schemes, Cartesian space schemes, Joint space Verses Cartesian space, point to point and continuous trajectory.

Unit 4: Robot end Effectors, Sensors And Vision System (8 hrs)

Types of End effectors – mechanical, vacuum, magnetic, adhesive grippers, tools as end effectors, gripper force analysis and design.

Introduction to Sensors: Need of sensors in a robotic system, Types of sensors, Desirable features and characteristics of sensors, Photo sensors, range sensors, proximity sensors, touch sensors, RCC device.

Vision System: Need of vision system in a robotic system, Image acquisition and illumination techniques.

Unit 5: Robot Programming Languages (6 hrs)

Introduction, Robot programming methods, Robot programming languages, Artificial intelligence in robotics.

Unit 6: Automation (6 hrs)

Objectives, Automation in Manufacturing, Robot application in industry, Modern robots, future application and challenges.

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

Recommended Text Books for Reference:

1. Industrial Robotics, M.P.Groover, M.Weiss R.N, McGraw Hill 1996
2. Robot technology and flexible automation, S.R.Deb, Tata McGraw Hill
3. Robotics: Control, Sensors, Vision and intelligence, K.S. Fu, R.C. Gonzalez and C.S.G. Lee, McGraw Hill 1987
4. Robotics and Control, R.K. Mittal, Tata McGraw Hill
5. Fundamentals of Robotic Analysis and control, Klafter, Richard D., et al, Prentice Hall of India Pvt. Ltd.
6. Robotics for Engineers, YoramKoren, McGraw Hill International 1st Edition 1985

Pattern of the Question Paper:

The units in the syllabus are divided in two equal sections. Question Paper shall consist of two sections A and B. Section A questions shall be set on first 3 units (1, 2 and 3) and sections B questions shall be set on remaining 3 units (4, 5 and 6). Question paper should cover the entire syllabus.

For 80 marks Paper:

1. Five questions in each Section
2. Question no. 1 and 6 are compulsory for 10 marks each which contains short answer questions of 02 marks each
3. From remaining four questions, attempt any two questions from each section

ELECTIVE- I ADVANCED THERMODYNAMICS

Teaching Scheme
Lectures: 4 Hrs/Week
Credit: 4

Examination Scheme
Theory Examination: 80 Marks (3 Hrs)
Class Test: 20 Marks (1 Hr)

Objectives:

- To have in-depth study of thermodynamics
- To study statics of thermodynamics
- To introduce research base in thermodynamics

Unit 1: Introduction to Thermodynamics (7 hrs)

First, Second, and third law of thermodynamics, and its applications, thermodynamic potentials, generalized relations for C_p and C_v. Equations of State: Benedict-Webb-Rubin Equation of State, Virial Equation of State. Thermodynamic relations and Entropy**:** Cyclic and reciprocity relations, general relations, Iso-thermal compressibility and coefficient of volume expansion.

Unit 2: Entropy (7 hrs)

Concepts of entropy: entropy flow, entropy generation during heat transfer and thermodynamic processes, Entropy generation associated with heat transfer, Joule-Thomson coefficient, Clapeyron equation, Basic principles of liquefaction: Liquefaction of gases, Storage and uses of cryogenic fluids.

Unit 3: Thermodynamic Relations (6 hrs)

Gibbs and Helmholtz relations, Maxwell relations, T.dS equations, Heat capacity equation, entropy change, isentropic efficiency, T-s diagrams, effect of efficiency on compressor input, and nozzle exit velocity.

Unit 4: Exergy (6 hrs)

Exergy: Reversible work/Maximum power output, Irreversibility, availability function, second law analysis and efficiency, change of exergy, and exergy destruction

Unit 5: Chemical Reaction (7 hrs)

Chemical Reactions: Fuels and combustion, elemental analysis of fuels, thermo-chemistry, combustion equations, reverse combustion analysis, evaluation of enthalpy of combustion, analysis of steady flow combustion, analysis of combustion in bomb, adiabatic flame temperature, reversible work associated with combustion and second law analysis of isothermal and adiabatic combustion.

Unit 6: Thermodynamics of high speed gas flow (7 hrs)

Thermodynamics of high speed gas flow: Stagnation properties, compression of high speed air and sound, Mach number and its applications, isentropic flow, air/gas flow through convergent divergent nozzle, Tc and Pc in gas flow, back pressure, shock wave in Converging–Diverging nozzle, flow through non-isentropic nozzles. Shock Waves and Expansion, Normal Shocks, Oblique Shocks.

Reference Books:

1. Applied Engineering Thermodynamics (5/e) - P K Nag
2. Thermodynamics- J.P.Holman, 3/e. McGraw-Hill Inc, New York, 1980
3. Advanced Thermodynamics for Engineers- Kenneth Wark Jr. McGraw-Hill Inc, New York, 1995
4. Advanced Engineering Thermodynamics- Bejan A, 2/e, New-York, Wiley Interscience, 1997
5. Thermodynamics an engineering approach- Yunus A Cengel, Michael A Boles, Tata McGraw-Hill,
6. Fundamentals of Classical Thermodynamics- G. J. Van Wylen, R.E.Sonntag, 3/e,
7. Introduction to Chemical Engineering Thermodynamics- Smith. J.M, and Van Ness, 4/e, McGraw-Hill.

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

Pattern of the Question Paper:

The units in the syllabus are divided in two equal sections. Question Paper shall consist of two sections A and B. Section A questions shall be set on first 3 units (1, 2 and 3) and sections B questions shall be set on remaining 3 units (4, 5 and 6). Question paper should cover the entire syllabus.

For 80 marks Paper:

1. Five questions in each Section
2. Question no. 1 and 6 are compulsory for 10 marks each which contains short answer questions of 02 marks each
3. From remaining four questions, attempt any two questions from each section

LAB– V: - DESIGN MACHINE ELEMENTS – II

Teaching Scheme
Practical: 2 Hrs/Week
Credit: 1

Examination Scheme
Term Work: 25 Marks
Practical Exam: 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

- Gearbox design.
- Clutch design.
- Brake design.

B) Assignments based on

- Sliding contact bearing.
- Rolling contact bearing.
- Design of belt drives.

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.

LAB– VI: HEAT TRANSFER

Teaching Scheme
Practical: 2 Hrs/Week
Credit: 1

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

Practical/ Term-work consist of the performance and record of the following experiments

1. Determination of the thermal conductivity of a given 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 flow.
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.

Term work:
The term work shall consist of Performing / Studying above mentioned experiments. The candidate shall submit the report of each experiment and the assignments.

Practical Examination:
The Practical Examination will comprise of performing the experiments and viva voce on the Syllabus. The practical will be assessed by two examiners, one will be the subject teacher and other will be examiner appointed by Dr. B.A.M.U. Aurangabad.
Practical examination shall consist of performing one of the experiments and producing the results followed by Viva. Performing experiment shall be allotted 15 marks and 10 marks for viva.

LAB– VII: TOOL ENGINEERING

Teaching Scheme
Practical: 2 Hrs/Week
Credit: 1

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

(First Angle projection to be adopted)

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 and detail drawings of different clamping elements.
Sheet 3: Design and drawing of jig for given component.
Sheet 4: Design and drawing of milling fixture for given component or design and drawing of turning fixture for given component.
Sheet 5: Design and drawing of any one press tool (compound die / progressive die/Drawing Die)
Prepare a single point cutting tool made up of any soft material.
Demonstration of generation of various chips during machining operations.
Practical Examination should be based on Viva-Voce on the above syllabus.

Term work:
The term work shall consist of Performing / Studying above mentioned experiments. The candidate shall submit the report of each experiment and the assignments.

Practical Examination:
The Practical Examination will comprise of performing the experiments and viva voce on the Syllabus. The practical will be assessed by two examiners, one will be the subject teacher and other will be examiner appointed by Dr. B.A.M.U. Aurangabad.

LAB- VIII: COMPUTER AIDED DESIGN / COMPUTER AIDED MANUFACTURING (CAD/CAM)

Teaching Scheme
Practical: 2 Hrs/Week
Credit: 2

Examination Scheme
Practical Exam: 50 Marks

Performing minimum 7 experiments out of the following and preparing record of the experiments.

1. Creating 2-D model of any two components on any drafting tool which should contain dimensions, tolerances and get its hardcopy output
2. Creating Solid model and its Drafting of any two components which should contain dimensions, tolerances using any higher end CAD software and get its hardcopy output
3. Building a composite assembly consisting of at least five components using any higher end CAD software and get its hardcopy output
4. Developing and executing a part program for contouring on CNC milling machine
5. Developing and executing a part program for CNC lathe machine
6. Developing and executing a part program for point to point on CNC drilling machine
7. Assignment on Unit 5
8. Assignment on Unit 6

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.

Mini Project

Teaching Scheme
Practical: 2 Hrs/Week
Credit: 2

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

Objective:

To train students in identification, analysis, finding solutions and execution of live engineering and managerial problems. It is also aimed to enhance the capabilities of the students for group activities. Individual students are required to choose a topic of their interest. The subject content of the mini project shall be from emerging / thrust areas, topics of current relevance having research aspects or shall be based on industrial visits. Students can also choose live problems from manufacturing organizations as their mini project.

Term Work:

At the end of the semester, the students should submit a report duly authenticated by the respective guide, to the head of the department.

Practical Exam:

The practical examination shall be based on presentation on the topic of mini project.