Shirpur Education Society's

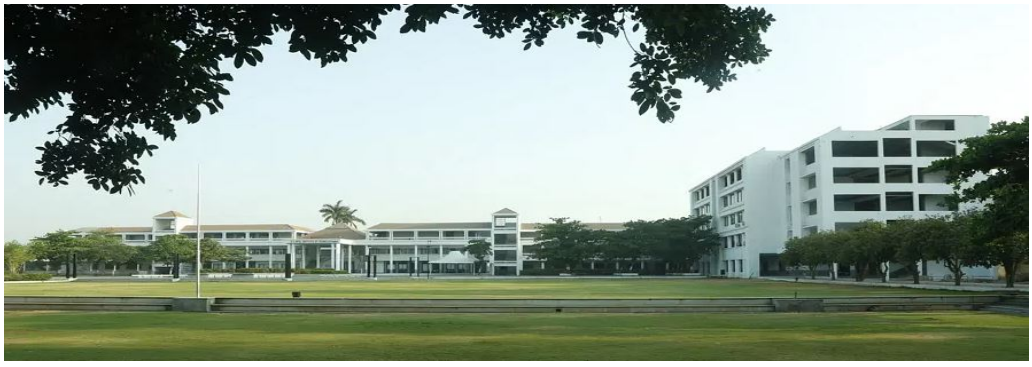
R. C. Patel Institute of Technology, Shirpur

(An Autonomous Institute)

Syllabus Structure

Second Year B.Tech in Mechanical Engineering

(RCP22 Scheme) with effect from Year 2023-24



Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405 Ph: 02563 259 802,
Web: www.rcpit.ac.in/mechanical-engineering-syllabus

Institute Vision and Mission

Vision of the Institute

"To become a leading Institute in Technical education fostering innovation, research, ethical values, and sustainable development for the betterment of society."

Mission of the Institute

To impart high quality Technical Education through:

M1: Innovative and Interactive learning process and high quality globally recognized instructional programs.

M2: Fostering a collaborative scientific temper among students with ethical responsibility towards the society.

M3: Preparing students from diverse backgrounds to have aptitude for employment, entrepreneurship and research with a spirit of Professionalism.

M4: To contribute to nation's sustainable development.

Mechanical Engineering Department

Vision Statement

"To achieve excellence in Mechanical Engineering education through innovation, research, and strong ethical values for sustainable societal development."

Mission Statements

M1: To deliver innovative and practical mechanical engineering education through quality instruction and hands-on learning.

M2: To promote teamwork, ethical values, and scientific curiosity through collaborative and socially relevant projects.

M3: To develop competent engineers with technical expertise, research aptitude, and entrepreneurial spirit for sustainable national growth.

Programme Educational Objectives (PEOs)

PEO 1: Graduates will apply scientific, mathematical, and engineering principles to solve complex mechanical problems ethically and sustainably.

PEO 2: Graduates will design and implement efficient mechanical solutions addressing societal needs through innovation, collaboration, and environmental stewardship.

PEO 3: Graduates will demonstrate professional competence, communication, teamwork, and lifelong learning for career growth, entrepreneurship, and higher education.

Programme Specific Outcomes (PSOs)

PSO 1: Students will be able to apply Mechanical Engineering principles and modern tools to design and improve mechanical systems with innovative solutions.

PSO 2: Students will demonstrate ethical practice, teamwork, and communication to develop engineering solutions for societal and sustainable development.

Department of Mechanical Engineering
(Autonomous – RCP22)

Semester – III (w.e.f.2023-24)

Sr. No	Course Category	Course Code	Course Title	Teaching Scheme (hrs.)			Evaluation Scheme (CA) (marks)				ESE (marks)	Total	Credit	
				L	T	P	TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Best (TT1 & TT2)				
							[A]			[B]	[C]	[A+B+C]		
1	BS	22BSME3010T	Engineering Mathematics III	4	-	-	20	15	15	15	65	100	4	4
2	PC	22PCME3020T	Engineering Thermodynamics	3	-	-	20	15	15	15	65	100	3	3
3	PC	22PCME3030T	Mechanics of Materials	3	-	-	20	15	15	15	65	100	3	4
		22PCME3030L	Mechanics of Materials Laboratory	-	-	2	25	-	-	-	25	50	1	
4	PC	22PCME3040T	Manufacturing Processes	2	-	-	20	15	15	15	65	100	2	2
5	PC	22PCME3050L	Computer Aided Machine Drawing Laboratory	-	-	4	50	-	-	-	50	100	2	2
6	PC	22PCME3060L	Manufacturing Processes Laboratory	-	-	4	50	-	-	-	50	100	2	2
7	HM	22HMME3070T	Universal Human Values	2	-	-	20	15	15	15	65	100	2	2
8	PC	22PCME3080L	Python for Mechanical Engineering Laboratory	-	-	2	25	-	-	-	25	50	1	1
9	PJ	22PJME3090L	Semester Project-I	-	-	2	25	-	-	-	25	50	1	1
			Total	**14**	**0**	**14**	**275**	**75**	**75**	**75**	**500**	**850**	**21**	**21**

BS – Basic Science, PC-Professional Course, PJ- Project, MC- Mandatory Course, A-Audit Course.

Prepared by
Mr. N. G. Shinde

Checked by
Mr. S. V. Yeole

BOS Chairman
Prof. P. L. Sarode

Dean Academic & Dy. Director
Prof. Dr. P. J. Deore

C.O.E.
Mr. S. P. Shukla

Director
Prof. Dr. J. B. Patil

Mechanical Department R.C.P.I.T. SHIRPUR OFFICE SEAL

Department of Mechanical Engineering
(Autonomous – RCP22)

Semester – IV (w.c.f. 2023-24)

Sr. No	Course Category	Course Code	Course Title	Teaching Scheme (hrs.)			Evaluation Scheme (CA) (marks)				ESE (marks)	Total	Credit	
				L	T	P	TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Best (TT1 & TT2)				
							[A]			[B]	[C]	[A+B+C]		
1	BS	22BSME4010T	Engineering Mathematics IV	4	-	-	20	15	15	15	65	100	4	4
2	PC	22PCME4020T	Fluid Mechanics	3	-	-	20	15	15	15	65	100	3	4
		22PCME4020L	Fluid Mechanics Laboratory	-	-	2	25	-	-	-	25	50	1	
3	PC	22PCME4030T	Kinematics of Machinery	3	-	-	20	15	15	15	65	100	3	4
		22PCME4030L	Kinematics of Machinery Laboratory	-	-	2	25	-	-	-	25	50	1	
4	PC	22PCME4040T	Engineering Materials	2	-	-	20	15	15	15	65	100	2	3
		22PCME4040L	Material Testing Laboratory	-	-	2	25	-	-	-	-	25	1	
5	PC	22PCME4050T	Advanced Manufacturing Processes	2	-	-	20	15	15	15	65	100	2	2
6	PC	22PCME4060T	Mechanical Measurement and Metrology	3	-	-	20	15	15	15	65	100	3	4
		22PCME4060L	Mechanical Measurement and Metrology Laboratory	-	-	2	25	-	-	-	-	25	1	
7	PC	22PCME4070L	Advanced Manufacturing Processes Laboratory	-	-	4	50	-	-	-	50	100	2	2
8	MC	22MCME4080T	Constitution of India	1	-	-	-	-	-	-	-	-	A	A
9	PJ	22PJME4090L	Semester Project-II	-	-	2	25	-	-	-	25	50	1	1
10	HM	22HMME4100L	Employability Skill Development Program - I	-	-	2	50	-	-	-	-	50	1	1
			Total	**18**	**-**	**16**	**345**	**90**	**90**	**90**	**515**	**950**	**25**	**25**

BS – Basic Science, PC-Professional Course, MC- Mandatory Course, PJ- Project, HM- Humanity and Management, A-Audit.

Prepared by
Mr. N. G. Shinde

Checked by
Mr. S. V. Yeole

BOS Chairman
Prof. P. L. Sarode

Dean Academic & Dy. Director
Prof. Dr. P. J. Deore

C.O.E.
Mr. S. P. Shukla

Director
Prof. Dr. J. B. Patil

Mechanical Department R.C.P.I.T. SHIRPUR OFFICE SEAL

Shirpur Education Society's

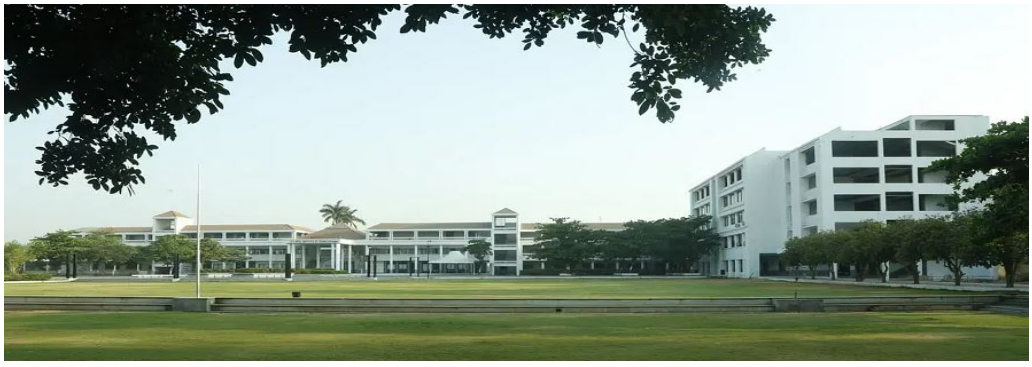
R. C. Patel Institute of Technology, Shirpur

(An Autonomous Institute)

Syllabus Details of Semester-III

Final Year B.Tech in Mechanical Engineering

(RCP22 Scheme) with effect from Year 2023-24



Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405 Ph: 02563 259 802,
Web: www.rcpit.ac.in/mechanical-engineering-syllabus

Program: Mechanical Engineering	S.Y. B.Tech.	Semester: III
Engineering Mathematics III (22BSME3010T)		

Prerequisites:

-

Course Objectives:

1. To provide sound foundation in the mathematical fundamentals necessary to formulate, solve and analyze engineering problems.
2. To study the basic principles of Laplace Transform, Fourier Series, Complex variables

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Use Laplace and inverse Laplace Transform to the Ordinary Differential Equations.	L3	Apply
CO2	Determine analytic and harmonic functions.	L3	Apply
CO3	Solve real integrals using complex integration.	L3	Apply
CO4	Apply Fourier series to periodic functions to simplify and evaluate infinite series.	L4	Analyze
CO5	Solve certain partial differential equations analytically and numerically; Correlate different variables of data.	L3	Apply
CO6	Analyze different variables of data.	L4	Analyze

Engineering Mathematics III (22BSME3010T)

Course Contents

Unit-I **12 Hrs.**

Laplace Transform and Inverse Laplace Transform

Laplace Transform
L.T. of Standard Functions such as $1, t^n, e^{at}, \sin at, \cos at, \sinh at, \cosh at$, Heaviside Unit step function, Dirac Delta function, Periodic functions.
Linearity property of Laplace Transform, First Shifting property, Second Shifting property, Change of Scale property of L.T. (without proof).
$L\{t^n f(t)\}$, $L\left\{\frac{f(t)}{t}\right\}$, $L\left\{\int_0^t f(u)\,du\right\}$, $L\left\{\frac{d^n f(t)}{dt^n}\right\}$.
Inverse Laplace Transform
Linearity property, Partial fractions method and convolution theorem.
Applications to solve ordinary differential equations with one dependent variable with given boundary conditions.

Unit-II **10 Hrs.**

Complex Variables and Differentiation

Analytic functions, Cauchy-Riemann equations in Cartesian and polar coordinates (only statement). Milne-Thomson method to determine analytic function when it's real or imaginary or its combination is given. Harmonic function, orthogonal trajectories.
Bilinear Transformation with fixed points, cross-ratio (for self study).

Unit-III **06 Hrs.**

Complex Integration

Line integral (for self study), Cauchy's theorem for analytic function, Cauchy's integral formula (all without proof).
Taylor's and Laurent's series.
Residue at removable singularity, poles and isolated singularity and its evaluation. Residue theorem, application to evaluate real integral of type
$\int_0^{2\pi} f(\cos\theta, \sin\theta)\,d\theta, \quad \int_{-\infty}^{\infty} f(x)\,dx$

Unit-IV **10 Hrs.**

Fourier Series

Fourier series of periodic function with period 2π& $2l$.
Even and odd functions, Half range sine and cosine series, Parseval's identities (without proof).
Complex form of Fourier series. Orthogonal and Orthonormal functions.

Unit-V **10 Hrs.**

Partial Differential Equations

Numerical Solution of PDE using Bender-Schmidt Method and Crank- Nicolson method.
Partial differential equations governing transverse vibrations of an elastic string its solution using

Fourier series.
Heat equation, steady-state configuration for heat flow.

Unit-VI **08 Hrs.**

Correlation, Regression and Curve-Fitting

Correlation-Karl Pearson's coefficient of correlation, Spearman's Rank correlation, Regression analysis-lines of regression.
Curve fitting by the method of least squares- fitting of the curves of the form: $y = ax + b$, $y = ax^2 + bx + c$ and $y = e^{bx}$

Books Recommended

Textbooks

1 Higher Engineering Mathematics, Dr B. S. Grewal, Khanna Publication

2 Advanced Engineering Mathematics, E Kreyzig, Wiley Eastern Limited

Reference Books

1 Higher Engineering Mathematics, B.V. Ramana, McGraw Hill Education, New Delhi

2 Complex Variables: Churchill, Mc-Graw Hill

3 Integral Transforms and their Engineering Applications, Dr B. B. Singh, Synergy Knowledgeware, Mumbai

4 Numerical Methods, Kandasamy, S. Chand & CO

5 Fundamentals of Mathematical Statistics by S.C. Gupta and Kapoor.

Program: Mechanical Engineering	S.Y. B.Tech.	Semester: III
Engineering Thermodynamics (22PCME3020T)		

Prerequisites:

-

Course Objectives:

1. To familiarize the concepts of Energy in general and Heat and Work in particular.
2. To study the fundamentals of quantification and grade of energy.
3. To study the effect of energy transfer on properties of substances in the form of charts and diagrams.
4. To familiarize application of the concepts of thermodynamics in vapour power, gas power cycles.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Demonstrate application of the first law of thermodynamics to wide range of systems.	L3	Apply
CO2	Analyze thermodynamic cycles including vapor power cycles, refrigeration cycles, and heat-pump.	L4	Analyze
CO3	Use thermodynamic relations in the evaluation of thermodynamic properties.	L3	Apply
CO4	Use steam table and Mollier chart to compute thermodynamics interactions.	L3	Apply
CO5	Calculate the performance of air standard cycles.	L3	Apply
CO6	Analyze various gas turbine cycles.	L4	Analyze

Engineering Thermodynamics (22PCME3020T)

Course Contents

Unit-I **08 Hrs.**

First Law of Thermodynamics

Basics concepts of thermodynamics, quasi-static process, Relation between Heat and Work- Joules Constant, First law of thermodynamics for a closed system undergoing a cycle and change of state. Conservation principle, First Law of Thermodynamics applied to open system – Steady Flow Energy Equation, Perpetual motion Machine of First kind.
Application of first law of thermodynamics to Open Systems like Steam Nozzle, Boiler, Steam Turbine, Pump, Heat Exchanger, Throttling Process

Unit-II **09 Hrs.**

Second Law of Thermodynamics

Limitation of first law of thermodynamics, Thermal Reservoir – Source and Sink, Concept of Heat Engine, Heat Pump and Refrigerator, Second law of thermodynamics – Kelvin Planck and Clausius Statements. Equivalence of Clausius and Kelvin Planck Statement, Reversible and Irreversible Process. Causes of Irreversibility, Perpetual Motion Machine of Second Kind, Need of Carnot theorem and its corollaries, Carnot cycle, Thermodynamic Temperature Scale and its equivalence with Ideal Gas Scale.
Entropy: Clausius Inequality, Clausius Theorem, Entropy is Property of a system, Isentropic Process, Temperature Entropy Plot and its relationship with heat interactions, Entropy Principle, Entropy change During a Process. Interpretation of concept of entropy.

Unit-III **05 Hrs.**

Thermodynamic Relations

Thermodynamic Relations: Reciprocal Relation, Cyclic Relation Property relations, Maxwell Relations, TdS equations, Heat capacity relations, Volume Expansivity, Isothermal Compressibility, Clausius Clapeyron Equation.
Exergy: High grade and Low-Grade Energy, Available and Unavailable Energy, Dead State, Available energy with respect to a process and a cycle.

Unit-IV **07 Hrs.**

Properties of Pure Substance and Vapour Power Cycle

Properties of Pure Substance: Pure substance and Phase changes: Phase change processes of pure substance, Property diagrams for phase change process (T-v, T-s and p-h diagrams), Understanding of Steam Table and Mollier chart.
Vapour Power cycle: Carnot cycle and its limitations as a vapour cycle, Rankine cycle with different turbine inlet conditions, mean temperature of heat addition, Methods to improve thermal efficiency of Rankine cycle – Reheat cycle and Regeneration Cycle.

Unit-V 06 Hrs.

Gas Power Cycle

Gas Power cycles: Assumptions of Air Standard Cycle, Otto cycle, Diesel Cycle and Dual cycle, Brayton Cycle, Actual Brayton cycle, open and closed cycle gas turbine, methods to improve efficiency and specific output, open cycle with intercooling, reheat, and regeneration, Effect of operating variable on thermal efficiency and work ratio.

Unit-VI 07 Hrs.

Compressors

Reciprocating Air Compressor, Single stage compressor – computation of work done, isothermal efficiency, effect of clearance volume, volumetric efficiency, Free air delivery, Theoretical and actual indicator diagram, Multistage compressors – Constructional details of multistage compressors, Need of multistage, Computation of work done, Volumetric efficiency, Condition for maximum efficiency, Inter cooling and after cooling (numerical), Theoretical and actual indicator diagram for multi stage compressors.

Books Recommended

Textbooks

1 Thermodynamics by P K Nag, Tata McGraw Hill Publishers

2 Thermodynamics by Onkar Singh, New Age International

Reference Books

1 Thermodynamics: An Engineering Approach by Yunus A. Cengel and Michael ABoles,7th edition, TMH.

2 Fundamentals of Engineering Thermodynamics by Michael J. Moran and Howard N. Shapiro, Wiley.

3 Fundamentals of Thermodynamics by Claus Borgnakke and Richard E. Sonntag, Wiley.

4 Engineering Thermodynamics by P Chattopadhyay, Oxford University Press India

Program: Mechanical Engineering	S.Y. B.Tech.	Semester: III
Mechanics of Materials (22PCME3030T)		
Mechanics of Materials Laboratory (22PCME3030L)		

Prerequisites:

-

Course Objectives:

1. To gain knowledge of different types of stresses, strains and deformations induced in the mechanical components due to external loads.
2. To study the distribution of various stresses in mechanical elements that deform under loads.
3. To study the effect of component dimensions and materials properties on stresses and deformations.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Calculate stresses, strains, deformation and properties of materials in mechanical components/ structures.	L3	Apply
CO2	Outline SFD and BMD for different types of loads and support conditions for a beam.	L4	Analyze
CO3	Calculate and Illustrate direct, bending and shear stresses across sections of a given beam.	L3	Apply
CO4	Calculate torsional shear stresses and strain energy in mechanical components.	L3	Apply
CO5	Calculate deflections and slopes in beams.	L3	Apply
CO6	Demonstrate buckling phenomenon in columns and struts.	L3	Apply

Mechanics of Materials (22PCME3030T)

Course Contents

Unit-I **10 Hrs.**

Moment of Inertia, Stress, Strain, Elastic Constants and their relations

Moment of Inertia: Centroid, Area Moment of Inertia, Parallel Axis theorem, Polar Moment of Inertia, Principal axes, Principal moment of inertia.

Stress and Strain: Definition, Simple stress-strain, uni-axial, bi-axial and tri-axial stresses, tensile stress, compressive stress and shear stresses, elastic limit, Hooke's Law, deformation due to self-weight, bars of varying sections, composite sections, deformation of tapering members, Thermal Stresses.
Elastic Constants and their relations: Poisson's Ratio, Modulus of elasticity, Modulus of rigidity, Bulk modulus, Yield stress, Ultimate stress. Factor of safety, state of simple shear, relation between elastic constants, Volumetric strain for tri-axial loading.

Unit-II **07 Hrs.**

Shear Force and Bending Moment

Axial force, shear force and bending moment diagrams for statically determinate beams (excluding beams with internal hinges), relationship between rates of loading, shear force and bending moment.

Unit-III **06 Hrs.**

Bending stresses and Shear Stresses

Bending stresses: Theory of pure Bending, Assumptions, Flexural formula for straight beams, moment of resistance, bending stress distribution, Section modulus, beams of uniform strength.
Shear Stresses: Distribution of shear stresses for the section of beam.

Unit-IV **06 Hrs.**

Torsion and Principal stresses and Strains

Torsion: Torsion of circular shafts-solid and hollow, stresses in shafts when transmitting power, shafts in series and parallel.
Principal stresses and Strains: Principal plane and principal stresses, analytical and graphical method (Mohr's circle) for determining stresses on the oblique section.

Unit-V **06 Hrs.**

Deflection

Deflection of Beams: Deflection of Cantilever, simply supported and over hanging beams using Macaulay's or double integration method for different type of loadings.

Unit-VI **07 Hrs.**

Columns, Struts and Strain Energy

Columns and Struts: Buckling load, crushing load, Types of end conditions for column, Euler's column theory and its limitations, Rankine- Gordon Formula.
Strain Energy: Resilience, Proof Resilience, strain energy stored in the member due to gradually applies load, suddenly applied load, impact load. Strain energy stored due to Shear, Bending and Torsion.

Mechanics of Materials Laboratory (22PCME3030L)

Suggested Experiments

A Any 5 experiments:

1 Tension test on mild steel bar (stress-strain behaviour, determination of yield strength and modulus of elasticity) using Universal Testing Machine (UTM).
2 Impact test on metal specimen (Izod test/ Charpy test).
3 Hardness test on metals – (Brinell Hardness Number / Rockwell Hardness Number).
4 Flexural test on beam (central loading).
5 Flexural test on beam (three-point loading).
6 Torsion test on mild steel bar / cast iron bar.
Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

B Assignments

Term work shall consist of minimum 5 experiments and 6 assignments. Oral examination will be based on the entire syllabus including, the experiments performed during laboratory sessions.

Books Recommended

Textbooks

1 Strength of Materials by S. Ramamrutham, Dhanpat Rai Pvt. Ltd
2 Mechanics of Materials by S.S.Ratan, Tata McGraw Hill Pvt. Ltd
3 Strength of Materials by R. Subramanian, Oxford University Press, Third Edition 2016

Reference Books

1 Strength of Materials by Ryder, Macmillan
2 Mechanics of Materials by James M. Gere and Barry J. Goodno, Cengage Learning.
3 Mechanics of Materials by Gere and Timoshenko, CBS
4 Strength of Materials by Basavrajaiah and Mahadevappa, Khanna Publishers,New Delhi
5 Elements of Strength of Materials by Timoshenko and Youngs, Affiliated East -West Press
6 Mechanics of Materials byBeer, Jhonston, DEwolf and Mazurek, TMH Pvt Ltd., New Delhi

7 Mechanics of Structures by S.B. Junnarkar, Charotar Publication

8 Introduction to Solid Mechanics by Shames, PHI

9 Strength of Materials by Nag and Chandra, Wiley India

10 Strength of Materials by W.Nash, Schaum's Outline Series, McGraw Hill Publication, Special Indian Edition

Program: Mechanical Engineering	S.Y. B.Tech.	Semester: III
Manufacturing Processes (22PCME3040T)		

Prerequisites:

-

Course Objectives:

1. To impart the knowledge of manufacturing processes like casting, forging, rolling, metal cutting processes like turning, drilling, thread cutting etc.
2. To train the students in machining various operations on CNC to enrich their practical skills.
3. To impart the fundamentals of various power metallurgy techniques and various polymeric composite manufacturing.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Demonstrate types of machine tools, their classification, specifications and constructional features, with machining operations to generate cylindrical, and planar components.	L3	Apply
CO2	Explain various metal casting processes, analyze various defects, their probable causes and remedial measures confronted with metal casting.	L4	Analyze
CO3	Apply the concept of various metal forming processes, analyze various defects, their probable causes and remedial measures confronted with metal forming.	L3	Apply
CO4	Explain sheet metal operations to build the concepts pertaining to press tools.	L2	Unserstand
CO5	Calculate various forces, velocities, shear angle, strain, shear stress and power consumption in metal cutting operation.	L3	Apply
CO6	Analyze various power metallurgy techniques and various polymeric composite manufacturing techniques.	L4	Analyze

Manufacturing Processes (22PCME3040T)

Course Contents

Unit-I **03 Hrs.**

Introduction to Manufacturing Processes

Introduction to Manufacturing Processes: Examples and Application.
Need and classification of manufacturing process based on chip-less and chip-removal processes. Various generating & forming processes. Illustrate machine tools required to generate cylindrical and planar components.
Metal Cutting Processes: Machine tools: lathe, drill, shaper, milling, gear hobbing and grinding, their operations, operating parameters, MRR, various cutting tools, accessories, and attachments. Super finishing processes like, Honing, Lapping, Buffing and Polishing.
(Metal Cutting Processes To be covered in laboratory)

Unit-II **05 Hrs.**

Metal Casting and joining Process

Metal Casting Process: Expendable and Permanent Mould Casting Processes –sand casting, investment casting, shell moulding, die casting, centrifugal casting, vacuum casting, casting defects and their remedies.
Metal Joining Processes : Classification of welding, Fusion welding processes like - Gas welding, Arc welding, Resistance, Electron beam welding, laser beam welding. Solid state welding processes like – friction welding, ultrasonic welding, and Thermo-chemical welding processes. Soldering and brazing processes. Welding defects, inspection & testing of welds, Safety in welding.
(Metal Joining Processes To be covered in laboratory)

Unit-III **08 Hrs.**

Rolling, Forging, Extrusion and Sheet Metal Operations

Rolling: Principles and process characteristics, rolling types, rolling parameters, Thread rolling, Production of seamless tubes through rolling, defects, and remedies in rolling process.
Forging: Basic operations, types of forging, forging hammers/ presses, forging stages, forging applications, defects, and remedies in forging process.
Extrusion: Equipment and principles, types of extrusion, direct, indirect, impact, continuous, hydrostatic, tube extrusion, metal flow in extrusion, defects and remedies in extrusion, wire drawing process.
Sheet Metal Operations: Theory in Press Working, Functions of different elements of a press tool, Press working perations: piercing, lanking, notching, embossing, coining, bending, forming and drawing perations. Benefit.

Unit-IV **05 Hrs.**

Theory of Metal Cutting

Introduction, machining parameters, orthogonal and oblique cutting, mechanism of metal cutting, types of chips, Merchant's circle diagram, calculation of cutting forces, shear stress and strain, strain rate, power requirement, Geometry of Single point cutting tool (SPTT), Significance of various angles of SPTT, ISO coding for tipped tools and tool holders.

Unit-V **04 Hrs.**

Powder Metallurgy and Polymeric composites manufacturing process

Powder Metallurgy: Principles of powder metallurgy, Processes of powder making, mechanisms of sintering, CIP and HIP, Finishing operations in Powder metallurgy, Applications of Powder metallurgy. Polymeric composites manufacturing process : Injection Moulding, Compression moulding, transfer moulding, blow moulding, Rotational Moulding, Thermoforming and Extrusion.

Unit-VI **03 Hrs.**

Manufacturability assessment of given product design.

Manufacturability assessment of given product design.
Classifying operations, basic process operation, principal process and auxiliary process.
Process planning of complete manufacturing process for a given components.

Books Recommended

Reference Books

1 Elements of Workshop Technology: Machine Tools by S. K. Hajra Choudhary, A. K. Hajra Choudhary, Nirjhar Roy, Media promoters 15th edition (2010)

2 A Course in Workshop Technology Vol. II (Machine Tools) by B. S. Raghuvanshi, Dhanpat Rai & Co. (2019)

3 Production Technology – HMT, Tata McGraw-Hill (2017).

4 A Textbook of Production Technology Vol. I and II by O. P. Khanna, Dhanpat Rai Publication 19th edition.

5 Fundamentals of Modern Manufacturing- Materials, Processes and Systems, 7th edition by Mikell P. Groover, Wiley India (May 2019).

6 Manufacturing Processes for Engineering Materials, 8th edition by Serope Kalpakjian, Steven R. Schmid, Pearson (2020).

7 Manufacturing Processes by P. N. Rao, Vol. 1 (5th edition) and Vol. 2 (4th edition), McGraw Hill Publishers (2018).

8 Welding Technology by O. P. Khanna, Dhanpat Rai & Co (2015).

9 Composites Manufacturing – Materials, product, and Process Engineering by Sanjay K. Muzumdar, CRC Press (2002).

10 Process Engineering for Manufacturing, Donald F. Eary and Gerald E. Johnson, Prentice-Hall, Inc.

Program: Mechanical Engineering	S.Y. B.Tech.	Semester: III
Computer Aided Machine Drawing Laboratory (22PCME3050L)		

Prerequisites:

-

Course Objectives:

1. To familiarize conversion of an object into a drawing.
2. To study conventional representation of various machining and mechanical details as per IS.
3. To become conversant with 2-D and 3-D drafting.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Interpret and prepare detail drawing of a given object.	L2	Understand
CO2	Read and interpret the drawing.	L2	Understand
CO3	Show details and assembly of different mechanical systems.	L3	Apply
CO4	Illustrate detailed drawing into assembly drawing using modelling software.	L4	Analyze
CO5	Illustrate assembly drawing into detailed drawing using modelling software.	L4	Analyze
CO6	Examine detailed drawing of any given physical object/machine element with actual measurements.	L3	Apply

Computer Aided Machine Drawing Laboratory (22PCME3050L)

Course Contents

Unit-I **06 Hrs.**

Introduction:

Review of graphic interface, various tools and settings for preparation of graphics work space. Introduction of basic sketching commands (Line, circle, arc, rectangle, slot, spline, fillet polygon, text, dimensioning etc.) modify commands (move, trim, copy, replace, extend, split, offset etc.), feature commands (extrude, revolve, loft, sweep, rib, coil, emboss etc.) and navigational commands (Pan, zoom in, zoom out, orientation etc.). Types of drawing sheets and its sizes, Drawing units, grid and snap, title block. Conversion of 3D views into orthographic projections of simple machine parts like (nuts, bolts, keys, screws, spring etc.), Editing, Hidden line view, shaded view, render view, presentation of various view along with different orientations.

Unit-II **06 Hrs.**

Details and assembly drawings, GD&T and threaded parts

Details and assembly drawings: Types of assembly drawings, part drawings, drawings for catalogues and instruction manuals, patent drawings, drawing standards, Introduction to unit assembly drawing, steps involved in preparing assembly drawing from details and vice-versa.
Geometric Dimensions and Tolerances (GD&T): Introduction of Limits, fits, deviations, and tolerances with their applications, dimensioning with tolerances indicating various types of fits in details and assembly.
Conventional representation of threaded parts: Types of threads, thread designation, Thread terminology, sectional views of threads. ISO Metric (Internal & External) BSW (Internal & External) square and Acme, American Standard thread.

Unit-III **12 Hrs.**

Preparation of details/assembly drawings of Machinery parts, Joints and Keys, Couplings

Machinery parts : Clapper block, Single tool post, Lathe and Milling tail stock, jigs and fixtures.
Joints and Keys : Cotter joints, knuckle joints, keys-sunk, parallel woodruff, saddle, feather etc.
Couplings : simple, muff, flanged Protected flange coupling, Oldham's coupling, Universal coupling.

Unit-IV **08 Hrs.**

Preparation of details and assembly drawings of Bearings

Simple bearing, Solid bearing, Bushed bearing, I.S. conventional representation of ball and roller bearing, Pedestal bearing, footstep bearing.

Unit-V **08 Hrs.**

Preparation of details and assembly drawings of pulleys, Pipe joints

Pulleys: Flat belt, V-belt, rope belt, Fast and loose pulleys.
Pipe joints : Flanged joints, Socket and spigot joint, Gland and stuffing box, expansion joint.

Unit-VI **12 Hrs.**

Preparation of details / assembly drawings of Valves, I.C. Engine parts and Reverse Engineering of a physical model

Preparation of details / assembly drawings of Valves: Air cock; Blow off cock, Steam stop valve, Gate valve, Globe valve, non-return Valve.
Preparation of details / assembly drawings of I.C. Engine parts: Piston, Connecting rod, Cross head, Crankshaft, Carburetor, Fuel pump, injector, and Spark plug.
Introduction to Reverse Engineering of a physical model: Historical Background, scope and task of Reverse Engineering in Modern Industries, Applications of Reverse Engineering & 3D scanning.

Computer Aided Machine Drawing Laboratory (22PCME3050L)

Suggested Experiments

---

1 General machine elements - nuts, bolts, keys, cotter, screws, spring etc. (any one)

2 Details/Assembly of Clapper block, Single tool post, Lathe and Milling tail stock, jigs and fixtures. (any one)

3 Details/Assembly of coupling - simple, muff, flanged Protected flange coupling, Oldham's coupling, Universal coupling. (any one)

4 Details/Assembly of ball and roller bearing, Pedestal bearing, footstep bearing. (any one)

5 Details/Assembly of different types of pulleys. (any one)

6 Details/Assembly of pipe joints - Flanged joints, Socket and spigot joint, Gland and stuffing box, expansion joint. (any one)

7 Details/Assembly of Air cock; Blow off cock, Steam stop valve, Gate valve, Globe valve, Non return Valve. (any one)

8 Details/Assembly of Piston, Connecting rod, Cross head, Crankshaft, Carburetor, Fuel pump, injector, and Spark plug. (any one)

9 Reverse engineering drawing of any machine assembly or details of machine system.

A3/ A4 size Printouts/plots of the problems solved in practical class from the practical part of each module. Problems from practical parts of each module should be solved using any standard CAD packages like IDEAS, PRO-E, CATIA, Solid Works, Inventor etc.

Books Recommended

Reference Books

1 Machine Drawing by N.D. Bhatt.

2 A textbook of Machine Drawing by Laxminarayan and M.L. Mathur, Jain brothers Delhi

3 Machine Drawing, Kamat and Rao

4 Machine Drawing, M. B. Shah

5 A text book of Machine Drawing, R. B. Gupta, Satyaprakashan, Tech. Publication

6 Machine Drawing, K.I.Narayana, P. Kannaiah, K.Venkata Reddy

7 Machine Drawing, Sidheshwar and Kanheya

8 Autodesk Inventor 2011 for Engineers and Designers, ShamTickoo and SurinderRaina, Dreamtech Press

9 Engineering Drawing, P J Shah

10 . Engineering Drawing by N D Bhatt

Program: Mechanical Engineering	S.Y. B.Tech.	Semester: III
Manufacturing Processes Laboratory (22PCME3060L)		

Prerequisites:

-

Course Objectives:

1. To impart the knowledge of machine tools and basic machining processes like turning, drilling, boring, broaching, milling, shaping, planning, slotting, and grinding etc.
2. To provide an insight to different machine tools, accessories, and attachments.
3. To train the students in machine operations to enrich their practical skills.
4. To inculcate team qualities and expose students to shop floor activities.
5. To educate the students about ethical, environmental and safety standards.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Demonstrate precautions and safety norms followed in Machine Shop and exhibit interpersonal skills towards working in a team.	L3	Apply
CO2	Use the construction, working and operation of various conventional machine tools and various accessories and attachments used; and determine suitable cutting parameters.	L3	Apply
CO3	Use working drawings, understand operational symbols and execute machining operations.	L3	Apply
CO4	Perform and demonstrate various operations such as plain turning, taper turning, step turning, thread cutting, facing, knurling, internal thread cutting, eccentric turning and estimate cutting time	L3	Apply
CO5	Perform and demonstrate machining operations such as plain shaping, inclined shaping, keyway cutting, Indexing and Gear cutting and estimate cutting time.	L3	Apply
CO6	Demonstrate the importance of grinding and super finishing operations.	L3	Apply

Manufacturing Processes Laboratory (22PCME3060L)

Suggested Experiments

---

1 One job involving Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling, Drilling, Boring, Internal Thread cutting and Eccentric turning on lathe machine. Exercises should include selection of cutting parameters and cutting time estimation.) [16 Hours]

2 Introduction to Shaping Machine, demonstration of various machining operations performed on Shaping Machine.
(One job on shaping machine to make horizontal and inclined surface) [18 Hours]

3 One job involving Cutting of Gear Teeth / Hexagonal nut using Milling Machine and Cutting of V Groove / dovetail / Rectangular groove using a shaper. Exercises should include selection of cutting parameters and cutting time estimation. [20 Hours]

4 One job (Group Job) using cylindrical grinding machine. Exercises should include selection of cutting parameters and cutting time estimation. [18 Hours]

Books Recommended

Reference Books

1 Workshop Technology by W. A. J. Chapman Vol I & II

2 Workshop Technology by Hazra Choudhary Vol. I & II

Program: Mechanical Engineering	S.Y. B.Tech.	Semester: III
Universal Human Values (22HMME3070T)		

Prerequisites:

-

Course Objectives:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society, and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society, and nature/existence.
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Define the concepts and need of value education and develop awareness of harmony in oneself, family, society and nature, leading to responsible behavior and critical thinking for sustainable solutions.	L2	Understand
CO2	Identify and apply harmony in oneself, family and society, and develop sensitivity and commitment towards human values, human relationships, social responsibility and professional ethics.	L3	Apply
CO3	Apply the holistic understanding of harmony in day-to-day personal, social and professional life situations, initiating value-based practices in real-life decision making.	L3	Apply

Universal Human Values (22HMME3070T)

Course Contents

Unit-I **6 Hrs.**

Introduction

Introduction: Need, Basic Guidelines, Content and Process for Value Education Purpose and motivation for the course. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration.
Continuous Happiness and Prosperity- A look at basic Human Aspirations.
Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.
Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario.
Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Unit-II **5 Hrs.**

Understanding Harmony in the Human Being

Harmony in Myself! Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. Understanding the Body as an instrument of 'I' (I am being the doer, seer and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Health.

Unit-III **4 Hrs.**

Understanding Harmony in the Family

Harmony in Human-Human Relationship. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust;Difference between intention and competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.

Unit-IV **4 Hrs.**

Understanding the harmony in society (society being an extension of family

Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Unit-V **4 Hrs.**

Understanding Harmony in Nature and Existence

Whole existence as Coexistence Understanding the harmony in the Nature. Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all pervasive space. Holistic

perception of harmony at all levels of existence.

Unit-VI **5 Hrs.**

Implications of the above Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order, b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists, and managers, b. At the level of society: as mutually enriching institutions and organizations

Books Recommended

Textbooks

1 Understanding the harmony in society (society being an extension of family

Reference Books

1 Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.

2 Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

3 The Story of Stuff (Book).

4 The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.

5 Small is Beautiful - E. F Schumacher. 6. Slow is Beautiful - Cecile Andrews.

6 Economy of Permanence - J C Kumarappa.

7 Bharat Mein Angreji Raj – PanditSunderlal.

8 Rediscovering India - by Dharampal.

9 Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi.

10 India Wins Freedom - Maulana Abdul Kalam Azad.

11 Vivekananda - Romain Rolland. (English)

12 Gandhi - Romain Rolland. (English)

Program: Mechanical Engineering	S.Y. B.Tech.	Semester: III
Python for Mechanical Engineering Laboratory (22PCME3080L)		

Prerequisites:

-

Course Objectives:

1. To understand the coding environment of Python Programming.
2. To apply Python coding skills to solve various Mechanical problems.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Explain the coding environment of Python software.	L2	Understand
CO2	Explain the basics of Python.	L2	Understand
CO3	Read, analyze and visualize data.	L4	Analyze
CO4	Apply the python skills for Mechanical problems.	L3	Apply

Python for Mechanical Engineering Laboratory (22PCME3080L)

Course Contents

Unit-I **04 Hrs.**

Introduction to Python

Python history, Introduction to Anaconda, Spyder IDE, programming basics, understanding the layout of the programming environment and Spyder.

Unit-II **06 Hrs.**

Basics of Python

Assignment Statement, variable and datatypes, Loops, Strings, Lists, Operators, Arrays, Sorting, Functions and Dictionaries.

Unit-III **06 Hrs.**

Data Handling and Manipulation

Reading Data, Introduction to Pandas Data frame and Numpy, Data Visualization, exploratory Data Analysis.

Unit-IV **10 Hrs.**

Using Python for Mechanical Applications

Using Python for Mechanical Applications (Design, Thermal and Manufacturing.)

Python for Mechanical Engineering Laboratory (22PCME3080L

Suggested Experiments

---

1 To take input from user and print the sum, smaller no, larger no.

2 At least two programs involving operations related to basics of Python.

3 At least two programs related to Data handling and manipulation.

4 Python applied to Mechanical Applications – At least 3.

Minimum eight experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Books Recommended

Reference Books

1 Problem Solving and Programming; S. Kuppuswamy, S. Malliga, C.S. Kanimozhi Selvi, K. Kousalya; 2019; Tata McGraw Hill.

2 Introducing Python Modern Computing in Simple Packages; Bill Lubanovic; 1st edition; 2014; O'Reilly Media.

3 Python: The Complete Reference; Martin C; 1st edition; 2018; Tata McGrawHill.

4 Core Python Programming; R. Nageswara Rao; 2nd edition; 2018; DreamTech Press.

5 Let Us Python; Yashavant Kanetkar; 2019; BPB Publication.

Program: Mechanical Engineering	S.Y. B.Tech.	Semester: III
Semester Project-I (22PJME3090L)		

Prerequisites:

–

Course Objectives:

1. Students are expected to design, simulate/implement a project based on the knowledge acquired from current semester subjects.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Analyze a survey of several available literatures in the preferred field of study.	L4	Analyze
CO2	Describe various/alternate approaches to complete a project.	L2	Understand
CO3	Apply a collaborative project environment by interacting and dividing project work among team members.	L3	Apply
CO4	Use technical communication skills to present project work in the form of a technical report/paper.	L3	Apply
CO5	Apply teamwork and project management skills to plan, execute, and manage the research study.	L3	Apply

Semester Project-I (22PJME3090L)

The purpose of introducing a semester project at the Second-year level is to provide exposure to students with a variety of projects based on the knowledge acquired from the semester subjects. This activity is supposed to enrich their academic experience and bring enough maturity to the student while selecting the project. Students should take this as an opportunity to develop skills in implementation, presentation, and discussion of technical ideas/topics. Proper attention shall be paid to the content of report, which is being submitted in partial fulfillment of the requirements of the Second-year, and it is imperative that a standard format be prescribed for the report.
Each student shall work on a project approved by the departmental committee approved by the Head of the Department. A group of 3 to 5 students (maximum allowed: 5 students in extraordinary cases, subject to the approval of the department committee and the Head of the department) shall be allotted for each Semester Project. Each group shall submit at least 3 topics for the Semester Project. The departmental committee shall finalize one topic for every group. The Semester Project Title or Theme should be based on the knowledge acquired during the semester. The project work shall involve sufficient work so that students get acquainted with different aspects of knowledge acquired from semester subjects.

Student is expected to:

- Select an appropriate project title based on acquired knowledge from current semester subjects.
- Maintain a Log Book of weekly work done (Log Book Format will be as per Table 1).
- Report weekly to the project guide along with the log book.

Table 1: Log Book Format

Sr	Week (Start Date:End Date)	Work Done	Sign of Guide	Sign of Coordinator
1				

Assessment Criteria:

- At the end of the semester, after confirmation by the project guide, each project group will submit a project completion report in the prescribed format for assessment to the departmental committee (including project guide).
- Assessment of the project (at the end of the semester) will be done by the departmental committee (including project guide).

Prescribed project report guidelines:

The Project Report (minimum of 25 pages) should include appropriate content for:

- Introduction
- Literature Survey,
- Related Theory
- Implementation details
- Project Outcomes, Conclusion
- References

Assessment criteria for the departmental committee (including project guide) for Continuous Assessment:

Guide will monitor weekly progress, and marks allocation will be as per Table 2.

Table 2: Continuous Assessment table

Sr	PRN	Name of Student	Student Attendance	Log Book Maintain	Literature Review	Depth of Understanding	Report	Total
			5	5	5	5	5	25

Assessment criteria for the departmental committee (including project guide) for End Semester Exam:

The departmental committee (including project guide) will evaluate the project as per Table 3.

Table 3: Evalution Table

Sr	PRN	Name of Student	Project Selection	Design/ Simulation	model/ programming	Result Verification	Presentation	Total
			5	5	5	5	5	25

Each group shall present/publish a paper based on the semester project in reputed/peer-reviewed Conference/Journal/TechFest/Magazine before the end of the semester.

Shirpur Education Society's

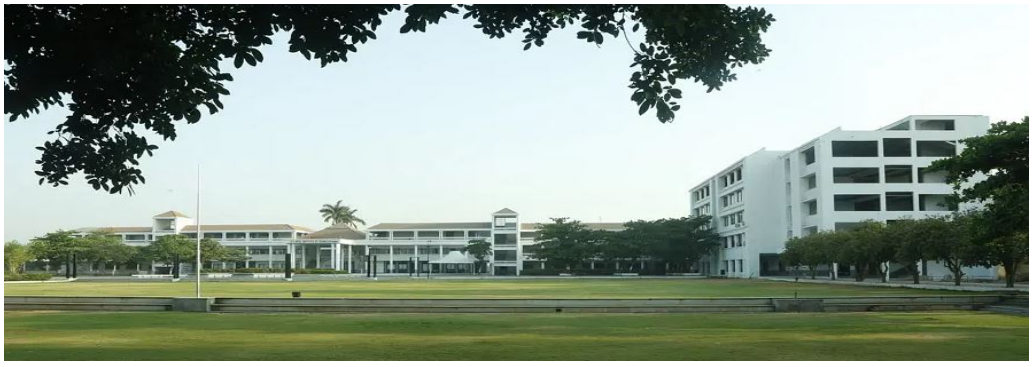
R. C. Patel Institute of Technology, Shirpur

(An Autonomous Institute)

Syllabus Details of Semester-IV

Final Year B.Tech in Mechanical Engineering

(RCP22 Scheme) with effect from Year 2023-24



Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405 Ph: 02563 259 802,
Web: www.rcpit.ac.in/mechanical-engineering-syllabus

Program: Mechanical Engineering	S.Y. B.Tech.	Semester: IV
Engineering Mathematics-IV (22BSME4010T)		

Prerequisites:

-

Course Objectives:

1. To inculcate an ability to relate engineering problems to mathematical context.
2. To provide a solid foundation in mathematical fundamentals required to solve engineering problem.
3. To study the basic principles of linear algebra, vector analysis, probability, test of hypothesis and correlation between data.
4. To prepare students for competitive exams.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Use eigenvalues and eigenvectors to identify diagonalizable and derogatory matrices and evaluate functions of square matrices.	L3	Apply
CO2	Evaluate vector integrals.	L5	Evaluate
CO3	Use probability to solve real-life engineering problems.	L3	Apply
CO4	Apply concepts of large and small sampling to draw valid conclusions about the population.	L3	Apply
CO5	Analyze the variances of multiple variables simultaneously.	L4	Analyze

Engineering Mathematics-IV (22BSME4010T)

Course Contents

Unit-I **14 Hrs.**

Linear Algebra

Characteristic equation, Eigenvalues and Eigenvectors with properties.
Cayley-Hamilton theorem to find higher order matrices and inverse of matrix.
Diagonalizability of similar matrices.
Functions of square matrix.
Quadratic Forms: Canonical form using congruent transformations, Orthogonal Transformation to find rank, index, signature and value class.

Unit-II **08 Hrs.**

Vector differentiation

Scalar and vector point functions. Gradient of a scalar function,
Divergence, curl and Scalar Potential of a vector function.
Solenoidal, Irrotaional and conservative Fields.

Unit-III **06 Hrs.**

Vector Integration

Line integrals (For Self-Study), Green's theorem (without proof) for planes and verification of line integrals.
Stokes theorem and Gauss divergence theorem (without proof and verification).

Unit-IV **11 Hrs.**

Probability

Discrete and Continuous random variables, Probability mass and density function, Probability distribution for random variables, Expected value, Variance.
Probability Distributions: Binomial, Poisson and Normal Distributions (for detailed study)

Unit-V **11 Hrs.**

Sampling Theory

Sampling distribution. Test of Hypothesis. Level of significance, critical region. One tailed and two tailed tests. Interval Estimation of population parameters. Large and small sample.
Test of significance for Large samples: Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two samples.
Student's t-distribution and its properties. Test of significance of small samples: Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two Samples, paired t-test.
Chi-square test, Test for the Goodness of fit, Association of attributes.

Unit-VI **06 Hrs.**

ANOVA

Analysis of Variance (F-Test): One-way classification, Two-way classification (short-cut method)

Books Recommended

Textbooks

1 Higher Engineering Mathematics, Dr B. S. Grewal, Khanna Publication.

2 Advanced Engineering Mathematics, E Kreyzig, Wiley Eastern Limited.

Reference Books

1 Higher Engineering Mathematics, B.V. Ramana, McGraw Hill Education, New Delhi

2 Integral Transforms and their Engineering Applications, Dr B. B. Singh, Synergy Knowledge ware, Mumbai

3 Numerical Methods, Kandasamy, S. Chand & CO

4 Fundamentals of Mathematical Statistics by S.C. Gupta and Kapoor

Program: Mechanical Engineering	S.Y. B.Tech.	Semester: IV
Fluid Mechanics (22PCME4020T)		
Fluid Mechanics Laboratory (22PCME4020L)		

Prerequisites:

-

Course Objectives:

1. To study fluid statics and fluid dynamics.
2. To study application of mass, momentum and energy equations in fluid flow.
3. To learn various flow measurement techniques.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Explain the key fluid properties, calculate the pressure, hydro- static pressure force.	L2	Understand
CO2	Analyze various flow characteristics based on the velocity field and determine the streamline pattern and acceleration field given a velocity field.	L4	Analyze
CO3	Evaluate the development, uses, and limitations of the Bernoulli equation and apply the Reynolds transport theorem and the ma- terial derivative, analyze certain types of flows using the Navier- Stokes equations.	L5	Evalute
CO4	Analyze and understand various characteristics of the flow in pipes, calculate losses in straight portions of pipes as well as those in various pipe system components, apply appropriate equations and principles to analyze a variety of pipe flow situations.	L4	Analyze
CO5	Explain the fundamental characteristics of a boundary layer, in- cluding laminar, transitional, and turbulent regimes, calculate boundary layer parameters for flow past a flat plate.	L2	Understand
CO6	Explain some important features of different categories of com- pressible flows of ideal gases, solve useful problems involving isen- tropic and non-isentropic flows.	L2	Understand

Fluid Mechanics (22PCME4020T)

Course Contents

Unit-I **08 Hrs.**

Fluid Statics

Definition of fluid, fluid properties such as viscosity, vapour pressure, compressibility, surface tension, capillarity etc. pressure at a point in the static mass of fluid, variation of pressure, Pascal's law, pressure measurement by simple and differential manometers.
Hydrostatic forces on the plane and curved surfaces.

Unit-II **07 Hrs.**

Fluid Kinematics

Eulerian and Lagrangian approach to solutions; Velocity and acceleration in an Eulerian flow field; Definition of streamlines, path lines and streak lines; types of fluid flows; Definition of control volume and control surface, circulation, vorticity. Understanding of differential and integral methods of analysis. Definition and equations for stream function, velocity potential function in rectangular co-ordinates, rotational and irrotational flows.

Unit-III **08 Hrs.**

Integral Relations for a Control Volume

Basic Physical Laws of Fluid Mechanics, The Reynolds Transport Theorem, Conservation of Mass, The Linear Momentum Equation, Frictionless Flow: The Bernoulli's equation, NavierStokes equations (without proof) in rectangular Cartesian co-ordinates; Exact solutions of Navier-Stokes Equations to viscous laminar flow between two parallel planes (Couette flow and plane Poiseuille flow)

Unit-IV **07 Hrs.**

Real fluid flows

Definition of Reynold's number, Laminar flow through a pipe (HagenPoiseuille flow), velocity profile and head loss; Turbulent flows, Prandtl mixing length theory; velocity profiles for turbulent flows universal velocity profile, Velocity profiles for smooth and rough pipes Darcy's equation for head loss in pipe (no derivation), Moody's diagram, pipes in series and parallel, major and minor losses in pipes.

Unit-V **06 Hrs.**

Boundary Layer Flows

Boundary Layer Flows: Concept of boundary layer and definition of boundary layer thickness, displacement, momentum and energy thickness; Growth of boundary layer, laminar and turbulent boundary layers, laminar sub-layer; Von Karman Momentum Integral equation for boundary layers (without proof), analysis of laminar and turbulent boundary layers, drag, boundary layer separation and methods to control it, streamlined and bluff bodies.
Aerofoil theory: Definition of aerofoil, lift and drag, stalling of aerofoils, induced drag

Unit-VI **06 Hrs.**

Compressible Fluid flow

Propagation of sound waves through compressible fluids, Sonic velocity and Mach number; Application of continuity , momentum and energy equations for steady state conditions; steady flow through nozzle, isentropic flow through ducts of varying cross-sectional area, Effect of varying back pressure on nozzle performance, Critical pressure ratio, Normal shocks, basic equations of normal shock, change of properties across normal shock.

Fluid Mechanics Laboratory (22PCME4020L)

Suggested Experiments

A Any 7 experiments:

1 Flow measurement using Venturimeter
2 Flow measurement using Orificemeter
3 Flow measurement using Rotameter
4 Determination of friction factor for Pipes
5 Determination of major and minor losses in Pipe systems
6 Verification of Bernoulli's Equation
7 Experiment on Laminar flow in pipes (Reynolds Apparatus).
8 Verification of impulse momentum principle.
9 Flow over notches / weirs.
Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept

B Mini project or Assignments (minimum 5)

Books Recommended

Textbooks

1 Fluid Mechanics by R K Bansal
2 Introduction to Fluid Mechanics and Fluid Machines by S. K. Som and Gautam Biswas

Reference Books

1 Fluid Mechanics by Frank W. White, McGraw Hill Education
2 Fluid Mechanics by Yunus A Cengel and John M Cimbala, McGraw Hill Education, 3rd Edition
3 Fundamentals of Fluid Mechanics by Bruce Munson, John Wiley and sons
4 Introduction to Fluid Mechanics by Fox and McDonald, John Wiley and sons
5 Fluid Mechanics by Victor Streeter, Benjamin Wylie and K W Bedford, McGraw Hill Education, 9th Edition
6 Mechanics of Fluids by Merle Potter, Cengage Learning
7 Engineering Fluid Mechanics by Donald F. Elger, John Wiley and sons
8 Fluids Mechanics by Russel C. Hibbeler, Prentice Hall.

Program: Mechanical Engineering	S.Y. B.Tech.	Semester: IV
Kinematics of Machinery (22PCME4030T)		
Kinematics of Machinery Laboratory (22PCME4030L)		

Prerequisites:

-

Course Objectives:

1. To become acquainted with basic concept of kinematics and kinetics of machine elements
2. To acquaint oneself with various basic mechanisms and inversions
3. To study basics of power transmission

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Apply the principles of kinetics to solve problems involving rigid bodies.	L3	Apply
CO2	Explain the working of various mechanisms and machines.	L2	Understand
CO3	Determine the velocity and acceleration of the mechanism links.	L3	Apply
CO4	Build motion graphs for a given follower motion.	L6	Creating
CO5	Determine basic design parameters of belt drives and chain drives.	L3	Apply
CO6	Determine basic design parameters of gears and gear trains.	L3	Apply

Kinematics of Machinery (22PCME4030T)

Course Contents

Unit-I **04 Hrs.**

Kinetics of Rigid Bodies

Mass moment of Inertia, radius of gyration, rigid body kinetics - bodies in translating motion, rotation about fixed axis and in general plane motion.

Unit-II **06 Hrs.**

Basic Kinematics

Introduction, kinematic link & its types, kinematic pairs and types, types of constrained motions, kinematic chains, types of joints, degree of freedom (mobility), Kutzbach mobility criteria, Grubler's criteria & its limitations, four bar chain and its inversions, Grashoff's law, slider crank chain and its inversions, double slider crank chain and its inversions

Unit-III **11 Hrs.**

Velocity and Acceleration Analysis of Mechanism

Velocity and Acceleration Analysis of Mechanisms (mechanisms up to 6 links): Velocity analysis by instantaneous centre of rotation method and relative velocity method (Graphical approach), rubbing velocities at joints, mechanical advantage, Acceleration analysis by relative method including pairs involving Coriolis component (Graphical Approach)

Unit-IV **06 Hrs.**

Cam Mechanism

Fundamentals of cams and followers, classification of cams and followers, motion analysis and plotting of displacement - time, velocity-time, acceleration-time, jerk-time graphs for uniform velocity, UARM, SHM, and cycloid motions (combined motions during one stroke excluded)

Unit-V **07 Hrs.**

Power transmission drives

V-belt drive and rope drives: Introduction, classification, materials used, construction, ratio of driving tensions, power transmission.
Chains: Chain terminology, relation between pitch and pitch circle diameter, classification of chains, chordal action, variation in velocity ratio, length of chain.

Unit-V **08 Hrs.**

Gears and Gear Trains

Gears- Introduction, gear terminology, types of gears, law of gearing, velocity of sliding, involute and cycloidal tooth profile, length of arc of contact, contact ratio, interference in involutes gears, critical numbers of teeth for interference free motion, methods to control interference in involutes gears, Static

force analysis in spur gears.
Gear Trains: Kinematic analysis of simple and compound gear trains, reverted gear trains, epicycle gear trains with spur gear combination.

Kinematics of Machinery Laboratory (22PCME4030L)

Suggested Experiments

A Any 8 experiments:

1. Study of Exact straight line generating mechanisms (Peaucillier's and Hart's mechanisms)
2. Study of Approximate line generating mechanisms (Watt's, Grasshopper and Tchebicheff's mechanisms)
3. Study of Steering gear mechanisms (Ackerman, Davis steering gears)
4. Study of Offset slider crank mechanisms – (Pantograph, single and double Hook-joint).
5. Analysis of velocity of mechanisms by Instantaneous Center of Rotation (3-5 problems)
6. Analysis of velocity of mechanism by Relative method (3-5 problems)
7. Analysis of acceleration of mechanism by Relative method (3-5 problems)
8. Plotting of displacement–time, velocity-time, acceleration-time and jerk-time graphs for cams and followers (3-5 problems)
9. Layout of cam profiles (3-5 problems)
10. Construction of Involute and Cycloid gear tooth profile - 2 problems

B Assignments/ Mini project

The mini project or assignments based on the syllabus will be included as part of term work

Books Recommended

Textbooks

1. Theory of Machines by S. S. Ratan
2. Theory of Machines by R. S. Khurmi
3. Theory of Machines by P. L. Ballaney

Reference Books

1. Theory of Mechanisms and Machines, Amitabh Ghosh and A. Kumar Mallik.
2. Theory of Machines and Mechanism, Uicker Jr, Garden Pennock & J.F. Shigley, Oxford University Press.
3. Mechanism Design: Analysis and Synthesis Vol I by A. Erdman and G N Sander, Prentice Hall.
4. Kinematics and Dynamics of Planer mechanisms, Jeremy Hirsihham, McGraw Hill.
5. Theory of Machines, W. G. Green, Bluckie & Sons Ltd.

Program: Mechanical Engineering	S.Y. B.Tech.	Semester: IV
Engineering Materials (22PCME4040T)		
Materials Testing Laboratory (22PCME4040L)		

Prerequisites:

-

Course Objectives:

1. To study basic engineering materials, their structures, properties, applications selection.
2. To make the students familiarize with the concepts of material failure and failure analysis under different working environments.
3. To study the alloys, phase diagrams and rules, Iron –Iron carbide diagram, microstructural development.
4. To study heat treatment principles and alloying elements used in the development of materials with an engineering application.
5. To provide an insight for the latest developments in engineering materials and to know their needs and applications

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Classify the engineering materials and illustrate the related fun- damental concepts such crystal structure, processing-structure- property performance correlation, crystal defects, deformation mechanism and appreciate significance strengthening mechanisms.	L2	Understand
CO2	Explain and comprehend failure modes of engineering materials and related issues.	L2	Understand
CO3	Describe alloys and alloy phase diagrams, Iron-Iron Carbide based phase diagram, Microstructural development in steels and cast iron and demonstrate the application of phase rule and lever rule.	L2	Understand
CO4	Select and justify the proper heat treatment process and alloying elements for steel in order to obtain desirable properties to suit application requirements.	L4	Analyze
CO5	Describe the need for modern new age materials to cater the engineering application demands.	L2	understand

Engineering Materials (22PCME4040T)

Course Contents

Unit-I **04 Hrs.**

Introduction to Engineering Materials

Introduction to solid engineering materials, their classification and properties, crystal structures, crystal defects and their significance.
Deformation in crystalline material – Elastic and Plastic deformation, Slip and twin mechanism, Slip systems and their contribution, Critical resolved shear stress.
Strain hardening - Mechanism and its effect, dislocation interaction, frank reed source of dislocation generation.
Recrystallization Annealing and other strengthening mechanisms.

Unit-II **05 Hrs.**

Materials Failure

General classification of fracture modes, ductile and brittle fracture mechanism (including stress-strain diagram and microstructural aspects).
Metallurgical significance of Ductile- Brittle Transition Temperature, Griffith's theory of brittle fracture and Orowan's modification, fracture toughness.
Fatigue Failure: Definition, examples, type of fluctuating stress, experimental set up for fatigue test, S-N Curve and its interpretation, Macroscopic and microscopic characteristic, factors influencing fatigue, Fatigue failure prevention, Concept of thermal fatigue, corrosion fatigue and static fatigue.
Creep Failure: Definition and examples of creep, high temperature behavior and mechanism of creep, Creep testing, Creep curve, effect of stress and temperature on creep curve, Creep Resistant materials.

Unit-III **06 Hrs.**

Alloys and Alloy Phase Diagrams

Mechanism of solidification – Nucleation and growth of crystal, necessity of alloying, Interstitial and Substitutional solid solutions, Hume Rothery rule, types alloys.
Alloy phases and Construction of phase diagrams (unary, binary, ternary, Isomorphous etc), Gibb's phase rule for condensed phases, application of tie line and lever rule, Invariant reactions, Polymorphism in Iron etc.
Specific study of Iron –Iron Carbide Phase diagram - Construction, Important Phases, Compositions and Critical Temperatures.
Slow cooling behavior and microstructural development.
Plain carbon steels and Cast Irons.

Unit-IV **04 Hrs.**

Heat Treatment Principles and Techniques in Steel

Heat treatment purpose, process & environment, microstructure, properties and applications of – Annealing & its types, normalizing, quenching, tempering & its stages, Martempering and Maraging.
Construction of TTT and CCT diagram and its engineering significance.
Hardenability and Jominy End Quench Test.
Case Hardening Treatments – Carburizing, Nitriding and Carbonitriding etc.

Surface Hardening Treatments – Flame and Induction Hardening etc

Unit-V **04 Hrs.**

Effect of Alloying Elements on Structure and Properties of steel

Alloying elements in steels and cast iron and their effects, Ferrite Stabilizers, Austenite Stabilizers and strong carbide forming elements.
Stainless Steel and High Speed Steel: Composition, Properties, types and applications.
Effect of alloying element on Fe-Fe3C , TTT, CCT diagram and Hardenability.

Unit-VI **06 Hrs.**

Introduction to New Age Materials

Polymers, Ceramics, Composites, Nanomaterials, Smart Materials, energy materials, light metals and alloys:
Need of these materials, their types, properties and applications.

Materials Testing Laboratory (22PCME4040L)

Suggested Experiments

A Any 6 experiments:

1 Study and demonstration of metallurgical/optical microscope (Trinocular)
2 Specimen/Sample preparation for metallography
3 Study of microstructures of plain carbon steels
4 Study of microstructures of Cast Irons.
5 To carry out heat treatment process (Annealing, Normalizing and Hardening) of medium carbon steel and observation of changes in microstructure and properties
6 Study of tempering characteristics of hardened steel
7 To determine the hardenability of steel by conducting Jominy-End Quench test
8 Fatigue test – to determine number of cycles to failure of a given material at a given stress
Any other experiment based on syllabus can be included, which would help the learner to apply the concept learnt

B Assignments (Minimum five) or Mini project or Case study based seminar.

Term work shall consist of minimum 6 experiments and 5 assignments.

Books Recommended

Textbooks

1 Materials Science and Engineering: An Introduction, 10th Edition, William D. Callister, David G. Rethwisch, John Wiley and Sons, 2020.
2 Physical Metallurgy: Principles and Practice, 2nd Edition, V Raghavan, PHI Learning Pvt. Ltd., 2009.

3 Introduction to Physical Metallurgy, S. H. Avner, Mc Graw Hill, 2017.

4 Engineering Materials Technology, 3rd Edition, W. Bolton, Oxford [England]: Butterworth-Heinemann, 2001.

5 Nano Materials, 2nd Edition, A.K. Bandopadhyay, New age international publishers, 2010.

6 Engineering Materials (Properties and applications of metals and alloys), C.P. Sharma, 2004.

Reference Books

1 Experimental Techniques in Materials and Mechanics, by C. Suryanarayana, CRC press, Taylor & Francis Group, 2011.

2 Mechanical Metallurgy, 3rd Edition, G. E. Dieter, McGraw Hill International New Delhi, 2017.

3 Essentials of Materials Science and Engineering, 3rd Edition by Donald R Askeland, Wendelin J Wright, Cengage Learning, 2013.

4 Composite Materials – Science and Engineering, 3rd Edition, Krishnan K. Chawla, Springer, 2013.

5 Composites Manufacturing – Materials, Product, and Process Engineering, Sanjay K. Muzumdar, CRC Press, 2002.

6 Materials for Engineers and Technicians, 6th Edition, W. Bolton, R.A. Higgins, Routledge, 2015.

7 Engineering Materials, Henry Tindell, The Crowood Press ltd., 2014.

8 The Science and Engineering of Materials, 7th Edition by Donald R. Askeland, Wendelin J Wright, Cengage Learning, 2015.

9 Engineering Materials and Metallurgy, R. K. Rajput, S. Chand and Company Ltd., 2006.

10 Heat Treatment: Principles and Techniques, 2nd edition, T.V. Rajan, C.P. Sharma, and Ashok Sharma, PHI Learning Pvt Ltd., 2011.

11 Computational Material Science, June Gunn Lee, CRC Press, 2011.

12 Advanced Structural Materials, Winson O Soboyejo, T.S. Srivatsan, CRC press, Taylor and Francis Group, 2011.

Program: Mechanical Engineering	S.Y. B.Tech.	Semester: IV
Advanced Manufacturing Processes (22PCME4050T)		

Prerequisites:

-

Course Objectives:

1. To acquaint the knowledge of additive manufacturing processes, and its capabilities in the modern digital manufacturing industry.
2. To familiarize the students with unconventional modern machine tools manufacturing practices.
3. To familiarize oneself with various micro manufacturing techniques like Meso, Micro and Nano.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Explain the fundamentals of various non-conventional machining processes, and their capabilities with their application areas.	L2	Understand
CO2	Explain MEMS and Non-MEMS based manufacturing techniques.	L2	Understand
CO3	Explain the various Nano finishing techniques.	L2	Understand
CO4	Review the difference between traditional and additive manufacturing techniques.	L2	Understand
CO5	Explain and apply the fundamental principles of various Additive Manufacturing (AM) technologies in solid based, liquid-based and powder-based techniques.	L3	Apply

Advanced Manufacturing Processes (22PCME4050T)

Course Contents

Unit-I **06 Hrs.**

Unconventional machining processes

Unconventional machining processes: Classification of the Non-traditional machining process. Basic principles, machines, advantage, disadvantages, and applications of Electrical discharge machining (EDM), Electron beam machining (EBM), Plasma arc machining (PAM), Laser beam machining (LBM), Electrochemical machining (ECM), Chemical machining (CHM), Ultrasonic machining (USM), Abrasive jet machining (AJM), Water jet machining (WJM), Abrasive water jet machining (AWJM).
Introduction to Hybrid machining.

Unit-II **06 Hrs.**

MEMS Micro Manufacturing

MEMS Micro Manufacturing: Challenges in Meso, Micro, and Nano manufacturing, Overview about micro fabrication methods - Chemical vapour deposition (CVD); Physical vapour deposition (PVD), optical and electron beam lithography; Dry and wet etching.
NON – MEMS Micro Machining : Mechanics of micro machining, Difference between micro and macro machining Micro turning, Micro Milling, Micro grinding.

Unit-III **06 Hrs.**

Nano Finishing Techniques

Abrasive Flow Machining (AFM), Magnetic Abrasive Finishing (MAF), Magneto rheological Finishing (MRF), Magneto rheological Abrasive Flow Finishing (MRAFF), Magnetic Float Polishing (MFP), Elastic Emission Machining (EEM), Chemical Mechanical Polishing (CMP).

Unit-IV **04 Hrs.**

Introduction to Additive Manufacturing (AM)

Introduction to AM History, Traditional manufacturing v/s Additive Manufacturing, Discussion on different materials used in AM, Role of solidification rate in AM, Grain structure and microstructure in AM.
Extrusion based AM processes: Fused deposition Modeling (FDM), history of FDM, basic principle, material requirements, benefits and limitations, post-processing.
Other extrusion based systems: extrusion of: ceramics, metals, biomaterials, composites, contour crafting, concrete printing.

Unit-V **03 Hrs.**

Powder Bed Fusion AM Process

Selective Laser Sintering (SLS): process workflow and material requirements, powder fusion mechanism, polymer ageing and recycling. Other powder fusion systems: selective laser melting, electron beam melting.

Unit-VI **03 Hrs.**

Vat Polymerization AM process

Stereo lithography apparatus (SLA), history of SLA, material requirements, workflow, scan patterns, applications, benefits and limitations. Other liquid polymer-based systems: Solid Ground Curing (SGC), Digital Light Processing (DLP), Continuous Liquid Interface Production (CLIP).

Books Recommended

Reference Books

1 Additive manufacturing technologies: rapid prototyping to direct digital manufacturing, by IanGibson, David W. Rosen, Brent Stucker, Springer, 2010.

2 Understanding additive manufacturing: rapid prototyping, rapid tooling, rapid manufacturing,by Andreas Gebhardt, Hanser Publishers, 2011.

3 Emerging Nanotechnologies for Manufacturing, by Waqar Ahmed, Mark J. Jackson, 2ndEdition, Elsevier, 2015.

4 Introduction to Micromachining by Jain V. K. Narosa Publishing House, 2010.

5 Micro and Nano-manufacturing, by Mark J. Jackson, Springer, 2007.

6 Micromachining of Engineering Materials, by Joseph McGeough (Editor), Marcel Dekker,2002.

7 Micro-Manufacturing Engineering and Technology, by Yi Qin, Elsevier, 2010.

8 ATextBook of ProductionTechnologyVol.II byO. P. Khanna, Dhanpat Rai Publication, 2000.

Program: Mechanical Engineering	S.Y. B.Tech.	Semester: IV
Mechanical Measurements and Metrology (22PCME4060T)		
Mechanical Measurements and Metrology Laboratory (22PCME4060L)		

Prerequisites:

-

Course Objectives:

1. To impart knowledge of architecture of the measurement system
2. To deliver working principle of mechanical measurement system
3. To acquaint with measuring equipment used for linear and angular measurements.
4. To familiarize with different classes of measuring instruments and scope of measurement in industry and research
5. To acquaint with operations of precision measurement, instrument/equipment for measurement

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Apply the concepts of static characteristics and types of errors occurring in measurement systems.	L3	Apply
CO2	Classify and select proper measuring instrument for displacement, strain, pressure, and temperature measurement.	L4	Analyze
CO3	Select proper measuring instrument for linear and angular measurement.	L4	Analyze
CO4	Demonstrate inspection methods and design of different limit gauges.	L3	Apply
CO5	Demonstrate characteristics of surface texture, screw threads, and gear measurements.	L3	Apply

Mechanical Measurements and Metrology (22PCME4060T)

Course Contents

Unit-I **08 Hrs.**

Introduction to Mechanical Measurements and metrology

Introduction: Significance of Mechanical Measurements, Classification of measuring instruments, generalized measurement system, types of inputs: Desired, interfering and modifying Inputs.
Static characteristics: Static calibration, Linearity, Static Sensitivity, Accuracy, Static Error, Precision, Reproducibility, Threshold, Resolution, Hysteresis, Drift, Span & Range etc.
Introduction to Metrology: Fundamental Definitions, Types of Standards, Precision and Accuracy, Errors in measurement: Types of errors, Effect of component errors, Probable errors.

Unit-II **06 Hrs.**

Displacement and Strain Measurement Measurement

Displacement Measurement: Transducers for displacement, displacement measurement, potentiometer, LVDT, Capacitance Types, Digital Transducers (optical encoder), Nozzle, Flapper Transducer.
Strain Measurement: Theory of Strain Gauges, gauge factor, temperature Compensation, Bridge circuit, orientation of strain gauges for force and torque, Strain gauge-based load cells and torque sensors.

Unit-III **08 Hrs.**

Pressure, Flow and Temperature Measurement

Pressure Measurement: Mechanical Pressure-Measurement Devices, High Pressure Measurements, Bridge man Gauge. Vacuum measurement: Vacuum gauges viz. McLeod gauge, Ionization and Thermal Conductivity gauges.
Flow Measurement: Ultrasonic Flow meter, Magnetic flow meter, The Laser Doppler Anemometer and Hot-Wire and Hot-Film Anemometers.
Temperature Measurement: Electrical methods of temperature measurement Resistance thermometers, Thermistors and thermocouples and Pyrometers.

Unit-IV **10 Hrs.**

Measurements. Gauges design, Screw Thread and Gear measurement

Linear measurements, Angular Measurement.
Design of Gauges: Limits, Fits, Tolerances, Types of Gauges, Taylor's Principle of Limit Gauges, IS 919 for design of gauges.
Gear Measurement by Parkinson Gear tester and Gear tooth Vernier Caliper,
Screw Thread Measurement: Effective diameter measurement of screw thread by Floating Carriage micrometer.

Unit-V **05 Hrs.**

Surface Texture

Surface roughness, Waviness, Roughness Parameter Ra, Rz, RMS etc., working of Tomlinson surface meter, Tally-surf surface roughness tester, Surface roughness symbols

Unit-VI **05 Hrs.**

Advances in metrology

Basic concepts of lasers, advantages of lasers, laser interferometers, types, applications. Basic concepts of Coordinate Measuring Machinesconstructional features, applications.

Mechanical Measurements and Metrology Laboratory (22PCME4060L)

Suggested Experiments

A Any 7 experiments:

1 Dead Weight Pressure gauge
2 Calibration of Vacuum Gauges
3 Study of strain gauges
4 Torque measurement using strain gauges
5 Speed Measurement using tachometer, optical and magnetic pickup
6 Study of Vernier Caliper, Micrometer.
7 Gear measurement using Gear tooth Vernier caliper.
8 Thread Measurement using Floating carriage micrometer.

B Assignments (minimum 5) or Mini project

Oral and Practical examination of 25 marks will be based on the entire syllabus including, the practical performed during laboratory sessions.

Books Recommended

Textbooks

1 Mechanical Engineering Measurements, A K Sawhney, Dhanpat Rai& Sons, New Delhi
2 Instrumentation & Mechanical Measurements, A K Thayal
3 Engineering Metrology, K.J. Hume, Kalyani Publications
4 A text book of Engineering Metrology, I.C. Gupta, Dhanpat Rai Publications
5 Engineering Metrology and Measurements, Bentley, Pearson Education, 2017

Reference Books

1 Measurement Systems: Applications and Design, by EO Doebelin,5th Edition, McGraw Hill
2 Instrumentation and Control System, W. Bolton, Elsevier
3 Mechanical Measurements, S P Venkateshan, Ane books, India
4 Mechanical Measurements and Metrology, R K Jain, Khanna Publishers
5 Metrology and Measurement, Anand,Bewoor and VinayKulkarni, McGraw Hill
6 Engineering Metrology and Measurement, N V Raghavendra and Krishnamurthy, Oxford University Press.

Program: Mechanical Engineering	S.Y. B.Tech.	Semester: IV
Advanced Manufacturing Processes Laboratory (22PCME4070L))		

Prerequisites:

-

Course Objectives:

1. Practice writing complex "G" code programs for CNC turning centers that meet the part specification.
2. To Interpret and demonstrate complex "G" code programs for CNC milling centers that meet the part specification.
3. To know the importance of 3D printing in Manufacturing and gain skills related to 3D printing technologies.
4. To understand the various software tools, process, and techniques for manufacturing complex profiles using 3D Printing Technologies.
5. Evaluate manufacturing assignment based on critical thinking and problem-solving skills. Become a good communicator and effective team member

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Demonstrate the various CNC control and calculate technological data for CNC machining.	L3	Apply
CO2	Prepare programs, demonstrate, simulate, and operate CNC machines for various machining operations.	L3	Apply
CO3	Apply engineering knowledge, techniques, and modern tools to analyze problems in additive manufacturing.	L3	Apply
CO4	Use and demonstrate additive manufacturing (3D printing) processes to develop a working model.	L3	Apply
CO5	Apply lifelong learning adhering to professional, ethical, legal, safety, environmental and societal aspects for career excellence.	L3	Apply

Advanced Manufacturing Processes Laboratory (22PCME4070L)

Suggested Experiments

---

1 One Introduction to CNC lathe and CNC milling, use of measuring instruments, coordinate system, CNC controller, MDI, Offset measurement, simulation of programs. Practicing various turning cycles like OD/ID turning, grooving, threading etc. and canned cycles like drilling, reaming, boring etc.

2 Preparing a 3D model, simulating, and generating G and M codes on any software (Pro-e, UG NX, CREO, Fusion 360, etc.)

3 One job involving programming, simulation, and fabrication of the component on a CNC Turning centre.

4 One job involving programming, simulation, and fabrication of the component on a CNC Vertical Machining centre.

5 Generating STL files from the CAD (Computer Aided Design) model.

6 Processing and Simulation of process parameters in CURA Software for optimizing build-time and material consumption.

7 Fabricating the component by additive manufacturing.

Books Recommended

Reference Books

1 Workshop Technology, W. A. J. Chapman Vol I & II

2 Workshop Technology, Hazra Choudhary Vol. I & II

3 Additive Manufacturing Technologies, Ian Gibson, D.W. Rosen, and B. Stucker, , 2nd Edition, Springer 2015.

Program: Mechanical Engineering	S.Y. B.Tech.	Semester: IV
Constitution of India (22MCME4080T)		

Prerequisites:

–

Course Objectives:

1. To provide basic information about Indian constitution.
2. To identify individual role and ethical responsibility towards society.
3. To understand human rights and its implications.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Explain the historical background, philosophy, and salient features of the Indian Constitution.	L2	Understand
CO2	Interpret the fundamental rights, duties, and directive principles enshrined in the Constitution for responsible citizenship.	L2	Understand
CO3	Describe the structure, roles, and functions of the legislative, executive, and judiciary branches of government.	L2	Understand
CO4	Analyze the federal structure, center-state relations, and constitutional provisions for governance and emergency powers.	L4	Analyze
CO5	Apply constitutional principles to contemporary socio-political and legal issues, fostering ethical and democratic values.	L3	Apply

Constitution of India (22MCME4080T)

Course Contents

Unit-I **03 Hrs.**

Introduction to the Constitution of India

The Making of the Constitution and Salient features of the Constitution.
Preamble to the Indian Constitution Fundamental Rights & its limitations.

Unit-II **03 Hrs.**

Directive Principles of State Policy

Relevance of Directive Principles State Policy Fundamental Duties.
Union Executives – President, Prime Minister Parliament Supreme Court of India.

Unit-III **02 Hrs.**

State Executives

Governor, Chief Minister, State Legislature High Court of State.
Electoral Process in India, Amendment Procedures, 42nd, 44th, 74th, 76th, 86th & 91st Amendments.

Unit-IV **02 Hrs.**

Special Provisions

Special Provisions:
Provisions for Backward class section of society, Provision for Women, Children & Backward Classes Emergency Provisions.

Unit-V **02 Hrs.**

Human Rights

Meaning and Definitions, Legislation Specific Themes in Human Rights- Working of National Human Rights Commission in India Powers and functions of Municipalities, Panchyats and Co – Operative Societies.

Unit-VI **02 Hrs.**

Scope & Aims of Engineering Ethics

Responsibility of Engineers Impediments to Responsibility.
Risks, Safety and liability of Engineers, Honesty, Integrity & Reliability in Engineering.

Books Recommended

Textbooks

1 Durga Das Basu: "Introduction to the Constitution on India", (Students Edn.) Prentice –Hall EEE, 19th/20th Edn., 2001

2 Charles E. Haries, Michael S Pritchard and Michael J. Robins "Engineering Ethics" Thompson Asia, 2003-08-05.

Reference Books

1 M. V. Pylee, "An Introduction to Constitution of India", Vikas Publishing, 2002.

2 M. Govindarajan, S. Natarajan, V. S. Senthilkumar, "Engineering Ethics", Prentice – Hall of India Pvt. Ltd. New Delhi, 2004

3 Brij Kishore Sharma," Introduction to the Constitution of India", PHI Learning Pvt. Ltd., New Delhi, 2011.

4 Latest Publications of Indian Institute of Human Rights, New Delhi

Program: Mechanical Engineering	S.Y. B.Tech.	Semester: IV
Semester Project II (22PJME4090L)		

Prerequisites:

–

Course Objectives:

1. Students are expected to design, simulate/implement a project based on the knowledge acquired from current semester subjects.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Analyze a survey of several available literatures in the preferred field of study.	L4	Analyze
CO2	Describe various/alternate approaches to complete a project.	L2	Understand
CO3	Apply a collaborative project environment by interacting and dividing project work among team members.	L3	Apply
CO4	Use technical communication skills to present project work in the form of a technical report/paper.	L3	Apply
CO5	Apply teamwork and project management skills to plan, execute, and manage the research study.	L3	Apply

Semester Project II (22PJME4090L)

The purpose of introducing a semester project at the Second-year level is to provide exposure to students with a variety of projects based on the knowledge acquired from the semester subjects. This activity is supposed to enrich their academic experience and bring enough maturity to the student while selecting the project. Students should take this as an opportunity to develop skills in implementation, presentation, and discussion of technical ideas/topics. Proper attention shall be paid to the content of report, which is being submitted in partial fulfillment of the requirements of the Second-year, and it is imperative that a standard format be prescribed for the report.
Each student shall work on a project approved by the departmental committee approved by the Head of the Department. A group of 3 to 5 students (maximum allowed: 5 students in extraordinary cases, subject to the approval of the department committee and the Head of the department) shall be allotted for each Semester Project. Each group shall submit at least 3 topics for the Semester Project. The departmental committee shall finalize one topic for every group. The Semester Project Title or Theme should be based on the knowledge acquired during the semester. The project work shall involve sufficient work so that students get acquainted with different aspects of knowledge acquired from semester subjects.

Student is expected to:

- Select an appropriate project title based on acquired knowledge from current semester subjects.
- Maintain a Log Book of weekly work done (Log Book Format will be as per Table 1).
- Report weekly to the project guide along with the log book.

Table 1: Log Book Format

Sr	Week (Start Date:End Date)	Work Done	Sign of Guide	Sign of Coordinator
1				

Assessment Criteria:

- At the end of the semester, after confirmation by the project guide, each project group will submit a project completion report in the prescribed format for assessment to the departmental committee (including project guide).
- Assessment of the project (at the end of the semester) will be done by the departmental committee (including project guide).

Prescribed project report guidelines:

The Project Report (minimum of 25 pages) should include appropriate content for:

- Introduction
- Literature Survey,
- Related Theory
- Implementation details
- Project Outcomes, Conclusion
- References

Assessment criteria for the departmental committee (including project guide) for Continuous Assessment:

Guide will monitor weekly progress, and marks allocation will be as per Table 2.

Table 2: Continuous Assessment table

Sr	PRN	Name of Student	Student Attendance	Log Book Maintain	Literature Review	Depth of Understanding	Report	Total
			5	5	5	5	5	25

Assessment criteria for the departmental committee (including project guide) for End Semester Exam:

The departmental committee (including project guide) will evaluate the project as per Table 3.

Table 3: Evalution Table

Sr	PRN	Name of Student	Project Selection	Design/ Simulation	model/ programming	Result Verification	Presentation	Total
			5	5	5	5	5	25

Each group shall present/publish a paper based on the semester project in reputed/peer-reviewed Conference/Journal/TechFest/Magazine before the end of the semester.

Program: Mechanical Engineering	S.Y. B.Tech.	Semester: IV
Employability Skill Development Program- I (22HMME4100L)		

Prerequisites:

–

Course Objectives:

1. To enhance the problem solving skills.
2. To improve the basic mathematical skills for solving real life examples.
3. To implement the algorithms and draw flowcharts for solving Mathematical and Engineering problems.
4. To demonstrate an understanding of computer programming language concepts.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Explain the basic concepts of Quantitative Ability, including profit, loss, time, work, and geometry.	L2	Understand
CO2	Demonstrate the concepts of Quantitative Ability for problem solving.	L3	Apply
CO3	Demonstrate the concept of Variables and Functions through examples	L3	Apply
CO4	Demonstrate the concept of Multithreading and String Handling.	L3	Apply
CO5	Explain the fundamentals of Object-Oriented Programming.	L2	Understand
CO6	Describe the concepts of Distributed Database.	L2	Understand

Employability Skill Development Program- I (22HMME4100L)

Course Contents

Unit-I **04 Hrs.**

Aptitude

Quantitative Aptitude: Algebra, Profit and Loss, Average and Allegation/ Mixture, Time and Work, Geometry Mensuration, Numbers, Percentage, Permutation and Combination, Probability, Ratios Proportion, Time and Distance. Reasoning: Analytical, Puzzles, Blood relationship, Data Interpretation, Data sufficiency

Unit-II **08 Hrs.**

Fundamental of Programming

Variables: Local variables, Global variables, global keyword, Rules of Identities Functions: Introduction, Prototype, Classification of functions. No arguments and No return values, With arguments and With return values No arguments and With return values With arguments and No return values, Recursion, Argument type functions, Default arguments functions, Required arguments functions, Keyword arguments functions, Variable arguments function Operators: Arithmetic Operators, Relational operators, Logical operators, Bitwise operators, Shift operators.

Unit-III **06 Hrs.**

Statements

Control Statements: Conditional Control Statements, if, if-else, if-elif-else, nested-if, Loop Control Statements, While, For Branching Statements: Break, Continue, pass, return, exit Exception Handling: Introduction, The need of exception handling, Getting exceptions. Default exception handler, Handling exception, Try, Except Try with multiple except blocks: Handling exceptions using Exce - tion class, Finally, block, Releasing resources using Finally block, Raise, Creating a user exception class.Raise exception manually, Exceptions based application.

Unit-IV **05 Hrs.**

Multithreading

Multithreading: Introduction, Multitasking, Multi tasking v/s Multithreading, threading module, Thread class introduction, Creating thread, The life cycle of a thread, Single-threaded application, Multi-threaded application, Sleep() method. Sleep() v/s run(), Join() v/s Sleep(), Multiple custom threads creation, The execution time of single- threaded application, The execution time of multi-threaded application, Synchronization of threads. Inner classes: Basic syntax of inner class, Advantages of Inner classes, Access class level members of inner classes, Access object level members of inner classes, Local inner classes, Complex inner classes, Accessing data of inner classes. Regular expressions: re module, Match(). Search(), Find) etc, and actual projects web scrapping, Mail extraction: Date extraction, Mobile number extraction, Vehicle number extraction, zoom chat analysis Expressions using operators and symbols: Split string into characters, Split string into words, Lambda expressions String handling using regex: Introduction to Strings, Indexing and Slicing. Special operators in String handling, Old style String formatting, String library methods, Quotes and Escape characters in a String representation, String Immutability, Logical programs using Strings.

Unit-V **05 Hrs.**

Object Oriented Programming

Object Oriented Programming: Introduction to OOPs, Classes, Objects, Structure to OOP a plication, Contexts of OOP application. Class level members, Object level mem- bers, self variable, Constructor and Initialization of object. Access modifiers: Private. Protected. Public. Program codes. Encapsulation Rules, Implementation, Abstraction, Polymorphism Inheritance Introduction, Types of Inheritance, Single inheritance, Multi-Level inheritance, Method overriding, Object initialization using constructor, Multiple inheritances, Hierarchical inheritance, Method overriding in Multi level inheritance

Books Recommended

Reference Books

1 Quantitative Aptitude for Competitive Examinations by Dr. RS Aggarwal, S Chand Publication.

2 Programming Techniques through C, by M. G. Venkateshmurthy, Pearson Publication.

3 A Computer Science Structure Programming Approaches using C, by Behrouz Forouzan, Cengage Learning.

4 Let Us C, by Yashwant Kanetkar, BPB Publication.