

SIPNA COLLEGE OF ENGINEERING & 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.)
Syllabus- Semester V and VI
Department of Mechanical Engineering**

**B. Tech. Mechanical Engineering with Multidisciplinary Minor
(Semester Pattern)
Effective from Academic Year 2026-27**

Prepared by: Board of Studies - Mechanical Engineering

Approved by: Academic Council - Sipna COET, Amravati

			30/03/2026	1.00
Chairman Board of Studies	Dean Academics	Chairman Academic Council	Date of Release	Version



Semester V

Program:	B. Tech. (Mechanical Engineering)			Semester:	V			
Course:	Metrology & Quality Control			Code:	BTMEPC14ME5T			
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. Understand principles of metrology, inspection, and industrial measurement standards used in manufacturing systems.
2. Apply limits, fits, tolerances, and advanced metrology techniques for ensuring interchangeability and geometric accuracy of components.
3. Analyze manufacturing process quality using statistical quality control tools and quality management concepts.

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

CO	Course Outcomes	BT Level
CO-1	Explain fundamentals of metrology, inspection practices, and measurement standards.	L2
CO-2	Explain principles and applications of angular and thread measurement techniques.	L2
CO-3	Apply limits, fits, tolerances, and limit gauging principles for interchangeable manufacture.	L3
CO-4	Explain geometric errors, surface texture, and form accuracy using advanced metrology tools.	L4
CO-5	Explain quality control concepts, total quality management (TQM) and quality assurance systems.	L2
CO-6	Evaluate process variation and process stability using statistical quality control tools.	L5

Unit I: Fundamentals of Metrology and Inspection

(6 Hrs.)

Introduction to metrology: Definition, types, need of inspection, terminologies, Standards of measurements: Line standards, end standard, wave length standard. Linear measurement: various comparators such as mechanical, electrical, optical, pneumatic comparators, their principle, operations and applications.

Unit II: Angular and Thread Measurement

(6 Hrs.)

Angular Measurement: Universal bevel protractor, clinometers, sine bar, angle gauges

Thread measurement: Screw thread terminology, screw thread errors, Effective diameter measurement of screw thread by Floating Carriage micrometer

Unit III: Limits, Fits, Tolerances, and Gauging

(6 Hrs.)

System of Limits, fits and tolerances, Terminology of limits Fits, & Tolerances. Types of Fit, concept of interchangeability, interchangeability versus selective assembly practice, Indian Standard

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Specification for limits, Limit gauging – types of gauges, design principles of Go, No Go gauges, Design of limit gauges

Unit IV: Advanced Metrology and Surface Measurement (5 Hrs.)

Gear measurement: alignment error, master gear, Parkinson tester. Study and use of optical dividing head, auto collimator, tool makers microscope. Interferometry, flatness testing, squareness testing. Surface texture testing. Coordinate measuring machine- types, role and application.

Unit V: Quality Concepts and Quality Management Systems (7 Hrs.)

Concept of quality and quality control, quality of design and quality of conformance, Quality characteristics, Cost of quality & Value of quality, Specification of quality, quality control & inspection. Concept of TQM & Quality assurance.

Unit VI: Statistical Quality Control (6 Hrs.)

Concept of variation, Frequency distribution, Measures of Central tendency- Mean, Mode & Median, Measures of dispersion. -Range, Std. Deviation & Variance, variable and attribute data Concept of universe and population, Normal distribution curve; Control charts for variables, Control charts for attributes, comparison between variable charts and attribute charts, Process Capability Operating Characteristic curve, Sampling plans.

Total: 36Hrs

Textbooks:


1. Engineering Metrology by I. C. Gupta, Dhanpat Rai and Sons
2. Statistical Quality Control by M. Mahajan, Dhanpat Rai & Sons

Reference Books:

1. Engineering Metrology by R.K. Jain, Khanna Publisher, Delhi.
2. Quality Planning and Analysis by Juran U.M. & Gryna, Tata Mc Graw Hill
3. Statistical Quality Control & Quality Management by R. C. Gupta, Khanna Publisher, Delhi.

MOOC Links:

1. https://onlinecourses.nptel.ac.in/noc22_me75/preview
2. https://onlinecourses.nptel.ac.in/noc21_me57/preview



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Program:	B. Tech. (Mechanical Engineering)			Semester:	V	
Course:	Metrology & Quality Control Lab			Code:	BTMEPC15ME5P	
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	30	20	50
Course Objectives:						
<ul style="list-style-type: none">• Develop hands-on skills in dimensional and angular measurement using precision and non-precision metrology instruments.• Apply advanced inspection techniques for measurement of gears, threads, and cutting tool geometry.• Analyze manufacturing process quality through construction and interpretation of statistical quality control charts.						
Course Outcomes: After completion of the course, the students will be able to:						
CO	Course Outcomes					BT Level (L1 to L6)
CO-1	Analyze linear and angular measurement results obtained using precision and non-precision metrology instruments.					L4
CO-2	Analyze gear tooth thickness and screw thread measurement results using standard industrial inspection methods.					L4
CO-3	Evaluate cutting tool geometry and surface characteristics using optical inspection instruments.					L5
CO-4	Evaluate manufacturing process stability and variation using control charts.					L5

Experiment List

1. Study and analysis of measurement errors and calibration of precision and non-precision measuring instruments
2. Determination of Linear dimensions of a given specimen/ part using Precision/Non-Precision Measuring instruments.
3. Determination of Angular Measurement using Precision/Non-Precision measuring instruments.
4. Measurement of Gear Tooth Thickness by Gear Tooth Vernier Caliper/Constant Chord/Span Micrometer.
5. Measurement of Screw Thread Element by Floating Carriage Micrometer.
6. Measurements of various angles of single point cutting tool by using Profile Projector and Tool Maker's Microscope.
7. Analyzing process quality by preparing Variable Control Chart from given lot of samples.
8. Analyzing process quality by preparing Attribute Control Charts from given lot of samples.


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SoE. No.
24BTME-01

Program:	B.Tech. (Mechanical Engineering)			Semester:	V			
Course:	Heat Transfer			Code:	BTMEPC16ME5T			
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:								
<ul style="list-style-type: none"> To provide fundamental knowledge of heat transfer mechanisms—conduction, convection, and radiation. To develop the ability to analyze and solve numerical heat transfer problems in basic engineering systems such as fins, heat exchangers, and thermal devices. 								
Course Outcomes: After completion of the course, the students will be able to								
CO	Course Outcomes							BT Level
CO-1	Apply the basic modes of heat transfer and the laws of heat conduction to solve steady-state heat transfer problems in different systems.							L3
CO-2	Apply heat transfer principles to solve problems involving critical insulation, extended surfaces (fins), and unsteady-state heat conduction using lumped heat capacity analysis.							L3
CO-3	Explain the fundamentals of thermal radiation and apply radiation laws to various systems.							L3
CO-4	Analyze forced convection heat transfer in flat plates and circular tubes using dimensionless numbers and empirical correlations.							L4
CO-5	Understand the basic concept of combined convection heat transfer and analyze free convection heat transfer for different geometries using appropriate empirical correlations.							L4
CO-6	Analyze the performance of heat exchangers using the LMTD method and explain the working principles of heat pipes							L4

Unit I: Fundamentals of Heat Transfer and Steady-State Conduction: (07 Hrs.)

Introduction to Heat transfer and its basic modes, Governing Laws, General Heat Conduction Equation in cartesian coordinates, one-dimensional steady state heat conduction in slab, cylinder, sphere (simple and composite) without heat generation and with heat generation for homogeneous slab and cylinder.

Unit II: Critical Insulation, Extended Surfaces, and Unsteady-State Conduction: (06 Hrs.)

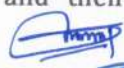
Concept of critical thickness of insulation and its derivation.
Extended Surfaces or Fins: classification, governing differential equation for fin (uniform cross-section), derivation of heat dissipation and temperature distribution for various boundary conditions (infinitely long fin, adiabatic tip and convective tip), fin efficiency, fin effectiveness.
Introduction to unsteady state heat conduction, lumped heat capacity analysis.

Unit III: Fundamentals of Thermal Radiation: (05 Hrs.)

General concepts and definitions, black body, white body, opaque body & gray body concept. Laws of radiation- Kirchoff's, Plank's, Stefan- Boltzmann's, Wein's law, Concept of Radiation shield.

Unit IV: Forced Convection Heat Transfer: (06 Hrs.)

Introduction to forced convection heat transfer; laminar and turbulent flow; Dimensionless numbers: Reynolds, Prandtl and Nusselt number and their physical significance. Forced...

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convection over flat plates – laminar flow case. Forced convection inside circular tubes – laminar and turbulent flow (concept, use of empirical correlations).

Unit V: Free Convection Heat Transfer: (06 Hrs.)

Introduction to free convection and comparison with forced convection. Mechanism of natural convection; Dimensionless numbers: Grashoff and Rayleigh number and their physical significance. Free convection heat transfer over vertical plates, horizontal plates and cylinders (concept and use of empirical correlations). Basic concept of Combined free and forced convection.

Unit VI: Heat Exchangers: (06 Hrs.)

Classification of heat exchanger, applications, overall heat transfer coefficient, fouling. L.M.T.D. method, temperature profiles. Heat pipes, types, applications and working with and without wick.

Total Lectures 36 Hours

Text Books:

1. Heat and Mass Transfer; R.K Rajput; S. Chand, New Delhi
2. Heat and Mass Transfer; V.M. Domkundwar; Dhanpat Rai & Co. Delhi
3. Heat Transfer; A. F.Mills, V. Ganesan, Pearson Publication

Reference Books:

1. Heat Transfer; J.P. Holman; McGraw Hill
2. Heat Transfer; P.K. Nag; TMH.

MOOC Links:

https://onlinecourses.nptel.ac.in/noc25_me171/preview


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SoE. No.
24BTME-01

Program:	B.Tech. (Mechanical Engineering)	Semester:	V
Course:	Heat Transfer Lab.	Code:	BTMEPC17ME5P
Teaching Scheme		Evaluation Scheme	
Practical	Tutorial	Hours	Credit
INT	EXT	Total	
2	-	2	1
30	20	50	

Course Objectives:

- To provide hands-on experience in conducting experiments related to conduction, convection, and radiation heat transfer.
- The course aims to develop the ability to measure thermal properties, verify heat transfer laws, and analyze the performance of basic thermal systems.


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

CO	Course Outcomes	BT Level
CO-1	Determine the thermal conductivity and thermal resistance of metallic, insulating, and composite materials.	L4
CO-2	Analyze radiative heat transfer characteristics by determining Emissivity and experimentally verifying the Stefan-Boltzmann law.	L4
CO-3	Determine convective heat transfer coefficients for forced and natural convection.	L4
CO-4	Analyze the heat transfer rate, efficiency, and effectiveness of extended surfaces (fins) under natural and forced convection conditions.	L4
CO-5	Analyze the performance of parallel-flow and counter-flow heat exchangers using the LMTD method.	L4

General Guidelines: Any six practicals to be conducted, ensuring all CO's are mapped.

List of Experiments

- 1) Determination of thermal conductivity of a metal rod at various sections to study the variation of thermal conductivity with temperature
- 2) Determination of thermal conductivity and thermal resistance of the composite slab.
- 3) Determination of thermal conductivity of insulating powder at average temperature.
- 4) Determination of Emissivity of test plate.
- 5) Verification of Stefan-Boltzmann law.
- 6) Determination of heat transfer coefficient in forced convection for internal flow.
- 7) Determination of heat transfer coefficient for vertical tube losing heat by natural convection.
- 8) Determination of heat transfer coefficient and efficiency of a pin-fin in natural and forced convection heat transfer.
- 9) Determination of heat transfer rate in parallel and counter flow heat exchanger using LMTD method.


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Program:	B. Tech. (Mechanical Engineering)	Semester:	V
Course:	Fluid Mechanics and hydraulic Machines	Code:	BTMEPC18ME5T
Teaching Scheme		Evaluation Scheme	
Lecture	Tutorial	Hours	Credit
3	-	3	3
		TA	MSE-I
		10	15
		MSE-II	ESE
		15	60
		Total	100

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

Course Objectives:

- To develop a comprehensive understanding of fluid mechanics by analyzing fluid behavior under static and dynamic conditions by applying the principles of kinematics.
- To evaluate losses in internal flows and understanding the performance of pumps, turbines, and hydraulic devices
- To introduce advanced topics in fluid flow like computational fluid dynamics.

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

CO	Course Outcomes	BT Level
CO-1	Explain fluid properties, pressure variation, hydrostatic forces, and stability of floating bodies.	L2
CO-2	Demonstrate the principles of fluid kinematics and Bernoulli's equation to determine flow parameters.	L3
CO-3	Apply principles of pipe flow to calculate frictional losses and understand the boundary layer effects, drag, and lift forces in internal flow systems.	L3
CO-4	Apply fluid machinery concepts to determine forces, work output, and efficiency in turbines.	L3
CO-5	Analyze performance characteristics of centrifugal, axial flow, and reciprocating pumps including cavitation effects.	L4
CO-6	Explain the working of hydraulic devices and basic concepts of CFD and compressible fluid flow.	L2

Unit I: Properties of fluid

(6 Hrs.)

Basic properties of fluid, Pressure at a point in the static mass of fluid, variation of pressure, Pascal's law, pressure measurement by simple and differential manometers using manometric expression.

Introduction to Hydrostatic forces and Centre of pressure, Buoyancy, Centre of buoyancy, stability of floating bodies, metacentre and metacentric height and its application in shipping.

Unit II: Fluid Kinematics

(6 Hrs.)

Velocity of fluid particle, types of fluid flow, Rate of flow, acceleration of fluid particle, rotational & irrotational flow, path line, streamline, flow net, continuity equation in three dimensional flow.

Integration of Euler's equation to obtain Bernoulli's equation, Bernoulli's theorem, Application of Bernoulli's theorem- Venturi meter.

Unit III: Flow through pipes

(6 Hrs.)

Reynolds's experiment, frictional loss in pipe flow, major and minor losses, Darcy's Weisbach equation, HGL and TEL, flow through series and parallel pipes.

Concept of boundary layer, Laminar and turbulent boundary layer.


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Unit IV: Principle of hydraulic machinery

(6 Hrs.)

Introduction to hydraulic Machines: classification and application.

Force exerted by fluid jet on plane, curved, stationary & moving vanes. Velocity diagrams, work done & efficiency.

Hydraulic Turbines - Theory of impulse and reaction turbines. Pelton and Kaplan turbines: classification, construction, analysis, characteristics and governing.

Unit V: Study of pumps

(6 Hrs.)

Centrifugal pumps: Basic Theory, classification, construction, operation, characteristics, multistage, NPSH and cavitation.

Axial flow pump: Basic theory, construction and operation.

Reciprocating pump theory, Slip, Indicator diagram, Effect of acceleration, performance characteristics.

Unit VI: Hydraulic Devices

(6 Hrs.)

Construction and working of hydraulic press, hydraulic lift, hydraulic coupling and hydraulic torque converter.

Introduction to CFD, Necessity, philosophy behind CFD, applications and limitations.

Introduction to compressible fluid flow.

Total:36Hrs

Textbooks:


1. Textbook of Fluid Mechanics and Hydraulic Machine, Dr. R. K. Bansal, Laxmi Publications, New Delhi
2. Hydraulics and Fluid Mechanics including Hydraulic Machines, Dr. P. N. Modi and Dr. S. M. Seth, Standard Book House
3. Computational fluid dynamics, Sen Gupta, Pearson Publishers

Reference Books:

1. Hydraulic machines, Jagdish Lal, Metropolitan Book Co. Pvt. Ltd.
2. Engineering Fluid Mechanics, R.K. Rajput, S. Chand publications.
3. Hydraulic, Fluid Mechanics & Fluid Machines, S. Ramamrutham, Dhanpatrai publishing company.

MOOC Links:

1. <https://nptel.ac.in/courses/105101082>
2. https://onlinecourses.nptel.ac.in/noc21_me118/preview
3. <https://digimat.in/nptel/courses/video/112107079/L01.html>


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Program:	B. Tech. (Mechanical Engineering)			Semester:	V	
Course:	Fluid Mechanics and Hydraulic Machines Lab			Code:	BTMEPC19ME5P	
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	30	20	50

Course Objectives:


- To experimentally verify fundamental principles of fluid mechanics.
- To analyze flow measurement, flow regimes, and pipe losses through laboratory experiments.
- To study the performance characteristics of hydraulic turbines and pumps.
- To introduce CFD as a modern tool for fluid flow analysis.

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

CO	Course Outcomes	BT Level (L1 to L6)
CO-1	Apply the principles of fluid statics and fluid dynamics to determine metacentric height and to verify Bernoulli's equation	L3
CO-2	Analyze experimental data to determine the coefficient of discharge, coefficient of friction, and to evaluate major losses in pipe flow systems.	L4
CO-3	Analyze the performance characteristics of hydraulic machines such as Pelton wheel turbines and centrifugal and reciprocating pumps	L4

Experiment List

1. Determination of metacentric height.
2. Verification of Bernoulli's equation.
3. Determination of co-efficient of discharge by Venturi meter.
4. Determination of co-efficient of friction (Major losses in Pipes) through pipe.
5. Trial on Pelton wheel turbine
6. Trial on centrifugal pump/ reciprocating pump


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Program:	B. Tech. (Mechanical Engineering)			Semester:	V			
Course:	PE-I: Power Plant Engineering			Code:	BTMEPE01ME5T			
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 Objective: To provide students with fundamental knowledge of thermal, natural gas, and hydroelectric power plants enabling them to understand working principles, components, performance characteristics, and economic considerations involved in electric power generation.								
Course Outcomes: After completion of the course, the students will be able to								
CO	Course Outcomes							BT Level
CO-1	Apply the basic principles of steam power plants to explain the layout, working, and major components and determine chimney draught and its performance parameters.							L3
CO-2	Explain the principles of fuel and ash handling systems used in steam power plants.							L2
CO-3	Compare and analyze different types of boilers, condensers and cooling towers in thermal power plants.							L4
CO-4	Explain the concept and basic working principle of natural gas power plants.							L2
CO-5	Explain the site selection, classification, components, working principles, advantages, and limitations of hydroelectric power plants.							L2
CO-6	Explain the load characteristics and economic considerations involved in power plants including electrical energy tariff structures.							L2

Unit I: Thermal Power Plant

(6 Hrs.)

Introduction, Layout of steam power plant and its components, site selection, advantages and disadvantages.

Chimney Draught: Definition, classification, natural draught, expression for chimney height and diameter, condition for maximum discharge Expression for efficiency of chimney, draught losses.

Unit II: Coal and Ash Handling

(6 Hrs.)

Coal handling systems: schematic layout, principle of operation of overfeed and underfeed stokers, pulverised fuel firing: introduction, advantages, disadvantages, unit system and central system, fluidised bed combustion.

Ash handling system: mechanical, hydraulic, pneumatic and steam jet system.

Unit III: Steam generators, condensers and cooling towers

(6 Hrs.)

Boilers: Introduction, classification, construction and working of Loeffler boiler, Lamont and Velox boiler, Supercritical Boilers, Introduction to boiler accessories and mountings with examples and function of each.

Condensers: Introduction, classification, construction and working of ejector and evaporative condensers.

Cooling towers: Introduction, classification, Natural draught and Mechanical draught cooling towers



Unit IV: Natural gas Power Plant

(6 Hrs.)

Introduction to natural gas power plants; basic working principle; types of natural gas power plants (simple cycle gas turbine power plant, combined cycle power plant, cogeneration plant); main components; applications; advantages and disadvantages; comparison with coal-fired thermal power plants.

Unit V: Hydroelectric Power Plants

(6 Hrs.)

Introduction, site selection, essential features/elements of hydroelectric power plant with flowchart, classification, brief description of each type, advantages and disadvantages of hydroelectric power plant.

Unit VI: Power Plant economics

(6 Hrs.)

Introduction, Terms and definitions: Connected load, demand, peak load, demand factor, load factor, diversity factor, utilisation factor, plant capacity factor and plant use factor, types of loads, load curve, load duration curve, Economics in plant selection and factors affecting it, Introduction to tariff for electrical energy: objectives, requirements and types of tariffs.

Total:36 Hrs.

Textbooks:

1. Power Plant Engineering, R.K. Rajput, Laxmi Publications
2. Power Plant Engineering, Arora Domkundwar, Dhanpatrai and Company.
3. Power Plant Engineering, P.K. Nag, Tata McGraw-Hill Education

Reference Books:

1. Power Plant Technology, M.M. El-Wakil, McGraw-Hill
2. Power Plant Engineering, M.M. El-Wakil, McGraw-Hill
3. Power Generation, Operation and Control, Allen J. Wood & Bruce F. Wollenberg, Wiley India

MOOC Links:

1. https://onlinecourses.nptel.ac.in/noc25_me113/preview
2. https://onlinecourses.nptel.ac.in/noc23_me08/preview
3. https://onlinecourses.nptel.ac.in/noc23_ge47/preview


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24BTME-01

Program:	B. Tech. (Mechanical Engineering)			Semester:	V			
Course:	PE-I: Advance Manufacturing Techniques			Code:	BTMEPE02ME5T			
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	0	3	3	10	15	15	60	100
Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance								
Course Objectives:								
<ul style="list-style-type: none">• "To introduce students with the fundamentals of advanced manufacturing techniques" and understand the principles, material removal mechanisms, process parameters, and their applications.• To enable students' ability to classify materials and select appropriate advanced manufacturing processes, including composite manufacturing methods and Advanced Metal Forming Processes for specific engineering applications.								
Course Outcomes: After completion of the course, the students will be able to								
CO	Course Outcomes							BT Level
CO-1	<i>Illustrate</i> the working principles and applications of advanced metal forming processes.							L2
CO-2	<i>Apply</i> the principles of ultrasonic and water jet machining processes to determine suitable process parameters and machining conditions.							L3
CO-3	<i>Differentiate</i> between chemical machining and electrochemical machining processes for given applications.							L4
CO-4	<i>Examine</i> the performance of thermal metal removal processes such as EDM and wire EDM with respect to process parameters and applications.							L4
CO-5	<i>Compare</i> the fundamentals and working principles of electron machining processes.							L4
CO-6	<i>Explain</i> suitable manufacturing methods and applications of composite materials.							L2

Unit I: Advanced Metal Forming Processes

(6 Hrs.)

- Working principle and elements of high energy rate forming (HERF), electromagnetic forming, explosive forming, electro hydraulic forming, stretch forming, contour roll forming.

Unit II: Advanced Mechanical Machining Processes

(6 Hrs.)

- Ultrasonic Machining: - (Drilling, Grinding, Slotting) Working principle and elements of USM, estimation of material removal rate, process parameters, applications and limitations.
- Water jet machining: - (Cutting & Drilling) Introduction to Water Jet Machining, its types, Working principle and elements of AWJM & WJM, estimation of material removal rate, process parameters, applications and limitations.

Unit III: Chemical Machining Processes

(6 Hrs.)

- Chemical Machining Processes: - Fundamentals of CM, estimation of material removal rate -maskants-elements. Advantages and applications of CM.
- Electro Chemical Process: - Fundamentals of Electro Chemical machining and grinding, metal removal rate in ECM, Tooling and applications.

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Unit IV: Thermal Metal Removal Processes

(6 Hrs.)

- Electric Discharge Machining Process: - Basic principle of spark erosion (EDM), wire cut EDM & Electric discharge grinding process, its Working, process parameters and applications.

Unit V: Electron Machining Processes

(6 Hrs.)

- Electron Beam Machining: - Generation and control of EBM for machining, theory of EBM, applications and limitations.
- Laser Beam Machining: - Process description, mechanism of material removal in LBM, process parameters, applications and limitations.
- Plasma Arc Machining: - Working principle of PAM, mechanics of material removal, process parameters, applications and limitations.

Unit VI: Composite Materials

(6 Hrs.)

- Introduction and Classification of Composite Materials.
- Manufacturing methods: Spray Lay-up, Wet/Hand Lay-up, Vacuum bagging, Resin transfer moulding (RTM), Resin, Film infusion and applications of composites.

Total: 36 Hrs.

Textbooks:

1. Elements of workshop technology, Vol 2 by Hazra Choudhary.
2. Textbook of workshop technology, Vol 2 by B. S. Raghuvanshi.

Reference Books:

1. Greg Bounds, Beyond Conventional Manufacturing, McGraw Hill.
2. Menon, H.G., TQM in New Product Manufacturing, McGraw Hill.

MOOCs Links and additional reading, learning, video material:

1. Advanced Manufacturing Processes:

https://onlinecourses.nptel.ac.in/noc20_mg34/preview


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Program:	B. Tech. (Mechanical Engineering)	Semester:	V
Course:	Community Engg. Project/Field project	Code:	BTMEFP01ME5P
Teaching Scheme		Evaluation Scheme	
Practical	Tutorial	Hours	Credit
2	-	2	1
		INT	EXT
		50	-
		Total	
		50	

Course Objectives:

- Apply mechanical engineering principles to solve real-world community and industrial problems.
- Design and implement energy-efficient and renewable solutions for local applications.
- Develop cost-effective and sustainable mechanical devices for rural and industrial use.
- Work effectively in teams while communicating technical findings and adhering to ethical practices.

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

CO	Course Outcomes	BT Level (L1 to L6)
CO-1	Identify real-world engineering problems in community or industrial settings	L3
CO-2	Apply engineering knowledge to design practical and sustainable solutions	L3
CO-3	Analyze performance, cost, and societal impact of engineering solutions	L4
CO-4	Demonstrate professional ethics and social responsibility.	L5

General Guidelines: Following is the sample list of projects. Student can select any one project from the list given below or may identify a problem associated with society and provide a solution to the problem.

Sample Project List

1. Rural water supply and pumping systems
2. Renewable energy applications (solar dryers, wind devices)
3. Energy conservation and waste heat recovery
4. Agricultural machinery improvements
5. Low-cost mechanical devices for local needs
6. Industrial safety and ergonomics
7. Maintenance and troubleshooting of machinery


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Semester VI

Program:	B. Tech. (Mechanical Engineering)			Semester:	VI			
Course:	Design of Machine Elements			Code:	BTMEPC20ME6T			
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:								
<ul style="list-style-type: none"> To impart fundamental knowledge of machine design principles and stress analysis for designing safe, reliable, and manufacturable machine elements. To develop the ability to design and select standard machine components such as joints, shafts, couplings, bearings, and springs for industrial applications. 								
Course Outcomes: After completion of the course, the students will be able to								
CO	Course Outcomes							BT Level
CO-1	Explain design philosophy, stress analysis, and design procedures for basic machine elements							L2
CO-2	Apply design procedures to riveted joints, and welded joints under given loading conditions.							L3
CO-3	Apply design procedures for shafts subjected to torsion, bending, and combined loading and design of keys and couplings.							L3
CO-4	Select suitable gear for power transmission systems by using design procedure for various types of gears.							L3
CO-5	Analyze rolling contact and journal bearings and determine bearing life and lubrication requirements.							L4
CO-6	Apply design procedures to power screw under given loading conditions.							L3

Unit I: Fundamentals of Design

(6 Hrs.)

(A) Design Fundamentals- Meaning and scope of machine design, Phases of design- conceptual, embodiment, detailed design, Design considerations- Strength, stiffness, rigidity, Factor of safety and reliability, Manufacturability and standardization. (B) Stresses in Machine Elements- Simple stresses and strains, Thermal stresses, Torsional and bending stress, Impact and shock loading. Design of hooks and C-clamps

Unit II: Design of Joints

(6 Hrs.)

A) Riveted Joints- Types, failures, strength and efficiency and Design of Riveted joints.
B) Welded Joints-Types of welded joints, Strength of transverse and parallel fillet welds And Design of welded joint

Unit III: Design of Shafts, Keys and Coupling

(6 Hrs.)

(A) Design of Shafts- Classification of shafts, Design for- Twisting moment, Bending moment and Combined bending and torsion (B) Keys - Types of keys and Failure of keys. (C) Couplings- Functions and classification, Design of Rigid couplings- Sleeve (muff) coupling, Clamp coupling. Design of flexible couplings- universal coupling.



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Unit IV: Design of Gears

(6 Hrs.)

Introduction, classification and gear terminology. Design of spur gear, helical gear, worm gear, and bevel gear.

Unit V: Design of Bearings

(6 Hrs.)

(A) Rolling Contact Bearings- Types and construction, Static and dynamic load ratings and Bearing life calculation. (B) Journal Bearings- Types of journal bearings, Principles of lubrication and Design procedure

Unit VI: Design of Power Screw

(6 Hrs.)

Types and applications, Torque required to raise and lower loads, Efficiency and helix angle, Self-locking and overhauling, Stresses in power screws, Design of screw jack

Total: 36Hrs

Textbooks:

1. Machine Design by Dr. P.C. Sharma & dr. D. K. Agrawal, Katsons Publications Ltd.
2. Machine Design by R. K. Jain, Khanna Publisher's
3. Machine Design, R.S. Khurmi, J.K. Gupta, Eurasia Publications, New Delhi.
4. Machine Design Data book by PSG, Coimbtore
5. Machine Design data book by Mahadevan.

Reference Books:

1. Design of Machine Element – Robert L. Norton
2. Design of Machine Element by V.B. Bhandari, Tata McGraw Hill Publuication.
3. Machine Design – Jindal, Pearson Publication.
4. Design of Machine Element – C. S. Sharma & Kamlesh Purohit, PHI Publication.

MOOC Links:

1. <https://www.youtube.com/playlist?list=PL3D4EECEFAA99D9BE>


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Program:	B. Tech. (Mechanical Engineering)			Semester:	VI	
Course:	Design of Machine Elements Lab.			Code:	BTMEPC21ME6P	
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	30	20	50
Course Objectives: <ul style="list-style-type: none">• To impart practical understanding of design principles and stress analysis for commonly used machine elements through numerical and design-based experiments.• To develop the ability to design and analyze machine components such as joints, shafts, couplings, bearings, and springs in accordance with functional and safety requirements.						
Course Outcomes: After completion of the course, the students will be able to:						
CO	Course Outcomes					BT Level (L1 to L6)
CO-1	Analyze and design knuckle joint, riveted and welded joints for given loading conditions.					L4
CO-2	Analyze and design power transmission elements such as shafts, keys, couplings, and gears.					L4
CO-3	Analyze and select suitable bearings and design a power screw for a given load and deflection using standard mechanical design principles.					L4

Experiment List

1. To design knuckle joint for a given tensile load.
2. To design riveted or welded joint for structural loading.
3. To design transmission shaft with key and rigid coupling.
4. To design gear for power transmission.
5. To select suitable rolling contact bearing/journal bearing.
6. To design power screw for given load and deflection.


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Program:	B. Tech. (Mechanical Engineering)			Semester:	VI			
Course:	Kinematics and Dynamics of Machines			Code:	BTMEPC22ME6T			
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:								
<ul style="list-style-type: none"> To understand and analyze the kinematics and dynamics of mechanisms used in automobiles and industrial machines, including static force analysis, velocity analysis, vibrations, and natural frequency determination. To study the synthesis, design, and application of machine mechanisms, including cams and spatial mechanisms, and to understand their role and importance in modern mechanical systems. 								
Course Outcomes: After completion of the course, the students will be able to								
CO	Course Outcomes							BT Level
CO-1	Explain the kinematic mechanisms with relevant Application							L2
CO-2	Perform synthesis of mechanisms using graphical and analytical methods.							L3
CO-3	Apply velocity and static force analysis in planar mechanisms.							L3
CO-4	Construct and analyse cam profiles for given follower motions.							L4
CO-5	Solve engineering problems involving different types of vibrations.							L3
CO-6	Evaluate gyroscopic effects in Ships, automobiles and aerospace systems and understand the concept of vehicle dynamic.							L5

Unit I: Kinematic Fundamentals of Mechanical Systems (6 Hrs.)

Introduction to mechanisms and machines, types of links, kinematic pairs. Grashof's law, Grubler's and Kutzbach's criterion for planar mechanism. Inversions of four-bar, single-slider, double-slider mechanisms. Special purpose mechanisms – Steering & Suspension mechanisms, Geneva wheel mechanism, and industrial linkages in automation.

Unit II: Synthesis of Mechanism for Industrial Applications (6 Hrs.)

Classification of synthesis of mechanism -Function generation, Path generation and Body guidance. Graphical and analytical synthesis for two, three, and four positions. Freudenstien's equation.

Unit III: Velocity and Force Analysis of Planar Mechanisms (6 Hrs.)

Velocity analysis: Relative velocity method, equivalent mechanism method, instantaneous centre method for 4-bar mechanism.

Static force analysis: Static equilibrium, superposition principle, static force analysis applied to planar mechanisms.

Unit IV: Cam-Follower Mechanisms in Automation Systems (6 Hrs.)

Introduction, types of cams & followers, types of follower motions. Displacement diagram- Unifrom velocity, Simple harmonic motion, uniform acceleration and retardations. Graphical layout of cam profiles and cams with specified contours. Applications in engines and automated machinery.



Unit V: Vibrations Analysis

(6 Hrs.)

Types of vibrations, elements of vibrating systems. Longitudinal vibrations – natural frequency (energy method), effect of inertia, damping. Torsional vibrations – single rotor, two rotor, and three rotor systems. Transverse vibrations – natural frequency due to point load and UDL on simply supported shaft, Dunkerley's method.

Unit VI: Dynamic Effects in Machines and Automotive Systems

(6 Hrs.)

Gyroscope and gyroscopic effect in ships, aircraft, two-wheelers, and four-wheelers. Vehicle dynamics – tractive resistance, braking, stability of vehicles. Introduction to balancing of rotating masses and reciprocating masses.

Total: 36 Hrs.

Textbooks:

- 1) Theory of Machines, P. L. Ballaney, Published by Dhanpat Rai and sons-N Delhi.
- 2) Theory of Machines, S. S. Ratan, Published by Tata Mc Graw Hill.
- 3) Theory of Machine, R. S. Khurmi and Gupta J.K., Published by Eurasia Publishing house-N Delhi.

Reference Books:

- 1) Theory of Machines and Mechanisms, J. E. Shigley, Uicker and Gordon, Published by Oxford University press-New York.
- 2) Theory of Machines, V. P. Singh, Published by Dhanpat Rai-N Delhi.
- 3) Theory of Machines and Mechanisms, Ghosh and Amitabh, Published Affiliated East West Press, N-Delhi.

MOOC Links:

https://onlinecourses.nptel.ac.in/noc26_me55/preview

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Program:	B. Tech. (Mechanical Engineering)			Semester:	VI	
Course:	Kinematics and Dynamics of Machines Lab.			Code:	BTMEPC23ME6P	
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	30	20	50
Course Objectives:						
<ul style="list-style-type: none">• To study and analyse the kinematic behaviour of planar mechanisms and cams using experimental, graphical, and computer-aided methods.• To investigate the dynamic characteristics of mechanical systems, including inertia, gyroscopic effects, and shaft vibrations, through laboratory experiments.						
Course Outcomes: After completion of the course, the students will be able to						
CO	Course Outcomes					BT Level (L1 to L6)
CO-1	Apply velocity analysis methods and computer-aided cam modelling techniques.					L3
CO-2	Analyze inertia characteristics using a compound pendulum and evaluate the effect of gyroscopic couple in rotating systems.					L4
CO-3	Analyze the whirling speed characteristics of a rotating shaft under varying operating conditions.					L4
CO-4	Analyze the effect of mass balancing on vibration, in rotating systems.					L4

Experiment List

1. Computer aided cam modelling.
2. Study of velocity analysis by relative velocity method (Virtual Lab)
3. Determination of inertia of compound pendulum.
4. Determination of gyroscopic couple.
5. Experiment on whirling speed of shaft.
6. Balancing of rotating masses.


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SoE. No.
24BTME-01

Program:	B.Tech. (Mechanical Engineering)			Semester:	VI			
Course:	Non-Conventional Energy Sources			Code:	BTMEPE03ME6T			
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: To explain various non-conventional energy sources, their principles, technologies, and applications for sustainable and environmentally friendly energy generation.								
After completion of the course, the students will be able to:								
CO	Course Outcomes							BT Level
CO-1	Classify energy resources and explain the need for non-conventional energy sources.							L2
CO-2	Estimate solar radiation intensity and explain the applications of solar energy.							L3
CO-3	Illustrate the construction, working, and applications of photovoltaic cells, fuel cells, and geothermal energy systems.							L2
CO-4	Explain the types and working principles of tidal power plants, ocean thermal energy conversion (OTEC) systems, and wind turbines.							L2
CO-5	Explain biomass conversion processes, biogas generation, biofuels, and MHD power generation techniques for alternative energy production.							L2
CO-6	Explain the basic properties, production methods, storage, transportation, and utilization of hydrogen energy.							L2

Unit-I: Introduction to Energy Resources & Sustainable Energy Development (5 Hrs.)

Classification of energy sources, Need of non-conventional energy sources, Energy scenario in Indian context, Impact of energy sources on environment, Role of non-conventional energy in sustainable development, Government initiatives & policies in India.

Unit-II: Solar Energy (7 Hrs.)

Solar radiation at the Earth's surface, Solar constant, Solar radiation geometry, Solar radiation measurement using Pyrheliometer, Pyranometer and Sunshine Recorder, Estimation of solar radiation intensity, Applications of solar energy in heating, cooling, distillation, drying, etc.

Unit-III: Direct Energy Conversion (6 Hrs.)

Photovoltaic cells: Principle, Types of PV cells, Construction & working of PV cell, Applications, Fuel cells: Types of fuel cells, Construction and working of Hydrogen and Oxygen fuel cell, Geothermal energy resources: Types of geothermal energy resources, Vapour dominated, liquid dominated and hot dry rock geothermal systems.

Unit-IV: Ocean & Wind Energy (6 Hrs.)

Tidal Power: Types of tidal plants such as single and two basin plants, Ocean thermal energy conversion system: Working of open cycle and closed cycle OTEC systems, Wind power: Introduction, Components & working of wind turbine, types of wind turbine & Principle movements.

Unit-V: Biomass Energy & MHD (6 Hrs.)

Biomass resource, Mechanism of green plant photosynthesis, Bio-gas – Types of biogas plants (Fixed



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& Floating), Factors affecting generation of biogas, Biomass gasification, Introduction to bio-diesel, Ethanol as alternative fuel, Principle of magneto hydro dynamic power generation.

Unit-VI: Hydrogen Energy

(6 Hrs.)

Introduction to hydrogen energy, Basic properties of hydrogen, Hydrogen production (Basic Methods), Types of hydrogen, Hydrogen storage, Hydrogen transportation, Utilization of hydrogen gas and Safety aspects of hydrogen handling.

Total: 36 Hrs.

Text Books:


1. Solar Energy by S. P. Sukhatme; TMH
2. Non-Conventional Energy Sources by G .D. Rai; Khanna Publications.
3. Non-Conventional Energy Sources by B. H. Khan; Mc Graw-Hill Publications.

Reference Books:

1. Renewable Energy by Dr. Sachin S. Ingole, Dr. Samir J. Deshmukh, Dr. Sanjay M. Kherde & Mr. Sumit S. Kalmegh; REST Publication.
2. Renewable Energy Sources and Emerging Technology by D.P. Kothari, K.C. Singal & Rakesh Ranjan; PHI
3. Non-Conventional Energy Resources by D. S. Chauhan & S. K. Srivastava; New Age International Publications.

MOOC Links:

1. https://onlinecourses.nptel.ac.in/noc22_ge14/preview
2. https://onlinecourses.nptel.ac.in/noc26_ch26/preview

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SoE. No.
24BTME-01

Program:	B.Tech. (Mechanical Engineering)			Semester:	VI	
Course:	Non-Conventional Energy Sources Lab.			Code:	BTMEPE04ME6P	
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	30	20	50
Course Objectives: To provide hands-on understanding of non-conventional and direct energy conversion systems through experimental study, measurement, and performance evaluation of solar, wind, bio energy, fuel cell, PV, and MHD technologies.						
Course Outcomes: After completion of the course, the students will be able to						
CO	Course Outcomes					BT Level
CO-1	Perform measurements of direct, global solar radiation and sunshine hours using standard instruments.					L-4
CO-2	Analyze the performance characteristics of fuel cells and photovoltaic panels under given operating conditions.					L-4
CO-3	Compare different types of windmills and biogas plants based on construction, working, and applications.					L-2
CO-4	Demonstrate basic understanding of MHD power generation and its role in direct energy conversion systems.					L-2

General Guidelines: Any six practicals to be conducted, ensuring all CO's are mapped.

List of Practical's

1. Study of Pyrheliometers & Pyranometers for the Measurement of Solar Radiations.
2. Experimental Determination of Global Solar Radiation Using Pyranometer.
3. Measurement of Sunshine Hours using a Sunshine Recorder.
4. To Investigate the Performance Characteristics of a Fuel Cell.
5. Performance Analysis of a Photovoltaic (PV) Panel.
6. To Demonstrate and Compare Different Types of Windmills.
7. To Demonstrate and Compare Different Types of Biogas Plants.
8. To Demonstrate the Principle and Working of Magneto-Hydro-Dynamic (MHD) Power Generation System.

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SoE. No.
24BTME-01

Program:	B. Tech. (Mechanical Engineering)			Semester:	VI			
Course:	Rapid Prototyping			Code:	BTMEPE05ME6T			
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:								
<ul style="list-style-type: none"> To introduce the fundamentals, processes, and systems of rapid prototyping used in modern product development and manufacturing industries. To develop the ability to apply rapid prototyping, rapid tooling, and reverse engineering concepts for engineering design, analysis, and industrial applications. 								
Course Outcomes: After completion of the course, the students will be able to								
CO	Course Outcomes							BT Level
CO-1	Explain the concept, role and classification of rapid prototyping in the product development cycle.							L2
CO-2	Differentiate suitable rapid prototyping systems for specific engineering applications.							L2
CO-3	Apply the rapid prototyping process chain, including 3D modelling, data conversion, file preparation, building, and post-processing.							L3
CO-4	Analyse direct and indirect rapid tooling processes and justify their selection based on merits, demerits, and applications.							L4
CO-5	Analyze reverse engineering techniques for given applications using different data acquisition methods.							L4
CO-6	Analyse the RP data formats and applications of rapid prototyping in various domains.							L4

Unit I: Fundamentals of Rapid Prototyping

(6 Hrs.)

Introduction to Prototype, Importance of Prototype, Classification of prototypes, Fundamentals of Rapid Prototyping (RP), Need of rapid prototyping, Role of RP in Product development cycle, Advantages and disadvantages of rapid prototyping.

Unit II: Rapid Prototyping Process Chain

(6 Hrs.)

Fundamental of Automated processes, Process chain- 3D Modelling, Data Conversion and Transmission, Checking and Preparing, Building and Postprocessing.

Unit III: Rapid Prototype Technologies

(6 Hrs.)

Classification of Rapid Prototype System, Liquid based- Stereolithography Apparatus (SLA) and Solid Ground Curing (SGC), Solid based- Laminated Object Manufacturing (LOM) and Fused Deposition Modelling (FDM), Power based- Selective Laser Sintering (SLS) and Three-dimensional Printing (3DP)

Unit IV: Techniques of Rapid Tooling

(6 Hrs.)

Introduction of rapid tooling, Direct rapid tooling process: Laminated tooling and Selective laser sintering, Indirect rapid tooling processes: Silicon rubber moulding, Sand casting, Investment casting, their merit, demerit and applications.

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Unit V: Digital Product Reconstruction

(6 Hrs.)

Introduction of reverse engineering, Acquiring point data- Contact type: Manual measurement and Touch probe measurement and Non-contact type: Laser scanning, CT scanning. Application of reverse engineering.

Unit VI: RP Data Formats and RP Applications

(6 Hrs.)

STL Format, Issues in STL File, STL File Repair and Other Translators.

Applications of RP: Design, Aerospace Industry, Automotive Industry, Biomedical Industry and Construction industry (Case study)

Total: 36Hrs.

Textbooks:

1. Chua C K, Leong K F, Chu S L, Rapid Prototyping: Principles and Applications in Manufacturing, World Scientific.
2. M Adithan " Rapid Product development" New Age International Publisher.
3. Gebhardt, A., "Rapid prototyping", Hanser Gardener Publications, 2003.

Reference Books:

1. Kalpakjin, "Manufacturing Engineering and Technology ", Addison Wesley Publishing Co., 1995.
2. Noorani R, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons.
3. Hilton P, Jacobs P F, Rapid Tooling: Technologies and Industrial Applications, CRC press.

MOOC Links:

1. https://onlinecourses.nptel.ac.in/noc24_me115/preview
2. https://onlinecourses.swayam2.ac.in/ntr24_ed41/preview

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Program:	B. Tech. (Mechanical Engineering)			Semester:	VI	
Course:	Rapid Prototyping Lab			Code:	BTMEPE06ME6P	
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	30	20	50
Course Objectives:						
<ul style="list-style-type: none">To provide hands-on experience in CAD modelling and data preparation required for rapid prototyping and additive manufacturing.To develop practical skills in setting up, operating, and fabricating components using 3D printing / rapid prototyping machines.						
Course Outcomes: After completion of the course, the students will be able to:						
CO	Course Outcomes					BT Level (L1 to L6)
CO-1	Create 3D CAD models and generate, analyze, and repair STL files for rapid prototyping.					L3
CO-2	Perform build preparation and slicing by selecting appropriate process parameters for 3D printing.					L3
CO-3	Operate a 3D printing / RP machine and check the quality of fabricated components.					L3

Review of CAD Modelling Techniques and Introduction to Rapid Prototyping (Prerequisite)

Experiment List

1. Creation of Simple 3D CAD Model Using Solid Modelling Commands
2. Generation and Analysis of STL Files from CAD Model
3. Build Preparation and Slicing for Rapid Prototyping
4. Setup of 3D Printing / Rapid Prototyping Machine
5. Fabrication of a Simple Component Using a 3D Printer / RP Machine

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SoE. No.
24BTME-01

Program:	B.Tech. (Mechanical Engineering)			Semester:	VI			
Course:	Refrigeration & Air Conditioning			Code:	BTMEPE07ME6T			
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: To explain and apply the principles of refrigeration, air conditioning, psychrometry, system components, and human comfort for effective design, operation, and performance evaluation of HVAC systems.								
Course Outcomes: After completion of the course, the students will be able to								
CO	Course Outcomes							BT Level
CO-1	Apply pressure–enthalpy (p–h) charts to interpret the performance of simple vapour compression refrigeration system.							L3
CO-2	Explain compound vapour compression refrigeration systems and apply intercooling & subcooling, concepts to interpret their performance improvement.							L3
CO-3	Illustrate the construction, working, and functions of refrigeration system components, controls, defrosting methods, and leak detection practices.							L2
CO-4	Apply the psychrometric chart to represent air-conditioning processes and mixing of air streams.							L3
CO-5	Compare air conditioning systems and interpret basic duct design principles, fan selection, and air distribution considerations.							L2
CO-6	Apply refrigeration, air-conditioning, and human comfort concepts to interpret the operation of practical HVAC systems.							L3

Unit-I: Simple Vapour Compression Refrigeration System

(6 Hrs.)

Refrigeration, Application & Types of refrigeration systems, Unit of refrigeration, C.O.P., Analysis of simple vapour compression refrigeration system, Types of vapour compression cycle, Pressure – Enthalpy (p-h) chart, Effect of suction & discharge pressure, superheating and subcooling on the performance of VCRS.

Unit-II: Compound Vapour Compression Refrigeration System & Refrigerants

(7 Hrs.)

Introduction, Advantages of compound VCRS, Types of compound VCRS- two stage compression with flash intercooling, water intercooling, flash & water intercooling, water & liquid subcooling, flash, water & liquid subcooling. Refrigerant: Introduction, Desirable properties of an ideal refrigerant, Classification of refrigerants & Eco-friendly refrigerants.

Unit-III: Refrigeration Components & Controls

(5 Hrs.)

Brief study of refrigerants compressor, condensers, evaporators, expansion valves, Defrosting, Methods of defrosting, charging & purging of refrigeration systems, leak detection methods. (No analytical treatment is expected)

Unit-IV: Psychrometry & Human Comfort

(6 Hrs.)

Psychrometry, Psychrometric properties of moist air, Psychrometric chart, Representations of psychrometric process on psychrometric chart, Mixing of two air streams (simple numericals based



on mixing of two air streams), Human comfort: Metabolism of human body, Factors influencing comfort, Concept of effective temperature.

Unit-V: Air Conditioning Systems & Duct design (5 Hrs.)

Air conditioning, Factors affecting comfort air conditioning, Classification of air conditioning systems, Window type & Split type air conditioning, Duct Design – Introduction, Classification of ducts, Methods for determination of duct size, Aspect ratio & its importance, (No Numerical treatment on duct design), Fans – Introduction, Types of fans.

Unit-VI: Cooling Load Estimation (7 Hrs.)

Cooling load estimates, Heating load estimates, By pass factor, Apparatus dew point, Sensible heat factor, Room sensible heat factor, Grand sensible heat factor, Effective sensible heat factor, Problems on air conditioning system considering mixing before and after the coil.

Total: 36 Hrs.

Text Books:

- 1) Refrigeration & air conditioning; C. P. Arora; Tata Mcgraw Hill Publication
- 2) Refrigeration & air conditioning; Arora, Domkundwar; Dhanpat Rai Publication
- 3) Refrigeration & air conditioning; Er. R. K. Rajput; S. K. Kataria & Sons Publication

Reference Books:

- 1) Principles of Refrigeration; J. Dossat; Pearson Education, Asia publication
- 2) Refrigeration & air conditioning- P. L. Balaney
- 3) Refrigeration & air conditioning- Manohar Prasad.

MOOC Link:

1. https://onlinecourses.nptel.ac.in/noc19_me58/preview


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SoE. No.
24BTME-01

Program:	B.Tech. (Mechanical Engineering)			Semester:	VI	
Course:	Refrigeration & Air Conditioning Lab			Code:	BTMEPE08ME6P	
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	30	20	50
Course Objectives: To provide hands-on exposure to the operation, testing, and performance evaluation of refrigeration and air-conditioning systems used in domestic, commercial, and industrial applications.						
Course Outcomes: After completion of the course, the students will be able to						
CO	Course Outcomes					BT Level
CO-1	Analyze the performance of refrigeration & air-conditioning systems.					L-4
CO-2	Explain the operation of refrigeration & air-conditioning systems applications.					L-2
CO-3	Demonstrate the concept of testing and charging of refrigeration system.					L-2
CO-4	Illustrate various refrigeration & air conditioning controls.					L-2

General Guidelines: Any six practicals to be conducted, ensuring all CO's are mapped.

List of Practical's

1. Experimental determination of COP of a vapour compression refrigeration system.
2. Experimental determination of COP of an air-conditioning system.
3. Performance Analysis of an Electrolux Refrigeration System.
4. Demonstration & working of window Air conditioner.
5. Demonstration & working of household refrigerator.
6. Industrial visit and study of manufacturing processes of refrigeration systems.
7. Study of testing and changing of refrigeration system.
8. Study of defrosting systems in refrigeration and air conditioning.
9. Study of refrigeration and air-conditioning control devices.


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 Dated:-.....30/03/2025.....



Sipna College of Engineering & Technology, Amravati
(An Autonomous Institution affiliated to Sant Gadge Baba Amravati University, Amravati)

(Accredited with 'A+' Grade by NAAC)

www.sipnaengg.ac.in

SoE. No.
24BTME-01

Program:	B.Tech.(Mechanical Engineering)	Semester:	VI
Course:	Robotics and Industrial Application	Code:	BTMEPE09ME6T
Teaching Scheme		Evaluation Scheme	
Lecture	Tutorial	Hours	Credit
03	0	03	03
TA	MSE-I	MSE-II	ESE
10	15	15	60
Total			
100			

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

Course Objectives:

- **To introduce** the fundamental concepts, configurations and components of industrial robots, including End-effectors and robot work cells.
- **To enable** students to understand robot kinematics, motion control and industrial applications of robots in manufacturing systems.
- **To develop** the ability to evaluate the economic feasibility and justification of robotic automation in industrial environments

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

CO	Course Outcomes	BT Level
CO-1	Explain robot anatomy, degrees of freedom, geometric configurations, workspace, and specifications of industrial robots.	L2
CO-2	Apply end-effector design principles to select suitable grippers for industrial robotic applications.	L3
CO-3	Apply homogeneous transformations and Denavit–Hartenberg parameters to solve forward and inverse kinematics of robotic manipulators.	L3
CO-4	Analyze robot cell layouts, control requirements, safety interlocks, and error handling in robotic workcells.	L4
CO-5	Analyze the applicability of robots in material handling, processing, assembly, and inspection operations.	L4
CO-6	Evaluate the economic feasibility of robotic automation using payback period, Return on Investment, and Equivalent Uniform Annual Cost methods.	L5

Unit I: Introduction to Robotics

(5Hrs.)

Definition and scope of robotics, Robot anatomy, links and joints used in robots, Geometric configurations of robots and their associated workspaces, Degree of Freedom, Robot specifications.

Unit II: Robot End-Effectors


(6 Hrs.)

Types of end-effectors, Mechanical grippers, Vacuum, magnetic, adhesive grippers, Tools as end-effectors, Gripper force analysis, Considerations in end-effector design and selection, Mechanical and functional interface between robot wrist and end-effector.

Unit III: Robot Kinematics

(7 Hrs.)

Introduction to manipulator kinematics, Homogeneous transformations, Forward kinematics, Inverse kinematics (geometric and algebraic methods), Work volume and precision of movement, Denavit–Hartenberg (D–H) representation. Introduction to trajectory planning.


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Unit IV – Robot Cell Design & Control

(6 Hrs.)

Layout of robotic cells, Workcell components, Multi-robot systems and interference, Control requirements for robotic workcells, Interlocks and safety systems, Error detection and recovery, Workcell controllers. Introduction to robot operating system (ROS).

Unit V: Industrial Applications of robots

(6 Hrs.)

Application of robots in material handling operations like pick and place, palletizing, machine loading-unloading. Processing operations like spot welding, spray painting, etc., assembly and inspection operations. Considerations and capabilities of robots for above categories of applications.

Unit VI – Economic Justification of robots

(6 Hrs.)

Need for economic justification of robots, Cost components and basic data required, direct and indirect cost components. Justification of a robotic investment project using Payback period, Return on investment (ROI) and Equivalent uniform annual cost (EUAC) method. Evaluation of robot investments.

Total: 36 Hrs.

Text Books:

1. Robotic Technology and Flexible automation by S. R. Deb, McGraw Hill Publication
2. Introduction to Robotics, Analysis, Systems, Applications by Saeed B. Niku, PHI
3. Industrial Robotics by McGraw Hill Publication

Reference Books:

1. Introduction to Robotics (Mechanics and Control), second edition by John J. Craig, Pearson Education

MOOC Link:

1. https://onlinecourses.nptel.ac.in/noc25_me166/course (Robotics)


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SoE. No.
24BTME-01

Program:	B. Tech. (Mechanical Engineering)	Semester:	VI			
Course:	Robotics and Industrial Application Lab	Code:	BTMEPE10ME6T			
Teaching Scheme		Evaluation Scheme				
Practical	Tutorial	Hours	Credit	INT	EXT	Total
02	0	02	01	30	20	50

Course Objective:


To develop operating skills of students for industrial robotic applications.

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

CO	Course Outcomes	BT Level
CO-1	Develop robot programs for industrial tasks using offline programming languages.	L3
CO-2	Analyze kinematic behavior of a 6-axis robot using RoboAnalyzer.	L4
CO-3	Apply end-effector design principles to determine gripper force for safe and effective grasping	L3
CO-4	Operate and program an industrial robot for pick and place operation	L3

List of experiments

1. Preparation of a program for simple pick and place operation using VAL
2. Forward Kinematic Analysis of Robot Using RoboAnalyzer
3. Inverse Kinematic Analysis of Robot Using RoboAnalyzer
4. Perform gripper force analysis for Robot End-Effector design for given application
5. Perform simple pick and place operation using Aristo XT 6 Axis Robot.


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Program:		B. Tech. (Mechanical Engineering)		Semester:		VI
Course:		CAD and Simulation Lab		Code:		BTMEVS05ME6P
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	1	3	2	50	-	50
Course Objectives: <ul style="list-style-type: none">• To develop competency in 3D CAD modelling, assembly creation, and drafting using SOLIDWORKS for mechanical engineering applications.• To introduce simulation-based analysis techniques for evaluating structural performance of mechanical components.						
Course Outcomes: After completion of the course, the students will be able to						
CO	Course Outcomes					BT Level (L1 to L6)
CO-1	Explain the SOLIDWORKS interface, sketching tools, and basic geometric constraints.					L2
CO-2	Create and modify basic and advanced parametric 3D part models using feature-based solid modelling techniques.					L3
CO-3	Analyze mechanical assemblies for correct constraints and create engineering drawings from CAD models.					L4
CO-4	Analyze structural behavior of mechanical components using simulation tools.					L4

Experiment List

1. Introduction to SOLIDWORKS Interface and Basic Sketching.
2. Creation of 3D Part Modelling Using Solid Modelling Features
3. Advanced Part Modelling Using Parametric Features
4. Assembly Modelling and Mating of Components
5. Generation of Engineering Drawings from CAD Models
6. Static Structural Simulation Using SOLIDWORKS Simulation packages.

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