Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur

(An Autonomous Institute)

Course Structure and Syllabus (Revised)

Second Year B.Tech. (Mechanical Engineering)

with efffective from Year 2023-24

Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405
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Semester-III (w.e.f.2023-24)

Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme (CA)				ESE	Total	Credit
				L	T	P	TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Best of (TT1 & TT2)			
							[A]			[B]	[C]	[A+B+C]	
1	BS	22BSME3010T	Engineering Mathematics III	3	1	-	20	15	15	15	65	100	4
2	PC	22PCME3020T	Engineering Thermodynamics	3	-	-	20	15	15	15	65	100	3
3	PC	22PCME3030T	Mechanics of Materials	3	-	-	20	15	15	15	65	100	3
4	PC	22PCME3030L	Mechanics of Materials Laboratory	-	-	2	25	-	-	-	25	50	1
5	PC	22PCME3040T	Manufacturing Processes	2	-	-	20	15	15	15	65	100	2
7	PC	22PCME3050L	Computer Aided Machine Drawing Laboratory	-	-	4	50	-	-	-	50	100	2
6	PC	22PCME3060L	Manufacturing Processes Laboratory	-	-	4	50	-	-	-	50	100	2
8	HM	22HMME3070T	Universal Human Values	2	-	-	20	15	15	15	65	100	2
9	PC	22PCME3080L	Python for Mechanical Engineering Laboratory	-	-	2	25	-	-	-	25	50	1
10	PJ	22PJME3090L	Semester Project-I	-	-	2	25	-	-	-	25	50	1
			Total	13	1	14	275	75	75	75	500	850	21

BS- Basic Science, PC-Professional Course, HM-Humanity and Management, PJ-Project

Prepared by

Checked by

BOS Chairman

Dean Academic/Dy. Director

C.O.E.

Director

OFFICE SEAL

Semester-IV (w.e.f.2023-24)

Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme (CA)				ESE	Total	Credit
				L	T	P	TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Best of (TT1 & TT2)			
							[A]			[B]	[C]	[A+B+C]	
1	BS	22BSME4010T	Engineering Mathematics-IV	3	1	-	20	15	15	15	65	100	4
2	PC	22PCME4020T	Fluid Mechanics	3	-	-	20	15	15	15	65	100	3
3	PC	22PCME4020L	Fluid Mechanics Laboratory	-	-	2	25	-	-	-	25	50	1
4	PC	22PCME4030T	Kinematics of Machinery	3	-	-	20	15	15	15	65	100	3
5	PC	22PCME4030L	Kinematics of Machinery Laboratory	-	-	2	25	-	-	-	25	50	1
6	PC	22PCME4040T	Engineering Materials	2	-	-	20	15	15	15	65	100	2
7	PC	22PCME4040L	Material Testing Laboratory	-	-	2	25	-	-	-	-	25	1
8	PC	22PCME4050T	Advanced Manufacturing Processes	2	-	-	20	15	15	15	65	100	2
10	PC	22PCME4060T	Mechanical Measurements and Metrology	3	-	-	20	15	15	15	65	100	3
11	PC	22PCME4060L	Mechanical Measurements and Metrology Laboratory	-	-	2	25	-	-	-	-	25	1
9	PC	22PCME4070L	Advanced Manufacturing Processes Laboratory	-	-	4	50	-	-	-	50	100	2
12	MC	22MCME4080T	Constitution of India	1	-	-	-	-	-	-	-	-	Audit
13	PJ	22PJME4090L	Semester Project-II	-	-	2	25	-	-	-	25	50	1
14	HM	22HMME4100L	Employability Skill Development Program -I	-	-	2	50	-	-	-	-	50	1
			Total	17	1	16	345	90	90	90	515	950	25

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

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Checked by

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OFFICE SEAL

Detailed syllabus of Second Year in Mechanical Engineering (Semester III w.e.f. 2023-24)

Engineering Mathematics III (22BSME3010T)

Teaching Scheme	**Examination Scheme**
Lectures : 3 Hrs./week	Term Test : 15 Marks
Tutorial : 1 Hr/week	Teacher Assessment : 20 Marks
Credit : 4	End Sem Exam : 65 Marks
	Total: 100 Marks

Prerequisite:

Knowledge of integration, complex numbers and differential equations along with basic concepts in Mathematics.

Course Objectives:

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

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Use Laplace and inverse Laplace Transform to the Ordinary Differential Equations	L3	Applying
CO2	Identify analytic and harmonic functions.	L1	Remembering
CO3	Solve real integrals using complex integration.	L1	Remembering
CO4	Find Fourier Series of periodic functions and simplify infinite series	L4	Analyzing
CO5	Solve certain partial differential equations analytically and numerically Correlate different variables of data	L4	Analyzing
CO6	Correlate different variables of data	L4	Analyzing

Course Contents

Unit-I: Laplace Transform, Inverse Laplace Transform

09 Hrs

Laplace Transform: LT 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).

$$L\{t^n f(t)\}, L\{\frac{f(t)}{t}\}, L\{\int_0^t f(u)du\}, L\{\frac{d^n f(t)}{dt^n}\} \quad (1)$$

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**(For Self-Study)**.

Unit-II: Complex Variables, Differentiation

06 Hrs

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

Unit-III: Complex Integration

06 Hrs

Line integral**(For Self-Study)**, Cauchys theorem for analytic function, Cauchys integral formula (all without proof).
Taylors and Laurents series.
Residue at removable singularity, poles and isolated singularity and its evaluation.Residue theorem, application to evaluate real integral of type:

$$\int_0^{2\pi} f(\cos\theta, \sin\theta)d\theta, \int_{-\infty}^{\infty} f(x)dx$$

Unit-IV Fourier Series

06 Hrs

Fourier series of periodic function with period $2\pi, and, 2l$
Even and odd functions, Half range sine and cosine series, Parsevals identities (without proof).
Complex form of Fourier series. Orthogonal and Orthonormal functions**(For Self-Study)**.

Unit-V: Partial Differential Equations

06 Hrs

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**(For Self-Study)**.

Unit-VI: Correlation, Regression

06 Hrs

Correlation-Karl Pearson's coefficient of correlation, Spearman's Rank correlation, Regression analysis-lines of regression.

Suggested Tutorials

1. Laplace transform.
2. Inverse Laplace transform.
3. Special Unit functions, Solving differential equations(related to Mechanical engineering) using Laplace transform.
4. Analytic functions, Milne-Thomson method to determine analytic function.
5. Bilinear Transformation with fixed points, cross-ratio.
6. Line Integration.
7. Cauchys theorem and Cauchys Integral formula problems.
8. Taylors and Laurents Series expansion.
9. Residue theorem, application to evaluate real integrals.
10. Fourier series, Parsevals identity.
11. Even and odd functions, Half Range series
12. Complex form of Fourier series. Orthogonal and Orthonormal functions.
13. Bender-Schmidt Method and Crank- Nicolson method.
14. Partial differential equations governing transverse vibrations of an elastic string and its solution using Fourier series, Heat equation, steady-state configuration for heat flow.
15. Correlation, Regression .

Tutorials: Minimum eight tutorials based on the syllabus will be conducted. A mini project relevant to the subject may be included, which would help the learner to apply the concept learnt.

Text Books

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

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Best of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Tutorial

Minimum eight tutorials shall be conducted.

Engineering Thermodynamics (22PCME3020T)

Teaching Scheme
Lectures : 3 Hrs./week
Credit : 3

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total: 100 Marks

Prerequisite:
Knowledge of basic Physics and Mathematics.

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 and gas power cycles.

Course Outcomes:

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

Course Contents

Unit-I: First Law of Thermodynamics

08 Hrs

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: Second Law of Thermodynamics

09 Hrs

Limitations 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: Thermodynamic Relations,Energy

04 Hrs

Thermodynamic Relations: Reciprocal Relation, Cyclic Relation Property relations, Maxwell Relations, TdS equations, Heat capacity relations, Volume Expansivity, Isothermal Compressibility, Clausius Clapeyron Equation

Energy: High grade and Low-Grade Energy, Available and Unavailable Energy, Dead State,Available energy with respect to a process and a cycle.

Unit-IV: Properties of Pure Substance, Vapour Power cycle

06 Hrs

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 with suitable examples.

Vapour Power cycle: Carnot cycle and its limitations as a power 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: Gas Power cycles:

06 Hrs

Assumptions of Air Standard Cycles, 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.Applications of gas turbine.

Unit-VI: Compressors

06 Hrs

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.

Text Books

1. Engineering Thermodynamics by P K Nag, Tata McGraw Hill Publishers
2. Applied 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

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Best of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Mechanics of Materials (22PCME3030T)

Teaching Scheme
Lectures : 3 Hrs./week
Credit : 3

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total: 100 Marks

Prerequisite:
Knowledge of Engineering mechanics.

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:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Evaluate stresses, strains, deformation and properties of materials in mechanical components/ structures.	L5	Evaluating
CO2	Draw SFD and BMD for different types of loads and support conditions for a beam.	L2	Applying
CO3	Compute and plot direct, bending and shear stresses across sections of given beam.	L4	Analyzing
CO4	Compute torsional shear stresses and strain energy in mechanical components.	L4	Analyzing
CO5	Compute deflections and slopes in beams.	L4	Analyzing
CO6	Analyze buckling phenomenon in columns and struts.	L4	Analyzing

Course Contents

Unit-I: Moment of Inertia,Stress and Strain,Elastic Constants and their relations

8 Hrs

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, Hookes Law, deformation due to self-weight, bars of varying sections, composite sections, deformation of tapering members, Thermal Stresses.
Elastic Constants and their relations: Poissons 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: Shear Force and Bending Moment in Beams

06 Hrs

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: Bending stresses,Shear Stresses

06 Hrs

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: Torsion, Principal stresses and Strains

06 Hrs

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 (Mohrs circle) for determining stresses on the oblique section.

Unit-V: Deflection of Beams

06 Hrs

Deflection of Cantilever, simply supported and over hanging beams using Macaulays or double integration method for different type of loadings.

Unit-VI: Columns and Struts, Strain Energy

07 Hrs

Columns and Struts: Buckling load, crushing load, Types of end conditions for column, Eulers 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.

Text Books

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, Schaums Outline Series, McGraw Hill Publication, Special Indian Edition

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Best of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Mechanics of Materials Laboratory (22PCME3030L)

Practical Scheme	**Examination Scheme**
Practical : 2 Hrs./week	Teacher Assessment : 25 Marks
Credits : 1	End Sem Exam : 25 Marks (Oral)
	Total: 50 Marks

List of Laboratory 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.

Evaluation Scheme:
Continuous Assessment (A):
Laboratory work shall consist of minimum 5 experiments and subject specific 5 lab assignment/case study

The distribution of marks shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of laboratory journal/manual/report will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the teacher assessment.

End Semester Examination (C):
Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Manufacturing Processes (22PCME3040T)

Teaching Scheme
Lectures : 3 Hrs./week
Credit : 3

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total: 100 Marks

Prerequisite:
Knowledge of basic Chemistry and Physics.

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:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe types of machine tools, their classification, specifications, and constructional features, with machining operations to generate cylindrical, and planar components.	L3	Applying
CO2	Identify various metal casting processes, analyze various defects, their probable causes and remedial measures confronted with metal casting.	L2	Understanding
CO3	Identify various metal forming, analyze various defects, their probable causes and remedial measures confronted with metal forming.	L3	Applying
CO4	Identify sheet metal operations to build the concepts pertaining to press tools.	L4	Analyzing
CO5	Calculate various forces, velocities, shear angle, strain, shear stress and power consumption in meta cutting operation.	L4	Analyzing
CO6	Describe various power metallurgy techniques and various polymeric composite manufacturing techniques.	L4	Analyzing

Course Contents

Unit-I

02 Hrs

Introduction to Manufacturing Processes: Need and classification of manufacturing process based on chip-less and chip-removal processes. Various generating and 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

04 Hrs

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: 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 operations: piercing, blanking, notching, embossing, coining, bending, forming and drawing operations. Benefits and limitations of using Press tools. Applications of pressed parts/components.

Unit-IV

05 Hrs

Theory of Metal Cutting: Introduction, machining parameters, orthogonal and oblique cutting, mechanism of metal cutting, types of chips, Merchants 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: 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

04 Hrs

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.

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.

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Best of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Computer Aided Machine Drawing Laboratory (22PCME3050L)

Teaching Scheme
Practical : 4 Hrs./week
Credit : 2

Examination Scheme
Teacher Assessment : 50 Marks
End Sem Exam : 50 Marks
Total : 100 Marks

Prerequisite:
Knowledge of engineering drawing.

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:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Visualize and prepare detail drawing of a given object	L1	Remembering
CO2	Read and interpret the drawing	L2	Understanding
CO3	Draw details and assembly of different mechanical systems	L3	Applying
CO4	Convert detailed drawing into assembly drawing using modelling software	L4	Analyzing
CO5	Convert assembly drawing into detailed drawing using modelling software	L4	Analyzing
CO6	Prepare detailed drawing of any given physical object/machine element with actual measurements	L3	Applying

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:
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 (GDT):** 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 and 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, Oldhams coupling, Universal coupling.

Unit-IV

08 Hrs

Preparation of details / 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 / 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: 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.

List of Laboratory Experiments- Part A: Any Six

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, Oldhams 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)

List of Laboratory Experiments- Part B: Any Two

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

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 by Kamat and Rao
4. Machine Drawing by M. B. Shah
5. A text book of Machine Drawing by R. B. Gupta, Satyaprakashan, Tech. Publication
6. Machine Drawing by K.I.Narayana, P. Kannaiah, K.Venkata Reddy
7. Machine Drawing by Sidheshwar and Kanheya
8. Autodesk Inventor 2011 for Engineers and Designers by Sham Tickoo and Surinder Raina, Dreamtech Press
9. Engineering Drawing by P J Shah
10. Engineering Drawing by N D Bhatt

Evaluation Scheme:

Continuous Assessment (A):

A-3 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.
The distribution of marks for Term work shall be as follows: Printouts/Plots. 40 marks Attendance. 10 marks

End Semester Examination (C):

1. Practical examination duration is three hours, based on the Term work, and should contain two sessions as follows: Session-I: Preparation of minimum five detailed 3-D part drawings from given 2-D assembly drawing. Session-II: Preparation of 3-D models of parts, assembling parts and preparing views of assembly from given 2-D detailed drawing.
2. Oral examination should also be conducted to check the knowledge of conventional and CAD drawing.

3. Questions provided for practical examination should contain minimum five and not more than ten parts.

4. The distribution of marks for practical examination shall be as follows: Session-I = 20 marks Session-II = 20 marks Oral = 10 marks

5. Evaluation of practical examination to be done based on the printout of students work.

6. Students work along with evaluation report to be preserved till the next examination.

Manufacturing Processes Laboratory (22PCME3060L)

Teaching Scheme
Practical : 4 Hrs./week
Credit : 2

Examination Scheme
Teacher Assessment : 50 Marks
End Sem Exam : 50 Marks
Total : 100 Marks

Prerequisite:
Knowledge of Manufacturing Processes.

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:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Demonstrate precautions and safety norms followed in Machine Shop and exhibit interpersonal skills towards working in a team.	L3	Applying
CO2	Understand the construction, working and operation of various conventional machine tools, and various accessories and attachments used. Select cutting parameters like cutting speed, feed, depth of cut, and tooling for various machining operations.	L3	Applying
CO3	Read working drawings, understand operational symbols and execute machining operations	L3	Applying
CO4	Perform various operations such as plain turning, taper turning, step turning, thread cutting, facing, knurling, internal thread cutting, eccentric turning and estimate cutting time.	L3	Applying
CO5	Perform machining operations such as plain shaping, inclined shaping, keyway cutting, Indexing and Gear cutting and estimate cutting time.	L3	Applying
CO6	Summarize the importance of grinding and super finishing operations.	L3	Applying

List of 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.
2. 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.
3. One job (Group Job) using cylindrical grinding machine. Exercises should include selection of cutting parameters and cutting time estimation.

RemarkRefer theory syllabus for the topic s to be covered in laboratory.

Reference Books

1. Workshop Technology by W. A. J. Chapman Vol I II
2. Workshop Technology by Hazra Choudhary Vol. I II

Evaluation Scheme:

Continuous Assessment (A):

1. Term work shall consist of Work-Shop book giving details of drawings of the completed jobs and time sheet.
2. The distribution of marks for term work shall be as follows: Laboratory work (Performance of job and workshop book): 50 marks
3. The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (C):

1. Practical examination of three hours duration will be held and evaluation will be done based on the performance during the examination for 50 marks.

Universal Human Values (22HMME3070T)

Teaching Scheme
Lectures : 2 Hrs./week
Credit : 2

Examination Scheme
Term Test : 15 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 65 Marks
Total : 100 Marks

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:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability.	L3	Applying
CO2	Become sensitive to their commitment towards what they have understood (human values, human relationship, and human society)	L3	Applying
CO3	Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.	L3	Applying

Course Contents

Unit-I

05 Hrs

Introduction: Need, Basic Guidelines, Content and Process for Value Education Purpose and motivation for the course. Self-Explorationwhat 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

05 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

03 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

04 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

04 Hrs

Understanding Harmony in the Nature and Existence: 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

05 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.

Text Books

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

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
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. 11.India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Best of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Python for Mechanical Engineering Laboratory (22PCME3080L)

Practical Scheme
Practical : 2 Hrs./week
Credits : 1

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total: 50 Marks

Course Objectives:

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

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the coding environment of Python software.	L1	Understand
CO2	Understand the basics of Python.	L1	Understand
CO3	To read, analyse and visualize data.	L1,L2,L4	Remember, Understand, Analyze
CO4	To apply the python skills for Mechanical problems.	L3	Apply

Unit-I 04 Hrs

Introduction to Python: Python history, Introduction to Anaconda, Spyder IDE, how to go about programming, understanding of the layout of the programming environment and spyder.

Unit-II 07 Hrs

Basics of Python: Assignment Statement, variable and datatypes, Loops, Strings, Lists,Operators, Arrays, Sorting, Functions and Dictionaries.

Unit-III 07 Hrs

Data Handling and Manipulation: Reading Data, Introduction to Pandas Dataframe and Numpy, Data Visualization, exploratory Data Analysis.

Unit-IV 10 Hrs

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

List of Laboratory 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

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

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 MacGrawHill

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

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

Evaluation Scheme:

Continuous Assessment (A): Term work shall consist of minimum 7 experiments and 1 Mini Project.

The distribution of marks shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of laboratory journal/manual/report will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the teacher assessment.

End Semester Examination (C):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Semester Project-I (22PJME3090L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

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

Course Outcomes:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Conduct a survey of several available literatures in the preferred field of study.	L4	Analyze
CO2	Demonstrate various/alternate approaches to complete a project.	L2	Understand
CO3	Ensure a collaborative project environment by interacting and dividing project work among team members.	L3	Apply
CO4	Present their project work in the form of a technical report / paper and thereby improve the technical communication skill.	L3	Apply
CO5	Demonstrate the ability to work in teams and manage the conduct of the research study.	L2	Understand

Semester Project:

The purpose of introducing semester project at 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 in student while selecting the project. Students should take this as an opportunity to develop skills in implementation, presentation and discussion of technical ideas/topics. Therefore, proper attention shall be paid to the content of semester project 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 project approved by departmental committee approved by the Head of Department, a group of 03 to 05 students (max 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. Semester Project Title or Theme should be based on knowledge acquired during 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 appropriate project title based on acquired knowledge from current semester subjects.
- Maintain Log Book of weekly work done(Log Book Format will be as per Table 1).
- Report weekly to the project guide along with log book.

Assessment Criteria:

- At the end of the semester, after confirmation by the project guide, each project group will submit project completion report in 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:

Size of report shall be of minimum 25 pages. Project Report 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.

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

Departmental committee (including project guide) will evaluate project as per Table 3.

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

Table 1: Log Book Format

Sr	Week (Start Date:End Date)	Work Done	Sign of Guide	Sign of Coordinator
1				
2				

Table 2: Continuous Assessment Table

Sr	Exam Seat No	Name of Student	Student Attendance	Log Book Maintain	Literature Review	Depth of Understanding	Report	Total
			5	5	5	5	5	25

Table 3: Evaluation Table

Sr	Exam Seat No	Name of Student	Project Selection	Design/ Methodology	Fabrication/ Modeling/ Simulation	Result Verification	Presentation	Total
			5	5	5	5	5	25

Detailed syllabus of Second Year in Mechanical Engineering (Semester IV)

Engineering Mathematics-IV (22BSME4010T)

Teaching Scheme	**Examination Scheme**
Lectures : 3 Hrs./week	Term Test : 15 Marks
Tutorial : 1 Hr/week	Teacher Assessment : 20 Marks
Credit : 4	End Sem Exam : 65 Marks
	Total: 100 Marks

Prerequisite:

Knowledge of differentiation, integration, matrices and probability along with basic concepts in Mathematics.

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 Vector analyses, complex integration, probability, test of hypothesis and correlation between data.
4. To prepare students for competitive exams

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Identify diagonalizable and derogatory matrices and find functions as a square matrix using eigenvalues and eigenvectors	L1	Remembering
CO2	Evaluate vector integrals	L3	Applying
CO3	Use probability to solve real-life engineering problems	L4	Analyzing
CO4	Draw conclusions on population based on large and small samples taken	L5	Evaluating
CO5	Analyze the variances of multiple variables simultaneously	L4	Analyzing

Course Contents

Unit-I

09 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 a matrix.

Quadratic Forms: Canonical form using Congruent transformations, Orthogonal Transformation to find rank, index, signature and value class.

Unit-II

06 Hrs

Vector differentiation

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

Unit-III

04 Hrs

Vector Integration

Line integrals **(For Self-Study)**, Greens theorem (without proof) for planes and verification of line integrals.

Stokes theorem and Gauss divergence theorem (without proof and verification)

Unit-IV

08 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

09 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.

Students 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

03 Hrs

ANOVA (For Self Study)

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

Suggested Tutorials

1. Eigen Values and Eigen Vectors.
2. Cayley-Hamilton Theorem, Linear independence of Eigen vectors.
3. Similarity of Matrices and diagonalization.
4. Functions of square Matrices
5. Quadratic forms.
6. Random Variables, Expectation, Variance.
7. Binomial distribution, Poisson distribution.
8. Normal distribution.
9. Sampling- (Z- test).
10. Sampling- (t- test).
11. Chi square distribution.
12. ANOVA.

Tutorials: Minimum eight tutorials based on the syllabus will be conducted. A mini project relevant to the subject may be included, which would help the learner to apply the concept learnt.

Text Books

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

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration all otted for writing each of the paper is 1 hr.
3. Best of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Tutorial

Minimum eight tutorials shall be conducted.

Fluid Mechanics (22PCME4020T)

Teaching Scheme	**Examination Scheme**
Lectures : 3 Hrs./week	Term Test : 15 Marks
Credit : 3	Teacher Assessment : 20 Marks
	End Sem Exam : 65 Marks
	Total: 100 Marks

Prerequisite:

-

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.
4. To learn dimensional analysis, similarity and its applications to model studies.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the key fluid properties, calculate the pressure, hydrostatic pressure force.	L3	Analyzing
CO2	Identify various flow characteristics based on the velocity field and determine the streamline pattern and acceleration field given a velocity field.	L1	Remembering
CO3	Explain the development, uses, and limitations of the Bernoulli equation and apply the Reynolds transport theorem and the material derivative, analyze certain types of flows using the Navier-Stokes equations.	L3	Analyzing
CO4	Identify 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.	L1	Remembering
CO5	Explain the fundamental characteristics of a boundary layer, including laminar, transitional, and turbulent regimes, calculate boundary layer parameters for flow past a flat plate.	L3	Analyzing
CO6	Understand some important features of different categories of compressible flows of ideal gases, solve useful problems involving isentropic and non-isentropic flows.	L2	Understand

Course Contents

Unit-I

07 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, Pascals law, pressure measurement by simple and differential manometers. Hydrostatic forces on the plane and curved surfaces, centre of pressure.

Unit-II

06 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 and cylindrical co-ordinates, rotational and irrotational flows.

Unit-III

07 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 Bernoullis equation, Navier-Stokes 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 Reynolds number, Laminar flow through a pipe (Hagen-Poiseuille 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 Darcys equation for head loss in pipe (no derivation), Moodys diagram, pipes in series and parallel, major and minor losses in pipes.

Unit-V

06 Hrs

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.

Text Books

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. Fluid Mechanics by john F. Douglas, Prentice Hall
7. Mechanics of Fluids by Merle Potter, Cengage Learning
8. Engineering Fluid Mechanics by Donald F. Elger, John Wiley and sons
9. Fluids Mechanics by Russel C. Hibbeler, Prentice Hall

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Best of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Fluid Mechanics Laboratory (22PCME4020L)

Practical Scheme	**Examination Scheme**
Practical : 2 Hrs./week	Teacher Assessment : 25 Marks
Credit : 1	End Sem Exam : 25 Marks (Oral)
	Total : 50 Marks

List of Laboratory 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 Bernoullis Equation
7. Experiment on Laminar flow in pipes (Reynolds Apparatus).
8. Verification of impulse momentum principle.
9. Flow over notches / weirs.

Evaluation Scheme:

Continuous Assessment (A):

Laboratory work shall consist of minimum 8 experiments and subject specific 5 lab assignment/case study The distribution of marks shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of laboratory journal/manual/report will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the teacher assessment.

End Semester Examination (C):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Kinematics of Machinery (22PCME4030T)

Teaching Scheme

Lectures : 3 Hrs./week

Credit : 3

Examination Scheme

Term Test : 15 Marks

Teacher Assessment : 20 Marks

End Sem Exam : 65 Marks

Total: 100 Marks

Prerequisite:

Knowledge of Engineering Mechanics and Strength of Materials.

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:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply the principles of kinetics to solve problems involving rigid bodies.	L5	Analyzing
CO2	Explain the working of various mechanisms and machines.	L1	Remembering
CO3	Determine the velocity and acceleration of the mechanism links.	L3	Applying
CO4	Sketch motion graphs for a given follower motion	L3	Applying
CO5	Determine basic design parameters of belt drives and chain drives.	L3	Applying
CO6	Determine basic design parameters of gears and gear trains.	L3	Applying

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:

05 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:

09 Hrs

Velocity 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-VI:

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

Text Books

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.

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Best of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Kinematics of Machinery Laboratory

(PCME4030L)

Practical Scheme	**Examination Scheme**
Practical : 2 Hrs./week	Teacher Assessment : 25 Marks
Credit : 1	Total : 25 Marks

List of Laboratory Experiments

1. Study of Exact line generating mechanisms (Peaucillier's, Hart's mechanisms), Approximate line generating mechanisms - Watt's, Grasshopper, Tchebich- eff's mechanisms)
2. Study of Approximate line generating mechanisms (Watt's, Grasshopper, Tchebich- eff'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 and acceleration-time, jerk-time and layout of cam profiles (3-5 problems)
9. Layout of cam profiles (3-5 problems)
10. Construction of Involute and Cycloid gear tooth profile - 2 problems

Text Books

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.

Evaluation Scheme:

Continuous Assessment (A):

Laboratory work shall consist of minimum 8 experiments and subject specific 5 lab assignment/case study

The distribution of marks shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of laboratory journal/manual/report will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the teacher assessment.

Engineering Materials(22PCME4040T)

Teaching Scheme	**Examination Scheme**
Lectures : 2 Hrs./week	Term Test : 15 Marks
Credit : 2	Teacher Assessment : 20 Marks
	End Sem Exam : 65 Marks
	Total: 100 Marks

Prerequisite:

Knowledge of basic Chemistry and Physics and Engineering Mechanics.

Course Objectives

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

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Classify the engineering materials and illustrate the related fundamental concepts such crystal structure, processing-structure-propertyperformance correlation, crystal defects, deformation mechanism and appreciate significance strengthening mechanisms.	L2	Understanding
CO2	Identify and comprehend failure modes of engineering materials and related issues.	L2	Understanding
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.	L4	Analyzing
CO4	Select and justify the proper heat treatment process and alloying elements for steel in order to obtain desirable properties to suit application requirements.	L5	Evaluating
CO5	Recognize the need for modern new age materials to cater the engineering application demands.	L2	Understanding

Course Contents

Unit-I

03 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

04 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, Griffiths theory of brittle fracture and Orowans 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

05 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 of alloys, Alloy phases and Construction of phase diagrams (unary, binary, ternary, Isomorphous etc), Gibbs 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 Advanced Materials: Composites, Nanomaterials and Smart Materials, energy materials, light metals and alloys: Need of these materials, their types, properties and applications.

Text Books

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.

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.

2. Total duration allotted for writing each of the paper is 1 hr.

3. Best of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.

2. Total duration allotted for writing the paper is 2 hrs.

Material Testing Laboratory (22PCME4040L)

Practical Scheme	**Examination Scheme**
Practical : 2 Hrs./week	Teacher Assessment : 25 Marks
Credit : 1	Total : 25 Marks

List of Laboratory 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

Evaluation Scheme:

Continuous Assessment (A):

Laboratory work shall consist of minimum 6 experiments and subject specific 5 lab assignment/case study

The distribution of marks shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of laboratory journal/manual/report will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the teacher assessment.

Advanced Manufacturing Processes

(22PCME4050T)

Teaching Scheme	**Examination Scheme**
Lectures : 3 Hrs./week	Term Test : 15 Marks
Credit : 3	Teacher Assessment : 20 Marks
	End Sem Exam : 65 Marks
	Total: 100 Marks

Prerequisite:

Knowledge of basic manufacturing processes.

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.
4. To familiarize the students with various hybrid machining processes.

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the fundamentals of various non-conventional machining processes, and their capabilities with their application areas2	L2	Understanding
CO2	Understand MEMS and Non-MEMS based manufacturing techniques.	L2	Understanding
CO3	Understand the various Nano finishing techniques.	L2	Understanding
CO4	Reviewing the difference between traditional and additive manufacturing techniques	L2	Understanding
CO5	Understand and apply the fundamental principles of various Additive Manufacturing (AM) technologies in solid based, liquid-based and powder-based techniques.	L2	Understanding

Course Contents

Unit-I

06 Hrs

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

05 Hrs

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

05 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).

Reference Books

1. Additive manufacturing technologies: rapid prototyping to direct digital manufacturing, by Ian Gibson, 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, 2nd Edition, 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. A Text Book of Production Technology Vol.II by O. P. Khanna, Dhanpat Rai Publication, 2000.

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Best of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Mechanical Measurements and Metrology

(22PCME4060T)

Teaching Scheme	**Examination Scheme**
Lectures : 3 Hrs./week	Term Test : 15 Marks
Credit : 3	Teacher Assessment : 20 Marks
	End Sem Exam : 65 Marks
	Total: 100 Marks

Prerequisite:

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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:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Classify various types of static characteristics and types of errors occurring in the system.	L4	Analyzing
CO2	Classify and select proper measuring instrument for displacement, strain, pressure and temperature measurement.	L4	Analyzing
CO3	Classify and select proper measuring instrument for linear and angular measurement.	L4	Analyzing
CO4	Demonstrate inspection methods and design of different limit gauges.	L3	Applying
CO5	Demonstrate characteristics of surface texture, screw threads, and gear measurements	L3	Applying

Course Contents

Unit-I

08 Hrs

Introduction to mechanical measurements and metrology: 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. Errors in measurement: Types of errors, Effect of component errors, Probable errors.

Unit-II

06 Hrs

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

07 Hrs

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:

08 Hrs

Linear measurements, Angular Measurement Design of Gauges: Limits, Fits, Tolerances, Types of Gauges, Taylors Principle of Limit Gauges, IS 919 for design of gauges. Gear Measurement 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 measurement: 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 Machines-constructional features, applications.

Text Books

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

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.

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Best of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Mechanical Measurements and Metrology Laboratory (22PCME4060L)

Practical Scheme	**Examination Scheme**
Practical : 2 Hrs./week	Teacher Assessment : 25 Marks
Credit : 1	Total : 50 Marks

List of Laboratory Experiments

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

Evaluation Scheme:

Continuous Assessment (A):

Laboratory work shall consist of minimum 6 experiments and subject specific 5 lab assignment/case study

The distribution of marks shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study: 10 Marks

The final certification and acceptance of laboratory journal/manual/report will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the teacher assessment.

End Semester Examination (C):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Advanced Manufacturing Processes Laboratory (22PCME4070L)

Teaching Scheme	**Examination Scheme**
Practical : 4 Hrs./week	Teacher Assessment : 50 Marks
Credit : 2	End Sem Exam : 50 Marks
	Total : 100 Marks

Prerequisite:

Knowledge of basic Physics and manufacturing processes.

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:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Demonstrate the various CNC control and calculate technological data for CNC machining.	L2	Understanding
CO2	Prepare programs, demonstrate, simulate, and operate CNC machines for various machining operations.	L2	Understanding
CO3	Apply engineering knowledge, techniques, and modern tools to analyze problems in additive manufacturing.	L3	Applying
CO4	Develop a working model using additive manufacturing (3D Printing) Processes.	L3	Applying
CO5	Engage in lifelong learning adhering to professional, ethical, legal, safety, environmental and societal aspects for career excellence.	L3	Applying

List of Laboratory Experiments

1. 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.

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

Evaluation Scheme:

Continuous Assessment (A):

1. Term work shall consist of Work-Shop book giving details of drawings of the completed jobs and time sheet.
2. The distribution of marks for term work shall be as follows: Laboratory work (Performance of job and workshop book): 50 marks
3. The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

End Semester Examination (C):

1. Practical examination of three hours duration will be held and evaluation will be done based on the performance during the examination for 50 marks.

Constitution of India (22MCME4080T)

Teaching Scheme

Lectures : 1 Hrs./week

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:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Have general knowledge and legal literacy and thereby to take up competitive examinations.	L1	Remembering
CO2	Understand state and central policies, fundamental duties.	L2	Understanding
CO3	Understand Electoral Process, special provisions.	L2	Understanding
CO4	Understand powers and functions of Municipalities, Panchayats and Co- operative Societies.	L2	Understanding
CO5	Understand Engineering ethics and responsibilities of Engineers.	L2	Understanding
CO6	Understand Engineering Integrity and Reliability.	L2	Understanding

Course Contents

Unit-I: Introduction to the Constitution of India

02 Hrs

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

Unit-II: Directive Principles of State Policy:

03 Hrs

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

Unit-III: State Executives:

02 Hrs

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

Unit-IV: Special Provisions:

02 Hrs

Special Provisions: For SC ST Special Provision for Women, Children Backward Classes Emergency Provisions.

Unit-V:Human Rights:

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: Scope Aims of Engineering Ethics

02 Hrs

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

Text Books

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. 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

Semester Project-II (22PJME4090L)

Practical Scheme
Practical : 02 Hrs./week
Credit : 01

Examination Scheme
Teacher Assessment : 25 Marks
End Sem Exam : 25 Marks
Total : 50 Marks

Course Objectives:

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

Course Outcomes:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Conduct a survey of several available literatures in the preferred field of study.	L4	Analyze
CO2	Demonstrate various/alternate approaches to complete a project.	L2	Understand
CO3	Ensure a collaborative project environment by interacting and dividing project work among team members.	L3	Apply
CO4	Present their project work in the form of a technical report / paper and thereby improve the technical communication skill.	L3	Apply
CO5	Demonstrate the ability to work in teams and manage the conduct of the research study.	L2	Understand

Semester Project:

The purpose of introducing semester project at 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 in student while selecting the project. Students should take this as an opportunity to develop skills in implementation, presentation and discussion of technical ideas/topics. Therefore, proper attention shall be paid to the content of semester project 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 project approved by departmental committee approved by the Head of Department, a group of 03 to 05 students (max 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. Semester Project Title or Theme should be based on knowledge acquired during 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 appropriate project title based on acquired knowledge from current semester subjects.
- Maintain Log Book of weekly work done(Log Book Format will be as per Table 1).
- Report weekly to the project guide along with log book.

Assessment Criteria:

- At the end of the semester, after confirmation by the project guide, each project group will submit project completion report in 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:

Size of report shall be of minimum 25 pages. Project Report 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.

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

Departmental committee (including project guide) will evaluate project as per Table 3.

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

Table 4: Log Book Format

Sr	Week (Start Date:End Date)	Work Done	Sign of Guide	Sign of Coordinator
1				
2				

Table 5: Continuous Assessment Table

Sr	Exam Seat No	Name of Student	Student Attendance	Log Book Maintain	Literature Review	Depth of Understanding	Report	Total
			5	5	5	5	5	25

Table 6: Evaluation Table

Sr	Exam Seat No	Name of Student	Project Selection	Design/ Methodology	Fabrication/ Modeling/ Simulation	Result Verification	Presentation	Total
			5	5	5	5	5	25

Employability Skill Development Program- I

(22HMME4100L)

Teaching Scheme

Practical : 2 Hrs./week

Credit : 1

Examination Scheme

Teacher Assessment : 50 Marks

Total : 50 Marks

Course Objectives

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

Course Outcomes:

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand and apply the basic concepts of Quantitative Ability i.e. profit, loss, time, work and geometry.	L2 and L3	Understand, Apply
CO2	Understand and apply the concepts of Quantitative Ability for the problem solving.	L2 and L3	Understand, Apply
CO3	Illustrate the concept of Variables and Functions	L2 and L3	Understand, Apply
CO4	Understand and illustrate the concept of Multithreading and string handling.	L2 and L3	Understand, Apply
CO5	Understand and describe the fundamental of object-oriented programming	L2	Understand

Course Contents

Unit-I: Aptitude

06 Hrs

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

Unit-II: Fundamental of Programming

10 Hrs

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, Re- cursion, Argument type functions, Default arguments functions, Required arguments functions, Keyword arguments functions, Variable arguments function Operators : Arithmetic Operators, Relational operators, Logical operators, Bitwise op- erators, Shift operators.

Unit-III: Statements

06 Hrs

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 Exception class, Finally, block, Releasing resources using Finally block, Raise, Creating a user exception class.Raise exception manually, Exceptions based application

Unit-IV: Multithreading

07 Hrs

Multithreading : Introduction, Multitasking, Multi tasking v/s Multithreading, thread- ing 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: Object Oriented Programming

06 Hrs

Object Oriented Programming : Introduction to OOPs, Classes, Objects, Structure to OOP application, 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 Inheri- tance, Single inheritance, Multi-Level inheritance, Method overriding, Object initializa- tion using constructor, Multiple inheritances, Hierarchical inheritance, Method overrid-ing in Multi level inheritance

Reference Books

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

2. Programming Techniques through C, by M. G. Venkateshmurthy, Pearson Publi- cation.

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

4. Let Us C, by YashwantKanetkar, BPB Publication.

Evaluation Scheme:

Continuous Assessment (A):

1. Teacher's assessment (TA) will carry weightage of 50 marks.Components of TA are: a. MCQ Test based on Aptitude: 20 Marks b. MCQ Test based on Programming skills: 20 Marks. c. Mock Interview: 10 Marks

2. Any other component recommended by BOS and approved by Dean Academics. grading.