SIPNA COLLEGE OFENGINEERING&TECHNOLOGY, AMRAVATI

An Autonomous Institute Affiliated to

Sant Gadge Baba Amravati University, Amravati, Maharashtra (India)

(Approved by AICTE, New Delhi and Recognized by DTE, Maharashtra)

(Accredited With 'A+' Grade by NAAC)

Bachelor of Technology (B. Tech.)

Multidisciplinary Minors Syllabus– Semester III and IV

Department of Mechanical Engineering

B. Tech. Mechanical Engineering with Multidisciplinary Minor

(Semester Pattern)

Effective from Academic Year 2025-26

Prepared by: Board of Studies - Mechanical Engineering

Approved by: Academic Council - Sipna COET, Amravati

			05/07/2025	1.00
Chairman Board of Studies	**Dean Academics**	**Chairman Academic Council**	**Date of Release**	**Version**

Syllabus Semester III

Program:	**B. Tech. (Mechanical Engineering)**			**Semester:**			**III**	
Course:	**Applied Mathematics**			**Code:**			**BTMEBS07SH3T**	
Teaching Scheme				**Evaluation Scheme**				
Lecture	**Tutorial**	**Hours**	**Credit**	**TA**	**MSE-I**	**MSE-II**	**ESE**	**Total**
3	**-**	**3**	**3**	**10**	**15**	**15**	**60**	**100**

Methods of Teacher Assessment (TA): Assignments & Class Attendance

Course Objectives: To expose students to understand the basic concepts of Numerical and Statistical methods.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Apply Numerical methods to find roots of the nonlinear equation.	L3
CO-2	Solve differential equation & integral equation by using Numerical methods.	L3
CO-3	Analyze the data to fit Curves Using Statistical Techniques.	L4
CO-4	Estimate the data points by using interpolation formulae.	L5
CO-5	Make use of Probability Concepts to solve Real-World Problems.	L3
CO-6	Find Laplace Transforms of various functions by using standard properties.	L1

Unit I: Numerical Methods -I **(6 Hrs.)**

Numerical Solution of nonlinear equation: Newton Raphson Method, Method of False position, Gauss- Seidel Method.

Unit II : Numerical Methods -II **(6 Hrs.)**

Numerical Differentiation: Eulers's Method, Runga-Kutta method Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule

Unit III : Statistics **(6 Hrs.)**

Curve fitting – Straight line, parabola, Coefficient of correlation, lines of regression

Unit IV: Interpolation **(6 Hrs.)**

Newton's forward and backward difference formula, Gauss forward and backward interpolation, Stirling formula

Unit V: Probability and Statistics **(6 Hrs.)**

Probability, Binomial distribution, Poisson distribution, Normal Distribution.

Unit VI : Laplace Transform **(6 Hrs.)**

Basic formulae, Properties of LT, Laplace Transform of Periodic Function.

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Total: 36 Hrs.

Textbooks:

1. A Text Book of Applied Mathematics Vol. II & III by P.N. Wartikar & J. N. Wartikar.
2. Higher Engineering Mathematics by Dr. B.S. Grewal.
3. Numerical Methods by Dr. B.S. Grewal.

Reference Books:

1. Fundamentals of Mathematical statistics by S. C. Gupta, V. K. Kapoor.
2. Probability & Statistics by Murray R. Spiegel, John Schiller, R. Alu Srinivasan.
3. Mathematical Statistics by J.N. Kapur & H.C. Saxena.

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Dated:- 05/07/25

Program:	**B. Tech. (Mechanical Engineering)**			**Semester:**			**III**	
Course:	**Mechanics of Materials**			**Code:**			**BTMEPC02ME3T**	
Teaching Scheme				**Evaluation Scheme**				
Lecture	**Tutorial**	**Hours**	**Credit**	**TA**	**MSE-I**	**MSE-II**	**ESE**	**Total**
3	**-**	**3**	**3**	**10**	**15**	**15**	**60**	**100**

Methods of Teacher Assessment (TA): Class Test, Assignments, Quiz & Class Attendance

Course Objectives: To develop the ability to understand and apply fundamental principles of stress, strain, and deformation in mechanical elements subjected to various loads for safe and efficient mechanical design.

After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	***Understand*** and ***apply*** the fundamental concepts of stress & strain to compute stresses in bars under axial and thermal loads.	L2 & L3
CO-2	***Apply*** elastic constant relations and ***analyze*** strain energy under static and impact loading.	L3 & L4
CO-3	***Apply*** structural ***analysis*** principles to draw shear force and bending moment diagrams for determinate beams.	L3 & L4
CO-4	***Analyze*** circular shafts in torsion to determine stress, twist and power.	L4
CO-5	***Analyze*** thin shells and ***evaluate*** stresses and dimensional changes under internal pressure.	L4 & L5
CO-6	***Analyze*** beams to determine stresses and deflections.	L4

Unit I: Fundamentals of Stress and Strain (07 Hrs.)

Introduction, Stress-strain relation, Factor of safety, Hooke's law, Bars with uniform cross-sections, Bars with cross-sections varying in steps, Bars subjected to varying loads, Compound bars of two materials only, Temperature stresses and Simple shear.

Unit II: Elastic Properties and Energy Considerations (05 Hrs.)

Poisson's ratio, Volumetric strain, Elastic constants and their relationships, Strain energy due to direct stresses and impact loads.

Unit III: Shear Force and Bending Moment in Statically Determinate Beams (06 Hrs.)

Shear force and bending moment, Sign Convention, Relationship among loading intensity, shear force and bending moment, Shear force and bending moment diagrams for cantilever, simply supported and overhanging beams subjected to concentrated and uniformly distributed loads.

Unit IV: Torsion (06 Hrs.)

Pure torsion, Torsional equations, Polar modulus, Power transmitted, Torsional rigidity and Closed-coil helical springs.

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Unit V: Thin Cylinders and Spheres **(05 Hrs.)**

Stresses in thin cylinders, Changes in dimensions of a cylinder, Riveted cylinders, Thin spherical shells.

Unit VI: Stresses in Beams and Deflection of Beams **(07 Hrs.)**

Theory of simple bending, Practical application of bending equation, Section modulus for rectangular, circular, T & I sections, Shearing stresses in beams, Shear stresses across rectangular, circular, T & I cross sections, Deflection of beam by Macaulay's method for cantilever and simply supported beams subjected to concentrated and uniformly distributed loads.

Total: 36 Hrs.

Textbooks:

1. Strength of Materials (Vikas Publishing House Pvt. Ltd.) by S. S. Bhavikatti
2. Strength of Materials (Danpat Rai and Sons, New Delhi) by Ramamruthm
3. Strength of Materials (S. Chand) by Rajput
4. Strength of Materials (Laxmi publications) by Dr. R. K. Bansal

Reference Books:

1. Mechanics of Material (Pearson Education) by R. C. Hibler -10th Edition
2. Strength of Materials (Joanna Cotler Books) by F. L. Singer

MOOC Links:

1. Strength Of Materials - IITM - Course

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Program:	**B. Tech. (Mechanical Engineering)**	**Semester:**	**III**
Course:	**Mechanics of Materials Lab**	**Code:**	**BTMEPC03ME3P**

Teaching Scheme				**Evaluation Scheme**		
Practical	**Tutorial**	**Hours**	**Credit**	**INT**	**EXT**	**Total**
2	**-**	**2**	**1**	**30**	**20**	**50**

Course Objectives: To enable students to practically determine the mechanical properties of materials through standard testing methods so they can observe, measure, and interpret fundamental strength and deformation behaviours used in real engineering applications.

Course Outcomes: After completion of the course, the students will be able to:

CO	**Course Outcomes**	**BT Level** (L1 to L6)
CO1	***Apply*** the experimental procedures of tension, compression, and shear tests to determine the mechanical properties of materials.	L3
CO2	***Analyze*** the mechanical behavior of materials by conducting hardness and impact tests and interpreting their response under surface and sudden loading conditions.	L4
CO3	***Apply*** the procedures of torsion and modulus of rupture tests to determine the material response to twisting and bending stresses.	L3
CO4	***Apply*** the procedure of beam deflection testing to determine the deflection of beams under various loading conditions.	L3

Sr. No.	**List of Experiments**	**Mapped CO**
1	Tension test on mild steel rod	CO 1
2	Compression test on timber	CO 1
3	Shear test on mild steel rod	CO 1
4	Hardness test (Brinell) on mild steel	CO 2
5	Impact test (Izod) on mild steel rod	CO 2
6	Torsion test on mild steel rod	CO 3
7	Modulus of rupture test on wooden beam	CO 3
8	Deflection test on simply supported beam.	CO 4

Note:

i) At least one practical should be conducted addressing each CO.

ii) Practical examination shall be viva-voce based on above practical & the theory syllabus of course.

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Program:	**B. Tech. (Mechanical Engineering)**			**Semester:**			**III**	
Course:	**Mechanical Shaping & Forming Process**			**Code:**			**BTMEPC04ME3T**	
Teaching Scheme				**Evaluation Scheme**				
Lecture	**Tutorial**	**Hours**	**Credit**	**TA**	**MSE-I**	**MSE-II**	**ESE**	**Total**
3	**-**	**3**	**3**	**10**	**15**	**15**	**60**	**100**

Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance

Course Objectives:

1. To understand the principles of moulding, casting, and metal forming processes.
2. To classify and compare various casting and shaping processes.
3. To study different melting furnaces and rolling/press forming operations.
4. To develop understanding of hot and cold working processes and their industrial applications

After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Explain the fundamental principles of pattern, core, core print and mould making.	L2
CO-2	Demonstrate the working principles of sand-casting process, gating systems and summarize casting defect causes, remedial actions.	L3
CO-3	Describe the working principles of special casting processes and distinguish it with sand casting.	L2
CO-4	Classify the construction, working and applications of various metal melting furnaces used in foundry.	L2
CO-5	Describe various metals forming processes and review the principles of hot and cold working.	L2
CO-6	Illustrate the operations involved in rolling and forging process.	L2

Unit I: Introduction to Foundry **(6 Hrs.)**

Introduction to Foundry terminology and safety practices in industry, Types of patterns – solid, split, match plate, sweep, skeleton; Pattern materials and selection criteria; Pattern allowances: shrinkage, draft, machining, distortion, rapping; Core and core prints – types, core materials, and functions. Types of moulds – temporary, permanent, composite; Moulding materials – sand composition, additives, and properties, Moulding methods – hand moulding, machine moulding, and shell moulding.

Unit II: Sand casting Process **(6 Hrs.)**

Steps in sand casting: pattern making, mould and core preparation, gating, pouring, solidification, shakeout, and fettling, Sprue, runner, riser, gating system; principles of fluid flow in gating. Pouring time calculations, Common casting defects- causes and remedies.

Unit III: Special casting processes **(6 Hrs.)**

Introduction, working principle and application of Die casting, Investment casting, Centrifugal casting, Continuous casting; Comparison of special casting methods with sand casting.

Unit IV: Melting Furnaces **(6 Hrs.)**

Introduction to melting furnaces; Construction, operation and application of Cupola furnace, Crucible furnace – oil/gas/electric , Induction furnace, Electric arc furnace.

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Unit V: Hot and cold working processes **(6 Hrs.)**

Introduction to forming processes; Differences between hot and cold working; Effects on material properties and microstructure; Typical hot and cold working operations: extrusion, piercing, pipes & tubes production, wire drawing, deep drawing, spinning, rotary swaging; Defects in hot and cold working.

Unit VI: Rolling and press operations **(6 Hrs.)**

Rolling, types of rolling mills, forging operations, upset forging, shearing operations, squeezing and bending operations, Introduction to Press and hammer forging.

Total: 36 Hrs

Textbooks:

1. Workshop Technology Vol I by Raghuwanshi,Dhanpat Rai Publishing Company (P) Ltd.
2. Workshop Technology Vol I by Hajra Chaudhary, Dhanpat Rai & Sons 2001.
3. Manufacturing Technology by P. N. Rao, Volume 1 McGraw Hill Education 2013.

Reference Books:

1. Manufacturing Processes by J.P. Kaushish, PHI
2. Processes and Materials of Manufacture by R.A.Lindberg, PHI Pub 2001.
3. Manufacturing Engineering and Technology by SeropeKalpakjian& Steven R. Schmid, Pearson 2023.

MOOC Links:

1. https://archive.nptel.ac.in/courses/112/107/112107083/
2. https://onlinecourses.nptel.ac.in/noc25_me63/preview

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Program:	**B. Tech. (Mechanical Engineering)**			**Semester:**	**III**	
Course:	**Mechanical Shaping & Forming Process Lab**			**Code:**	**BTMEPC05ME3P**	
Teaching Scheme				**Evaluation Scheme**		
Practical	**Tutorial**	**Hours**	**Credit**	**INT**	**EXT**	**Total**
2	**-**	**2**	**1**	**30**	**20**	**50**

Course Objectives:

- To acquire the knowledge of casting process for manufacturing defect free casting.
- To understand working principles and applications of forming processes.

Course Outcomes: After completion of the course, the students will be able to:

CO	**Course Outcomes**	**BT Level** (L1 to L6)
CO1	Prepare wooden pattern and develop a sand mold by using different pattern.	L3
CO2	Understand the working principle of various furnaces and Identify suitable furnace for different metal composition.	L2
CO3	Prepare a job of casting using sand mold.	L3
CO4	Demonstrate the fundamental knowledge of forging operations used in industrial practice and apply it to prepare job using hearth furnace.	L3

Experiment List

S.No.	**Experiment list**	**CO Mapping**
1	Preparation of wooden pattern in pattern making shop.	CO-1
2	Preparation of molding sand mixture along with mold cavity.	CO-1
3	Preparation of sand mold by using pattern.	CO-1
4	Demonstration of electric arc furnace and cupola furnace through industrial visit.	CO-2
5	Preparation of sand casted part by using sand casting mold.	CO-3
6	Preparation of forging job using hearth furnace.	CO-4
7	Demonstration of various press operations through industrial visit.	CO-4

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Program:	**B. Tech. (Mechanical Engineering)**			**Semester:**			**III**	
Course:	**Engineering Thermodynamics**			**Code:**			**BTMEPC06ME3T**	
Teaching Scheme				**Evaluation Scheme**				
Lecture	**Tutorial**	**Hours**	**Credit**	**TA**	**MSE-I**	**MSE-II**	**ESE**	**Total**
3	**1**	**4**	**4**	**10**	**15**	**15**	**60**	**100**

Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance

Course Objectives: To help students learn the basic laws and concepts of thermodynamics and understand how heat, work, and energy behave in different systems and cycles used in engineering.

After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Understand the basic concepts, laws, and properties of thermodynamics, including the application of gas laws to simple systems.	L2
CO-2	Explain the concepts of work and heat and calculate work done during various thermodynamic processes using P–V diagrams.	L3
CO-3	Apply the first law of thermodynamics to closed systems to determine heat transfer in various thermodynamic processes.	L3
CO-4	Derive and utilize the steady-flow energy equation to evaluate energy interactions in various open systems	L3
CO-5	Apply the second law of thermodynamics to heat engines, refrigerators, and heat pumps and explain the concept of entropy.	L3
CO-6	Describe basic gas and vapor power cycles and derive their efficiency equations.	L2

Unit I: Basic Concepts of Thermodynamics **(6Hrs.)**

Introduction to thermodynamic systems, Macroscopic and microscopic approaches, properties of thermodynamic systems, states, processes, and cycles; thermodynamic equilibrium, Zeroth law and quasi-static processes; gas laws, ideal gas equation and universal gas equation. (Numerical on gas laws and ideal gas equation.)

Unit II: Work and Heat **(6Hrs.)**

Definition of work and heat, concept of heat and work as a path function; comparison between work and heat; All thermodynamic processes (Isothermal Process, Isobaric Process, Isochoric Process, Adiabatic Process and Polytropic Process) with pressure, volume and temperature (PVT) relations, work done during various thermodynamic processes; pressure-volume (P–V) diagrams

Unit III: First law of thermodynamics **(6Hrs.)**

First law for closed systems undergoing cycles and change of state; Joule's experiment; Perpetual Motion machine of first kind (PMM-I); internal energy and enthalpy; energy as a property; Internal energy-a function of temperature, Mayer's relation; Heat Transfer during various non-flow processes.

Unit IV: First Law applied to flow processes **(6Hrs.)**

Concept of steady-flow process; derivation of steady-flow energy equation; applications to open

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systems limited to nozzles, diffusers, turbines, compressors, boilers, pumps, heat exchangers, and throttling devices.

Unit V: Second Law of thermodynamics **(6Hrs.)**

Limitations of the first law; second law of thermodynamics: Kelvin–Planck's and Clausius statements; PMM-II; Introduction to heat engines, refrigerators, and heat pumps; coefficient of performance (COP); Carnot cycle and efficiency; Carnot theorem and its corollaries; Clausius inequality; introduction to entropy.

Unit VI: Gas & Vapour Power Cycles **(6Hrs.)**

Basic gas and vapor power cycles – Otto, Diesel, Brayton, sterling and Rankine; derivation of efficiency equations; and their representation on P-V and temperature-entropy (T-S) diagram.

Total: 36 Hrs

Text Books:

1. Engineering Thermodynamic - by P. K. Nag.
2. Fundamentals of Engineering Thermodynamics; R. Yadav;
3. Thermodynamics Basics and Applied: by V. Ganeshan

Reference Books:

1. Basic Engineering Thermodynamics- by Reyner Joel
2. Thermodynamics- by C. P. Arora.
3. Thermal Engineering: by Mahesh M. Rathore.

MOOC Links:

1. https://onlinecourses.nptel.ac.in/noc25_cy04/preview

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Program:	**B. Tech. (Mechanical Engineering)**			**Semester:**			**III**	
Course:	**Industrial Management**			**Code:**			**BTMEHM01ME3T**	
Teaching Scheme				**Evaluation Scheme**				
Lecture	**Tutorial**	**Hours**	**Credit**	**TA**	**MSE-I**	**MSE-II**	**ESE**	**Total**
2	**-**	**2**	**2**	**10**	**15**	**15**	**60**	**100**

Methods of Teacher Assessment (TA): Attendance, Assignment, Viva

Course Objectives: To make students aware about organization structure and working environment in the organization by providing the knowledge / information about scientific methods & tools applied in business environment.

After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Explain the evolution of management thought, key management principles and organizational structure.	L3
CO-2	Apply the principles and practices of material management including inventory control, purchasing, material classification and economic order quantity.	L3
CO-3	Apply standard marketing principles and techniques including market research, marketing mix, product life cycle, consumer behaviour, promotional strategies and apply break even analysis for business decision making.	L3
CO-4	Apply basic principles of financial management including preparation and analysis of financial statements like balance sheet and profit & loss statement.	L2

Unit I: Principles and Techniques of Management **(6 Hrs.)**

Evolution of management thoughts. Concept, Definition, Function & Principles of Management. Concept of Administration Vs. Management, Organization definition, Process, organization structure, Departmentalization. Principles of scientific management by F. W. Taylor & its criticism, Fayol's principles of General Management. Delegation of Authority & Responsibility, Objectives, Elements, Relationship & Differences between Authority and Responsibility, Principles of effective delegation of authority, Barriers to effective delegation of authority, Span of Control & concept of Management by Exception

Unit II: Material Management **(6 Hrs.)**

Concept, Definition, Aim, Purpose, Objective & Function of Materials management, classes of materials, scope of material control, scope and function of purchasing department, purchasing procedure, inventory control, ordering procedure, material identification, store function. Economic order of quantity

Unit III: Marketing & Sales Management **(6 Hrs.)**

Concept, Definition, Function, difference between selling & marketing, Marketing strategy, market research, Marketing mix, Market types, Product development cycle, Product life cycle. Sales organization, Buying, motives, Advertising, Selling methods, Sales Promotion, Consumer behaviour. Break even analysis.

Unit IV: Finance Management **(6 Hrs.)**

Introduction, Definition, Aim, Purpose, Objective & Function of Financial Management. Financial

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Statement: Introduction, Advantages, Limitations & Essentials. Fundamental of Balance sheet and Profit & Loss statement, Importance and problems base on same.

Total: 24Hrs

Textbooks:

1. Management – Principles, Processes and Practices by A. Bhat, Aryakumar, Oxford University Press
2. Industrial Management by I. K. Chopde & A. M. Sheikh, S. Chand Publication

Reference Books:

1. Essentials of Management by Koontz, Harold; McGraw-Hill Education(India)

MOOC Links:

1. https://onlinecourses.nptel.ac.in/noc24_mg47/preview (Principles of Management)

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Syllabus Semester IV

Program:	**B. Tech. (Mechanical Engineering)**			**Semester:**			**IV**	
Course:	**Material Science**			**Code:**			**BTMEPC07ME4T**	
Teaching Scheme				**Evaluation Scheme**				
Lecture	**Tutorial**	**Hours**	**Credit**	**TA**	**MSE-I**	**MSE-II**	**ESE**	**Total**
3	**-**	**3**	**3**	**10**	**15**	**15**	**60**	**100**

Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance

Course Objectives:

1. To study the classification of materials and alloys along with their effects and applications.
2. To study the various heat treatment processes and their industrial applications.
3. To study the mechanical working of metals and process of powder metallurgy.

After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	***Explain*** the basic concepts of metallurgy, solidification, and deformation mechanisms in metals.	L2
CO-2	***Interpret*** the iron–carbon equilibrium diagram and related microstructures to determine structure–property relations in steels.	L3
CO-3	***Analyze*** various alloy steels and stainless steels based on their composition, properties, and applications.	L4
CO-4	***Analyze*** ferrous and non-ferrous alloys based on their composition, properties, and engineering applications.	L4
CO-5	***Apply*** heat-treatment and surface-hardening principles to interpret transformations and property changes in metals.	L3
CO-6	***Explain*** powder-metallurgy processes and their applications in engineering components.	L2

UNIT-I: Introduction to Metallurgy . **(6 Hrs)**

Basic concept of process metallurgy, physical metallurgy, and mechanical metallurgy, Classification of materials & their application, Structure of metals and alloys, formation of Alloys, Solid solutions, types and their formation, lever rule for phase mixtures. Solidification of pure metals, nucleation and growth, ingot structure, dendritic solidification. Luder's bands, Deformation mechanisms-Slip & twining.

UNIT II: Study of binary equilibrium diagram **(6 Hrs)**

Study of binary equilibrium diagram and invariant reactions, Construction and study of Iron-carbon Equilibrium Diagram, Critical temperatures, Microstructure of slowly cooled steel, Estimation of carbon from microstructure, structure property relation, Introduction to composite materials, advantages and applications.

UNIT III: Alloy Steels **(6 Hrs)**

Classification and application of plain carbon steel Effect of grain size and impurities on properties of plain carbon steel Purpose of alloying, classification of alloying elements

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and their effect on steels, effect on transformation in steel, Low alloy engineering steels and High speed steels. Ferritic, Austenitic and Martenstic stainless steels, their properties and applications, weld decay in stainless steel.

UNIT IV: Cast irons & Non Ferrous Metals (6 Hrs)

Factors governing condition of carbon in cast iron, Maurer's diagram, Solidification of grey and white cast iron, Malleabalizing, Constitution and properties of white, gray, Nodular and Malleable cast irons, their applications, Alloy cast irons.

Non Ferrous Metals and Alloys : Types, Properties and uses of Brasses and Bronzes. Important alloys of Aluminium, Lead, Tin and Zinc, their applications. Bearing materials, Season cracking, precipitation hardening.

UNIT V: Principles of Heat Treatment (6 Hrs)

Annealing, Normalizing, Tempering Iso-thermal transformation diagrams(S-curve), super imposition of continuous cooling curves on 's' Curve, pearlite, bainite and martenste transformation, Quenching media, severity of quench, Austempering, Martempering and patenting, Retained austenite and sub-zero treatment. Hardenability. Methods of surface hardening: Carburizing, Nitriding, Cyaniding, Flame and Induction Hardening. Work hardening, strain Ageing; Recovery, Recrystallization and grain growth.

UNIT VI: Powder Metallurgy (6 Hrs)

Concept, Methods of Manufacture of metal powders, compaction Process- Single die and double die, sintering, stages of sintering, Manufacture of porous bearings & cemented carbide tip tools by P.M.T. Advantages, limitations and applications of powder metallurgy.

Total: 36 Hrs

Textbooks:

1. Introduction to physical metallurgy ;Sidney H Avner, TATA Mc-Graw hill
2. Engineering materials & metallurgy R.K.Rajput, S chand publication.
3. Material Science & Metallurgy, by V.D. Kodgire. Everest Publication House.

Reference Books:

1. Mechanical Metallurgy, G. E. Dieter, Mc- Graw Hill International, London 3rd Edn. 1999
2. Physical metallurgy for engineers, Clarke and Varney, second Edn.,1987.
3. Power metallurgy, A.K Sinha First Edn. 1991.
4. Material Science and Metallurgy; V.D. Kodgire; Everest Publishing House
5. Engineering physical Metallugrgy, Y Lakhtin, Mir Publications. Second Ed. 1999
6. Material Science and Meallurgy- C Daniel Yesudian, Scitech Publication.

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MOOC Links:

1. Materials Science and Engineering (https://onlinecourses.nptel.ac.in/noc25_mm19/preview)
2. Nature and Properties of Materials (https://onlinecourses.nptel.ac.in/noc25_me54/preview)
3. Properties of Materials (https://onlinecourses.nptel.ac.in/noc25_mm34/preview)
4. Phase Diagrams in Materials Science and Engineering (https://onlinecourses.nptel.ac.in/noc25_mm25/preview)

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Program:	**B. Tech. (Mechanical Engineering)**			**Semester:**	**IV**	
Course:	**Material Science Lab**			**Code:**	**BTMEPC08ME4P**	
Teaching Scheme				**Evaluation Scheme**		
Practical	**Tutorial**	**Hours**	**Credit**	**INT**	**EXT**	**Total**
2	**-**	**2**	**-**	**30**	**20**	**50**

Course Objectives: To study the microstructure of various ferrous and non ferrous materials, along with their heat treatments processes.

Course Outcomes: After completion of the course, the students will be able to:

CO	**Course Outcomes**	**BT Level** (L1 to L6)
CO1	*Operate* metallurgical microscope and prepare samples for microstructural examination.	L3
CO2	*Analyze* microstructures of ferrous and non-ferrous metals and correlate them with properties.	L4
CO3	*Interpret* the iron–carbon equilibrium diagram and heat-treatment effects on steel microstructure.	L3
CO4	*Perform* heat-treatment and surface-hardening processes, evaluate hardness and justify property changes.	L4

Experiment List

Sr. No.	**List of Experiments**	**Mapped CO**
1	Operation of metallurgical microscope and observe its different parts.	CO 1
2	Preparation of specimen for microstructure-examination.	CO 1
3	Analyze the micro structures of different ferrous and non-ferrous metals.	CO 2
4	Analyze the Iron carbon Equilibrium diagram & Allotropic forms of iron.	CO 3
5	Study different Heat Treatment Process for steel.	CO 3
6	Study of different surface Hardening processes for steels.	CO 4
7	Performance of any one heat treatment process on a mild steel component.	CO 4
8	Performance of Brinell Hardness Test on above heat treated component.	CO 4

Note:
i) Practical examination shall be viva-voce based on above practical & the theory syllabus of course.

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Program:	**B. Tech. (Mechanical Engineering)**			**Semester:**			**IV**	
Course:	**Energy Conversion**			**Code:**			**BTMEPC09ME4T**	
Teaching Scheme				**Evaluation Scheme**				
Lecture	**Tutorial**	**Hours**	**Credit**	**TA**	**MSE-I**	**MSE-II**	**ESE**	**Total**
3	**-**	**3**	**3**	**10**	**15**	**15**	**60**	**100**

Methods of Teacher Assessment (TA): Class Test, Assignments, Quiz & Class Attendance

Course Objectives: To enable students to understand and apply the fundamental principles and practical working of major energy conversion systems.

After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	***Understand*** and ***apply*** the basic principles of energy conversion and the working principles of reciprocating air compressors.	L2 & L3
CO-2	***Explain*** the types, construction, and working principles of rotary air compressors.	L2
CO-3	***Outline*** the essential concepts of gas turbine plants to describe their operation and identify methods to improve efficiency.	L2
CO-4	***Understand*** the fundamentals of jet propulsion systems to explain their construction and operating principles.	L2
CO-5	***Demonstrate*** the basic concepts of nuclear power plants to explain their key components and essential safety practices.	L2
CO-6	***Interpret*** the principles of electromechanical energy conversion to explain the operating concepts of AC and DC machines.	L2

Unit I: Fundamentals of Energy Conversion **(07 Hrs.)**

Introduction, Overview of different forms of energy, Types of energy conversion devices.

Reciprocating Air Compressor

Introduction, Basic terminology, Compressed air systems, Classification, Construction & working, Minimization of compression work, Clearance volume in a compressor, Actual indicated diagram, Volumetric efficiency, Free air delivery and Multistage compression

Unit II: Rotary Air Compressors **(05 Hrs.)**

Introduction, Classification, Difference between reciprocating air compressor & rotary air compressor, Roots blower compressor, Vane type compressor, Screw compressor, Construction and working of Centrifugal and Axial compressor.

Unit III: Gas Turbine Plant **(06 Hrs.)**

Applications, Classification, Comparison between closed cycle & open cycle gas turbine, Modelling a gas turbine plant, Deviation of actual gas turbine cycle from Brayton cycle and Methods for improvement of thermal efficiency.

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Unit IV: Jet Propulsion **(06 Hrs.)**

Introduction, Principle, Classification, IC engine – driven propulsive systems, Ramming effect propulsion systems, Gas turbine propulsion systems, Turbojet engine, Turboprop engine, Turbofan, Terminology used with turbojet engine.

Unit V: Nuclear Power **(06 Hrs.)**

Introduction, Basic terminologies, Nuclear fission, Chain reaction, Nuclear fusion, Nuclear reactor, Basic Components of nuclear reactor, Types of nuclear reactor like PWR, BWR, CANDU, Gas cooled reactor &Breeder reactor, Reactor safety systems, Nuclear waste types and disposal methods.

Unit VI: Electrical Energy Conversion **(06 Hrs.)**

Electromechanical energy conversion **–** Introduction, Salient aspects of conversions & Energy balance, Introduction to electric motors – Background, Classification, Principal of operations of both AC & DC motors and Introduction to electric generators – Background, Classification, Principal of operations of both AC & DC generators.

Total: 36 Hrs.

Textbooks:

1. Thermal Engineering (Mc Graw Hill Edu.) by Mahesh M. Rathore
2. Thermal Engineering (Dhanpat Rai & Co.) by Domkundwar
3. Thermal Engineering (Laxmi Publications Ltd.) by R. K. Rajput
4. Power Plant Engineering (Tata Mc Graw, New Delhi) by P. K. Nag
5. Electrical Technology – Volume II (S. Chand) by B. L. Theraja and A. K. Theraja

Reference Books:

1. Thermal Engineering (Mc Graw Hill Edu.) by R. Rudramoorthy

MOOC Links:

1. Energy Resources and conversion processes - Course
2. Waste to Energy Conversion - Course

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Program:		**B. Tech. (Mechanical Engineering)**		**Semester:**		**IV**
Course:		**Energy Conversion Lab**		**Code:**		**BTMEPC10ME4P**
Teaching Scheme				**Evaluation Scheme**		
Practical	**Tutorial**	**Hours**	**Credit**	**INT**	**EXT**	**Total**
2	**-**	**2**	**1**	**30**	**20**	**50**

Course Objectives: To enable students to understand and apply basic operational and performance concepts of various energy conversion systems through structured laboratory experiments.

Course Outcomes: After completion of the course, the students will be able to:

CO	**Course Outcomes**	**BT Level** (L1 to L6)
CO1	***Apply*** the experimental procedures to conduct trials on air compressors.	L3
CO2	***Understand*** the layout, components, and working principles of gas turbine and nuclear power plants.	L2
CO3	***Understand*** the basic structure and propulsion mechanism of jet propulsion systems.	L2
CO4	***Understand*** the principles of electromechanical energy conversion in AC and DC motors.	L2

Sr. No.	**List of Practical**	**Mapped CO**
1	Trial on reciprocating air compressor.	CO 1
2	Trial on centrifugal blower.	CO 1
3	Study of gas turbine plant.	CO 2
4	Study of nuclear power plant.	CO 2
5	Study of jet propulsion.	CO 3
6	Study of electromechanical energy conversion in AC and DC motors.	CO 4

Note:
i) Practical examination shall be viva-voce based on above practical & the theory syllabus of course.

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Program:	**B. Tech. (Mechanical Engineering)**			**Semester:**			**IV**	
Course:	**Mechanical Machining Processes**			**Code:**			**BTMEPC11ME4T**	
Teaching Scheme				**Evaluation Scheme**				
Lecture	**Tutorial**	**Hours**	**Credit**	**TA**	**MSE-I**	**MSE-II**	**ESE**	**Total**
2	**-**	**2**	**2**	**10**	**15**	**15**	**60**	**100**

Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance

Course Objectives:

1. To introduce machine tools, their classification, and basic constructional features.
2. To develop understanding of machining fundamentals, cutting mechanics, tool geometry, and tool life.
3. To explain the working principles and applications of major conventional machine tools.

After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Describe the machine tools, their classification, and basic constructional features.	L2
CO-2	Explain the fundamentals of machining, metal cutting, tool geometry, tool wear, and tool life.	L2
CO-3	Illustrate the working principles and basic operations of lathe, milling, grinding, shaper, planer, and slotter machines.	L2
CO-4	Compare the construction, working, and applications of drilling, boring, and broaching machines.	L2

Unit I: Machine Tools & Classification **(6 Hrs.)**

Introduction to machine tools, Need and role of machine tools in manufacturing, Classification and Constructional features of machine tools like Bed, spindle, feed mechanisms, power drives, Basic elements like guideways, work holding devices, tool holding devices, Overview of conventional machine tools (Lathe, Drilling, Milling, Grinding, Shaper, Planer, Slotter), Machineability.

Unit II: Fundamentals of Machining **(6 Hrs.)**

Mechanism of metal cutting, Orthogonal and oblique cutting, Chip formation & chip types, Merchant's force diagram, machining parameters, cutting fluids: types & applications, Cutting tool materials, Tool geometry, Tool wear, Tool life

Unit III: Conventional Machine Tools-I (Lathe, Milling, Grinding) **(6 Hrs.)**

a) Lathe Machine: - Specifications, principal parts, accessories, Capstan, turret lathe, comparison with centre lathe, Turret indexing mechanism, Bar feeding mechanism.
c) Milling Machine: - Types, Types of Milling Cutters, Simple indexing
d) Grinding Machine: - Types: surface and cylindrical, Grinding wheel basics
d) Study of various part & Operation of Shaper, Planer, Slotter

Unit IV: Conventional Machine Tools-II (Drilling, Boring, Broaching) **(6 Hrs.)**

a) Drilling Machines - Classification of drilling machines, drill bit geometry
b) Boring Machines-Horizontal and vertical boring machine, Jig boring-machine
c) Broaching and its types, broach terminologies.

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Total: 24 Hrs

Textbooks:

1. A Text Book on Elements Workshop Technology (Volume-II) by Hajra Choudhary, Media Promotors & Publishers Pvt. Ltd.
2. A Text book on A course in Workshop Technology (Volume-II) by Raghuvanshi, Dhanpatrai & Sons.
3. A Text book of Manufacturing Technology (Volume-II) by P. N. Rao, McGraw Hill Publication

Reference Books:

1. A Text Book of Workshop Technology by O.P. Khanna, Dhanpatrai& Sons.
2. A Text Book of Production Technology by Dr. P. C. Sharma, S. Chand Publication.
3. A Text book of Technology of Machine Tools by Krar & Oswald 1st Edition (1984) Gregg Division, McGraw-Hill

MOOC Links:

1. https://onlinecourses.nptel.ac.in/noc21_me04/preview
2. https://onlinecourses.nptel.ac.in/noc21_me57/preview

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Program:	**B. Tech. (Mechanical Engineering)**	**Semester:**	**IV**
Course:	**Mechanical Machining Processes Lab**	**Code:**	**BTMEPC12ME4P**

Teaching Scheme				**Evaluation Scheme**		
Practical	**Tutorial**	**Hours**	**Credit**	**INT**	**EXT**	**Total**
2	**-**	**2**	**1**	**30**	**20**	**50**

Course Objectives:

- To understand the construction and working of conventional machine tools such as lathe, milling, and shaper machines.
- To relate machining practices with industrial applications.

Course Outcomes: After completion of the course, the students will be able to:

CO	**Course Outcomes**	**BT Level** (L1 to L6)
CO1	Infer the main parts, mechanisms, and working principles of conventional machine tools.	L2
CO2	Demonstrate basic and advanced operations on lathe machine through individual practice.	L3
CO3	Perform milling operations for slot cutting as a group activity.	L3
CO4	Perform shaping operations for surface finishing and relate machining processes with industrial applications.	L3
CO1	Infer the main parts, mechanisms, and working principles of conventional machine tools.	L2
CO2	Demonstrate basic and advanced operations on lathe machine through individual practice.	L3

Sr. No.	**List of Practical**	**Mapped CO**
1	Study and Demonstration of Lathe, Milling and Shaper Machines	CO 1
2	Study of Cutting Tools and Single Point Cutting Tool Geometry	CO 1
3	Lathe Practice – Basic Operations (Plain Turning, Facing, Step Turning, Drilling, Chamfering)	CO 2
4	Lathe Practice – Advanced Operations (Taper Turning, Knurling, Grooving, Threading	CO 2
5	Milling Machine Practice – Slot Milling Operation	CO 3
6	Shaper Machine Practice – Slot Finishing / Surface Shaping	CO 4

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Program:	**B. Tech. (Mechanical Engineering)**			**Semester:**			**IV**	
Course:	**Automobile Engineering and Electric Vehicles**			**Code:**			**BTMEPC13ME4T**	
Teaching Scheme				**Evaluation Scheme**				
Lecture	**Tutorial**	**Hours**	**Credit**	**TA**	**MSE-I**	**MSE-II**	**ESE**	**Total**
2	**-**	**2**	**2**	**10**	**15**	**15**	**60**	**100**

Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance

Course Objectives: To provide basic understanding of automobile system, including engines, transmission, safety system, and electric vehicle technologies.

After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Classify automobiles, identify engine components, and explain cooling & lubrication systems.	L2
CO-2	Explain the purpose and working of ignition system & power transmission systems.	L2
CO-3	Illustrate the construction and working of braking, suspension, and steering systems.	L2
CO-4	Outline the basic concept of electric and hybrid vehicles, including batteries and charging methods.	L2

Unit I: Introduction to Automobile and Engine Auxiliary Systems (6 Hrs.)

Classification of automobiles, Engine parts, Chassis layout, Multiple cylinder engines. Cooling system: Purpose, Air-cooling and water cooling, antifreeze mixtures. Lubrication system: Purpose, Types of lubricants, Types of lubricating systems – splash, dry sump & mist lubricating system.

Unit II: Ignition and Power Transmission Systems (6 Hrs.)

Ignition system: Purpose, Types of ignition system- Battery, Magneto and Electronic ignition system. Transmission system: Purpose, Construction and working – Single plate clutch, Sliding mesh gear box, Automatic gear box, Differential.

Unit III: Braking, Suspension and Steering Systems (6 Hrs.)

Braking system: Purpose, Mechanical & Anti-braking system. Suspension system: Need of shock absorber, Construction and working of Telescopic shock absorber. Steering system: Layout, Wheel alignment, steering geometry, Castor, Camber, King pin inclination and Toe in & out, Power Steering – Principle & working.

Unit IV: Electric & Hybrid Vehicle Technologies (6 Hrs.)

Need, Types, Cost, Electric vehicle technology, Layouts, Components, Controls. Batteries overview and its types. Charging methods and standards. Alternate charging sources wireless & solar. Hybrid vehicles: Layout & architecture, Series, Parallel and Series-Parallel.

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Text Books:

1. Automobile Engineering - Vol. I & II; Kirpal Singh; Standard Publishers Distributors.
2. Automobile Engineering; R. K. Rajput; Laxmi Publications, New Delhi.
3. Electric & Hybrid Vehicles, A. K. Babu, Khanna Publishing House.
4. Fundamentals of Hybrid and Electric Vehicles; K. C. Jain; Khanna Publishers.

Reference Books:

1. Automobile Mechanics, A. K. Babu & S. C. Sharma, T. R. Banga, Khanna Book Publishing.
2. Electric and Hybrid Vehicles, Tom Denton, Taylor & Francis, 2018

MOOC Links:

1. https://onlinecourses.nptel.ac.in/noc25_de02/preview

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Program:	**B. Tech. (Mechanical Engineering)**	**Semester:**	**IV**
Course:	**Machine Drawing**	**Code:**	**BTMEVS04ME4P**

Teaching Scheme				**Evaluation Scheme**		
Tutorial	**Practical**	**Hours**	**Credit**	**INT**	**EXT**	**Total**
1	**2**	**3**	**2**	**50**	**-**	**50**

Course Objectives:

1. To make students conversant with drawing standards, techniques, symbols, and notations.
2. To develop skills in creating part and assembly drawings using GD&T principles.
3. To understand conventions and practices used for sectional views, fits, and tolerances.
4. To interpret and prepare engineering drawings of mechanical components and assemblies

Course Outcomes: After completion of the course, the students will be able to:

CO	**Course Outcomes**	**BT Level** (L1 to L6)
CO1	Construct sectional and intersecting views of machine elements from given isometric drawings using standard drawing conventions.	L3
CO2	Apply the concepts of Geometric Dimensioning and Tolerance (GD&T), limits, and fits in preparing part and assembly drawings.	L3
CO3	Prepare complete part and assembly drawings following standard practices and conventions.	L3
CO4	Understand and compare various types of mechanical joints and couplings used in machine design.	L3

List of Practicals

Sheet No.	**Practical**	**Mapped COs**
1	To draw the Sectional and missing views of given mechanical components	CO1
2	Conventional representation of materials and machine parts	CO1
3	To draw curves of Intersection for intersecting solids	CO1
4	To represent Limits, Fits and Tolerances on drawings.	CO2
5	Assembly drawing of mechanical components from given details.	CO2, CO3
6	Detail drawing of mechanical components from given assembly drawing.	CO2, CO3
7	To draw various types of Keys and couplings	CO4
8	To draw orthographic views of various types of Riveted and welded joints	CO4

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Text Books:	
1.	Machine Drawing by K. L. Narayana, K. Venkata Reddy, Third Edition, New Age International Publishers
2.	Machine Drawing by N. D. Bhatt, 50th Edition, Charotar Publishing House Pvt. Ltd.
3.	Mechanical Engineering Handbook, Arihant Publication
4.	Design Data Book by K. Mahadevan and Reddy

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Program:	B. Tech. (Mechanical Engineering)			Semester:			III	
Course:	Mechanical Estimation & Costing			Code:			BTMEHM02ME4T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
2	-	2	2	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance

Course Objectives:

- To make students aware about estimation, estimating procedure, and calculation of material cost of machined components.
- To develop competency in estimation of machining time for various operations.
- To develop competency in estimation of fabrication cost used in industrial organizations.
- To explain the concept of cost & costing, objectives, advantages, elements of cost, overheads & their classification, costing techniques & applications. Calculation of depreciation fund by using various methods.

After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO1	Explain the fundamentals of estimation and calculate material cost for simple machined components.	L3
CO2	Calculate machining time for different operations such as turning, drilling, milling, shaping, grinding, etc.	L3
CO3	Estimate fabrication cost including welding and sheet metal jobs.	L5
CO4	Explain concepts of cost & costing, classify overheads, understand costing techniques and calculate depreciation using different methods.	L3

Unit I: Introduction to Mechanical Estimation **(07 Hrs.)**

Related terminology, Estimating: Importance and aim, objectives, functions, organization of Estimating department, Estimating Procedure, Constituents of Estimation. Calculation of volume & weight of machined component. Calculation of material cost of machined component.

Unit II: Estimation of Machining Time **(08 Hrs.)**

Introduction, Machine Shop Operations, Lathe Operations time calculation numerical based on turning, Knurling, Facing, Drilling, Boring, Reaming, Threading and Tapping, Introduction to Milling Operations and Numerical based on Milling time calculation, Introduction to Grinding Operations and Numerical based on Grinding time calculation, Introduction to Shaping & Planing Operations and Numerical based on Shaping time calculation.

Unit III: Estimation of Fabrication Cost **(08 Hrs.)**

Welding work: Introduction. Estimation of gas welding cost, Estimation of gas cutting cost, Estimation of arc welding cost, Factors affecting welding cost. Problem based on above welding/cutting process (like preparation cost, actual welding cost material, labour, finishing on cost, power cost).

Sheet Metal Work: Introduction, Operations in sheet metal work, types of sheet metal joints, blank layout and size, estimation of time in sheet metal shop, capacity for power presses, and numerical based on same.

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Unit IV: Fundamental of Costing & Depreciation **(07 Hrs.)**

Concept of Cost & Costing, Objectives, Advantages, elements of costs, components of cost, Overhead & Overhead Classification, Costing Techniques & Application.

Depreciation: - Concept, Causes, significance & Principals, methods of calculation of depreciation. (Straight Line Method, Reducing Balance Method, Production Unit Method, Production Hour Method, Repair Reserve Method, Sum of Digits Method, Annuity Method, Sinking Fund Method.)

Total: 30 Hrs

Textbooks:

1. Mechanical Estimating and Costing by T. R. Banga, S. C. Sharma, Khanna Publication 2016.
2. Process Planning & Cost Estimation by R. Kesoram, New Age International Publication New Delhi.
3. Cost Accounting Method & Problems by B. K. Bhar, Academic Publisher, Calcutta
4. Estimating and Costing by TTTI Madras

Reference Books:

1. Mechanical Estimating and Costing by B. P. Sinha , Tata McGraw Hill Publishing Co. Ltd. N. Delhi

MOOC Links:

1. Cost Accounting
(https://onlinecourses.nptel.ac.in/noc20_mg53/preview)

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Dated:- 05/07/25