Shamrao Patil (Yadravkar) Educational & Charitable Trust's
Sharad Institute of Technology College of Engineering
(An Autonomous Institute)
Yadrav (Ichalkaranji)-416121, Dist. – Kolhapur
Department of Mechanical Engineering

Teaching and Evaluation Scheme for Second Year B. Tech. as per New Education Policy 2020

Semester: III and IV

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Abbreviations

AEC: Ability Enhancement Course

BSC: Basic Science Course

CA-I: Continuous Assessment 1

CA-II: Continuous Assessment 2

CC: Co-curricular Courses

CEP: Common Engineering Project

ELC: Experimental Learning Course

ESC: Engineering Science Course

ESE: End Semester Exam

FP: Field Project

HSSM: Humanity Social Science and Management

IKS: Indian Knowledge System

L: Lecture

MC: Mandatory Course

MDM: Multidisciplinary Minor

MSE: Mid Semester Exam

OE: Open Elective

P: Practical

PCC: Programme Core Course

PEC: Programme Elective Course

RM: Research Methodology

T: Tutorial

VEC: Value Education Course

VSEC: Vocational and Skill Enhancement Course

SHARAD INSTITUTE OF TECHNOLOGY COLLEGE OF ENGINEERING YADRAV DEPT. OF MECHANICAL ENGINEERING

Head
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Shri Shamrao Patil (Yadravkar) Educational & Charitable Trust's

Sharad Institute of Technology College of Engineering

(An Autonomous Institute)

Yadrav (Ichalkaranji)-416121, Dist. – Kolhapur

Department: Mechanical Engineering **Rev:** Course Structure/01/NEP/2023-24

Class: S.Y. B. Tech. **Semester:** III

Course Code	Course Type	Course	Teaching Scheme				Examination scheme					Credits
			L	T	P	Total Hrs.	CA-I	CA-II	MSE	ESE	Total	
23ME2301	PCC	Engineering Thermodynamics	3	0	0	3	10	10	30	50	100	3
23ME2302	PCC	Material Science and Metallurgy	3	0	0	3	10	10	30	50	100	3
23ME2303	PCC	Analysis of Mechanical Elements	3	0	0	3	10	10	30	50	100	3
23ME2304	PCC	Engineering Thermodynamics Laboratory	0	0	2	2	15	15	-	20	50	1
23ME2305	PCC	Analysis of Mechanical Elements Laboratory	0	0	2	2	25	25	-	-	50	1
23ME2306	PCC	Machine Drawing and CAD Laboratory	0	0	2	2	15	15	-	20	50	1
23ME2307	CEP	Mini Project-II	0	0	2	2	25	25	-	-	50	1
23ME2308	HSSM	Account and Finance Management	1	0	0	1	25	25	-	-	50	1
23MILEXX	AEC	Modern Indian Language	2	0	0	2	25	25	-	-	50	2
23MEMDXX	MDM	Multidisciplinary Minor-I	2	0	0	2	10	10	30	50	100	2
23OEME21	OE	Open Elective-I*	2	0	0	2	10	10	30	50	100	2
23HSSM01	VEC	Aptitude Skill-I	1	0	0	1	25	25	-	-	50	1
23HSSM02	VEC	Language Skill-I	0	0	2	2	25	25	-	-	50	1
Total			**17**	**0**	**10**	**27**	**230**	**230**	**150**	**290**	**900**	**22**

Multidisciplinary Minor-I

Basket A (Production and Operation Management)	**Basket B (Aerospace)**	**Basket C (Mechatronics)**
Fundamentals of project management (23MEMDA1)	Fundamentals of combustion (23MEMDB1)	Introduction of Mechatronics (23MEMDC1)

DEPT. OF MECHANICAL ENGINEERING SHARAD INSTITUTE OF TECHNOLOGY COLLEGE OF ENGINEERING YADRAV

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Department: Mechanical Engineering **Rev:** Course Structure/01/NEP/2023-24

Class: S. Y. B. Tech **Semester:** IV

Course Code	Course Type	Course	Teaching Scheme				Examination scheme					Credits
			L	T	P	Total Hrs.	CA-I	CA-II	MSE	ESE	Total	
23ME2401	VSEC	Numerical Methods for Mechanical Engineering	2	0	0	2	10	10	30	50	100	2
23ME2402	PCC	Fluid Mechanics and Hydraulic Machines	3	0	0	3	10	10	30	50	100	3
23ME2403	PCC	Kinematics of Machines	3	0	0	3	10	10	30	50	100	3
23ME2404	PCC	Kinematics of Machines Laboratory	0	0	2	2	25	25	-	-	50	1
23ME2405	VSEC	Numerical Methods Laboratory	0	0	2	2	15	15	-	20	50	1
23ME2406	PCC	Fluid Mechanics and Hydraulic Machines Laboratory	0	0	2	2	15	15	-	20	50	1
23ME2407	VEC	Environmental Science	2	0	0	2	25	25	-	-	50	2
23ME2408	CEP	Mini Project-III	0	0	2	2	25	25	-	-	50	1
23ME2409	MC	Constitution of India	2	0	0	2	25	25	-	-	50	Audit
23MEMDXX	MDM	Multidisciplinary Minor-II	3	0	0	3	10	10	30	50	100	3
23OEME22	OE	Open Elective-II	3	0	0	3	10	10	30	50	100	3
23HSSM03	VEC	Aptitude Skill-II	1	0	0	1	25	25	-	-	50	1
23HSSM04	VEC	Language Skill-II	0	0	2	2	25	25	-	-	50	1
Total			**19**	**0**	**10**	**29**	**230**	**230**	**150**	**290**	**900**	**22**

Multidisciplinary Minor-II

Basket A (Production and Operation Management)	Basket B (Aerospace)	Basket C (Mechatronics)
Operation Research and Management (23MEMDA2)	Air craft propulsion (23MEMDB2)	Design of Mechatronics system (23MEMDC2)

SHARAD INSTITUTE OF TECHNOLOGY COLLEGE OF ENGINEERING, YADRAV DEPT. OF MECHANICAL ENGINEERING

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Engineering Thermodynamics

23ME2301	PCC	Engineering Thermodynamics	3-0-0	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Engineering physics, chemistry and mathematics.

Course Outcomes: At the end of the course, students will be able to

CO1	Recall the laws of thermodynamics and their applications in various engineering systems.
CO2	Illustrate properties of pure substances. Represent various processes with steam on property diagrams, Apply and compare equations of state for real gases.
CO3	Explain various vapour power cycles and thermodynamic cycles.
CO4	Describe working principle of steam generators, condensers and cooling towers.
CO5	Explain working principle of impulse and reaction turbine.
CO6	Explain gas turbine and jet propulsion.

Course Contents:

Unit 1: Fundamentals of Thermodynamics Basic concepts and definitions; System, surroundings, and boundary; Thermodynamic process; Properties and state of a system; Steady flow energy equation for pen system; First and second laws of thermodynamics; Definition of enthalpy, internal energy, entropy, specific heat, etc; Clausius inequality; Principle of increase in entropy; Concept of availability	[7]
Unit 2: Formation of Steam and Properties of Pure Substances Formation of steam and its properties; Use of steam table and Mollier chart; Dryness fraction and its determination; Equations of state (ideal gas equation, real gas behavior); P-V-T behavior of substances; Specific heat and heat capacities; Properties of Pure substances; Gas laws; Ideal Gas constant and Universal Gas constant; Ideal gas processes.	[6]
Unit 3: Vapour Power Cycles Carnot Cycle and limitations; Working of steam power plant, Rankine cycle; Effect of pressure and temperature on Rankine cycle; Reheat cycle; Regenerative cycle; Air standard power cycles.	[6]
Unit 4: Steam Generators, Condensers and Cooling Towers Types and classification- Low pressure fire & water tube boilers; Mountings & accessories; Performance testing of boilers; Equivalent evaporation; Boiler efficiency; Heat balance sheet; Criteria for selection of a boiler; Introduction of jet and surface condensers and cooling towers.	[7]

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Unit 5: Steam Turbines Classification of steam turbine; Working principles of impulse and reaction turbines; Velocity diagrams for simple impulse and reaction turbine; Combined velocity triangle; Compounding of steam turbine; Losses in steam turbines; Governing of steam turbines, Maximum discharge through nozzle; Expansion of effect of friction on nozzle.	[6]
Unit 6: Gas Turbine Classification and applications of gas turbine; Open & closed gas turbines; Ideal & actual cycles of gas turbine; Methods to improve performance- inter cooling, reheating & regeneration of gas turbine; Fuels used in gas turbine; Introduction of jet propulsion.	[6]

Text Books:

1. "Thermodynamics: An Engineering Approach" by Yunus A. Çengel and Michael A. Boles.
2. "Thermal Engineering" by R.K. Rajput.
3. "Advanced Engineering Thermodynamics" by Adrian Bejan.
4. "A Course in Thermal Engineering" by Domkundwar, A., Dhanpat Rai & Co., New Delhi, 2011.

Reference Books:

1. "Thermodynamics" by J. P. Holman, published by McGraw Hill.
2. "Thermal Engineering" authored by Kumar and Vasandani and published by Metropolitan Book Co. in Delhi.
3. Engineering Thermodynamics, Gupta & Prakash, Nemichand & Sons Hydraulic Machines by V.P. Vasantdani.
4. "Internal Combustion Engines" by V. Ganesan.

SHARAD INSTITUTE OF TECHNOLOGY COLLEGE OF ENGINEERING, YADRAV DEPT. OF MECHANICAL ENGINEERING

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Material Science and Metallurgy

23ME2302	PCC	Material Science and Metallurgy	3-0-0	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Physics

Course Outcomes: At the end of the course, students will be able to

CO1	Explain the importance of material science in mechanical engineering.
CO2	Explain the phase diagrams of various alloys with respect to compositions, properties and applications.
CO3	Explain the techniques for performing destructive and non-destructive tests.
CO4	Explain the principles of heat treatment and heat treatment furnaces.
CO5	Explain different heat treatment processes and its applications.
CO6	Explain powder metallurgy techniques for producing components.

Course Contents:

Unit 1: Metals and Alloy Systems Introduction to Metallic and Non-metallic materials and its classification (Metals/Alloys), Types of bonds, Crystal structure (SC, BCC, FCC, HCP), Imperfections in crystals, Alloy formation by crystallization, Nucleation and growth, Solid solutions and intermediate phases, Construction of equilibrium diagrams from cooling curves, Isomorphous system (Solid Solution), Eutectic, Partial solubility Peritectic and Intermetallic Compounds, Lever arm principle.	[6]
Unit 2: Study of Iron Carbon Equilibrium Diagram With respect to typical compositions, Properties and Applications for the following alloys: a) Fe- Fe3C equilibrium diagram - Ferrous alloys (Plain carbon steels, cast iron), b) Alloy steels- Free cutting steels, HSLA (High Strength Low Alloy steels), Maraging steels, Creep resisting steels, Stainless steels. Tool steels.	[6]
Unit 3: Principles of Metallurgical Testing a) Destructive Testing methods; Tensile, Compressive, Impact, Fatigue, Creep, Hardness etc. b) Non- Destructive Testing: - Dye penetrant, magnetic, ultrasonic, Radiography.	[6]
Unit 4: Principles of Heat Treatment a) Transformation of Pearlite into austenite upon heating, b) Transformation of austenite into Pearlite, Bainite and Martensite on cooling, c) TTT Diagram, CCT Diagrams, Effect of alloying elements on TTT diagram, d) Heat treatment furnaces and equipment's, controlled atmosphere.	[6]

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Unit 5: Heat Treatment Processes Heat Treatment of Steels: Annealing – Types-Full, Partial and Sub critical annealing (Various types) and purposes, Normalizing- Purposes, Hardening (Hardening types), Austempering and Martempering, Mechanism of quenching and Quenching media, Tempering Types, purposes of subzero treatment; Surface hardening - Flame and Induction, Chemical heat treatments for casehardening - Carburizing, Nitriding, Cyaniding, Carbonitriding, Heat treatment defects and remedies.	[6]
Unit 6: Powder Metallurgy Advantages, Limitations and Applications of Powder Metallurgy, Powder manufacturing, Mixing/ Blending, Compaction, Powder rolling and extrusion, Sintering, Finishing operations: Sizing, Machining, Infiltration and Impregnation.	[6]

Text Books:

1. "Material science and metallurgy for engineers", V.D. Kodgire, Everest Publishers Pune, 12th Edition.
2. "Introduction to Physical Metallurgy", S. H. Avner, TMH publication, 2010.
3. "Physical metallurgy", Vijendra Singh, Standard Publishers Delhi

Reference Books:

1. "Introduction to physical metallurgy", S. H. Avner, McGraw Hill Book Company Inc, Edition, 2nd, 1974.
2. "Material science and engineering" W. D. Callister, Wiley India Pvt. Ltd., 5th Edition.
3. "Heat Treatments Principles and Practices", T. V. Rajan/ C.P. Sharma, Prentice Hall of India Pvt Ltd, New Delhi,
4. "Engineering Metallurgy", R. A. Higgins, Viva Books Pvt. Ltd., New Delhi, 1st Ed., 1998.

DEPT. OF MECHANICAL ENGINEERING

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SIT COE, Yadrav

Analysis of Mechanical Elements

23ME2303	PCC	Analysis of Mechanical Elements	3-0-0	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Engineering Mechanics, Engineering Mathematics, Engineering Physics

Course Outcomes: At the end of the course, students will be able to

CO1	Demonstrate understanding of types of loading, stress and strain concepts induced in components.
CO2	Apply the principles of bending moment and shear force calculations to determine reactions, and construct shear force and bending moment diagrams for beams.
CO3	Apply the principles of bending stresses to calculate and determine suitable cross-sectional dimensions for beams subjected to bending moments.
CO4	Apply the double integration method to calculate deflection and slope of beam under point loads and uniform distributed loads (UDL).
CO5	Demonstrate the concept of principal stresses and strains on oblique planes, and apply graphical method to determine principal stresses and maximum shear stress for given loading conditions.
CO6	Apply their understanding of column stability to determine the critical buckling load for different types of columns under varying end conditions.

Course Contents:

Unit 1: Review of stress, strain & Elastic Constants Concept of Stress and Strain, (Linear, Lateral, Shear and Volumetric), Hooke's Law, Poisson's ratio, Modulus of Elasticity, Modulus of Rigidity, Stress-strain diagram for ductile and brittle material, Factor of safety, Working stress, Normal and shear stresses, Thermal stresses and strains. Concept, Numerical problems.	[6]
Unit 2: Bending moment and shear force in Mechanical Elements Introduction, Types of beams, Loads and Reactions, Shear forces and bending moments, Rate of loading, Sign conventions, Relationship between shear force and bending moments, Shear force and bending moment diagrams subjected to concentrated loads, uniform distributed load (UDL) for different types of beams.(UVL not included).	[6]
Unit 3: Stresses in Mechanical Elements Bending Stresses: Symmetric pure bending of beams, Flexure formula, moment of resistance of cross-sections, Simple built-up section, Design of rectangular and circular (solid and hollow) sections; I and T sections. Shear Stresses: Distribution of shear stresses in beams of various commonly used sections such as circular, I and T sections, Combined effect of shear and bending in beam.	[6]

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Unit 4: Deflection of Mechanical Elements Concept of deflection, Slope and deflection by double integration method, Slope and deflection for simply supported and cantilever beam (only for point load and UDL).	[6]
Unit 5: Principal Stresses and Strains Normal and shear stresses on any oblique planes, Concept of Principal planes, Derivation of expression for Principal stresses and maximum shear stress, Positions of principal planes and planes of maximum shear, Graphical solutions using Mohr's circle of stresses.	[6]
Unit 6: Analysis of columns and struts Introduction, Euler's theory on columns, Assumptions, Derivation of Euler's theory, Limitations of Euler's theory, Effective length, Slenderness ratio, Short and long columns, Radius of gyration, Buckling load, Buckling load for different end conditions, Rankine's formula. Numerical problems.	[6]
Text Books: 1. Strength of Materials, S. Ramamruthum, Dhanpat Rai and Sons, New Delhi. 2. Strength of Materials, R. K. Bansal, Laxmi Publication, 4th Edition. 3. Strength of Materials, Khurmi Gupta, S. Chand Publication. 4. Strength of Materials, R.K. Rajput, S. Chad Publication 5. Mechanics of structure, S.B Junnerkar,Charotar Publication House 6. Strength of Materials, S. S. Bhavikatti, Vikas Publication House 7. Strength of Materials, Timoshenko and Young, CBS Publication 8. Mechanics of Materials, S. S. Ratan, Tata McGraw Hill Publication, 2009 9. Strength of Materials,B. K. Sarkar, McGraw Hill Publication, 2003	
Reference Books: 1.Strength of Materials, Beer and Johnson, CBS Publication 2. Strength of Materials, G.H. Rider,Mac Millan India Ltd 3. Strength of Materials, Nag and Chanda, Willey India Publication 4. Advanced Mechanics of Materials, Boresi, Willey India Publication 5. Strength of Materials, Den Hartong, McGraw Hill Publication	

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Engineering Thermodynamics Laboratory

23ME2304	PCC	Engineering Thermodynamics Laboratory	0-0-2	1 Credit

Teaching Scheme:	**Examination Scheme:**
Lecture: - Practical: 2 hrs./week	CA-I: 15 Marks CA-II: 15 Marks End Semester Exam: 20 Marks

Pre-Requisites: Engineering Physics, chemistry and mathematics

Course Outcomes: At the end of the course, students will be able to:

CO1	Test for steam boiler, steam nozzle and steam condenser and explain working of steam power plant.
CO2	Identify the percentage of contaminant from flue gases/engine exhaust.
CO3	Determine the dryness fraction from separating and throttling calorimeter.

Experiments:

1. Measurement of dryness fraction of steam using separating & throttling calorimeter.
2. Flue gas analysis using emission measuring instruments.
3. Study of steam power plant.
4. Trial on steam boiler and steam nozzle.
5. Test on steam condenser.
6. Industrial visit to thermal power plant/thermal Industries.
7. Determination of calorific value by using bomb calorimeter.

Note: Students are expected to complete any six experiments listed above satisfactorily.

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Analysis of Mechanical Elements Laboratory

23ME2305	PCC	Analysis of Mechanical Elements Laboratory	0-0-2	1 Credit

Teaching Scheme	Examination Scheme
Lecture: - Practical: 2 hrs./week	CA-I: 25 Marks CA-II: 25 Marks

Pre-Requisites: NA

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain material behavior and their mechanical properties.
CO2	Explain the terms of stress and strains and their measurement techniques.
CO3	Apply numerical simulation for analysis and prediction.

Experiments:

1. Tensile test for Ductile and Brittle Material
2. Impact test for Ductile and Brittle material
3. Compression test of Mild Steel, Cast iron.
4. Torsion test on Mild Steel circular sections
5. Bending Test on Wood Material
6. Shear Test on Mild steel.
7. Strain Measurement in stress analysis by using Photoelasticity
8. Thermal stress measurement
9. Analyze the Thermal stress for different temperature condition in ANSYS
10. Analyze the stress and strain for different loading condition in ANSYS.

Note: Students are expected to complete any eight experiments listed above satisfactorily.

Text Books:

1. Strength of Materials, S. Ramamruthum, DhanpatRai and Sons, New Delhi.
2. Strength of Materials, R. K. Bansal, Laxmi Publication, 4th Edition.
3. Strength of Materials, Khurmi Gupta, S. Chand Publication.
4. Strength of Materials, R.K. Rajput, S. Chad Publication
5. Mechanics of structure, S.B Junnerkar,Charotar Publication House
6. Strength of Materials, S. S. Bhavikatti, Vikas Publication House
7. Strength of Materials, Timoshenko and Young, CBS Publication
8. Mechanics of Materials, S. S. Ratan, Tata McGraw Hill Publication, 2009
9. Strength of Materials, B. K. Sarkar, McGraw Hill Publication, 2003

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Reference Books:

1. Strength of Materials, Beer and Johnson, CBS Publication
2. Strength of Materials, G.H. Rider,Mac Millan India Ltd
3. Strength of Materials, Nag and Chanda, Willey India Publication
4. Advanced Mechanics of Materials, Boresi, Willey India Publication
5. Strength of Materials, Den Hartong, McGraw Hill Publication

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Machine Drawing and CAD Laboratory

23ME2306	PCC	Machine Drawing and CAD Laboratory	0-0-2	1 Credit

Teaching Scheme	Examination Scheme
Lecture: - Practical: 2 hrs./week	CA-I: 15 Marks CA-II: 15 Marks End Semester Exam: 20 Marks

Pre-Requisites: Engineering Graphics

Course Outcomes: At the end of the course, students will be able to:

CO1	Illustrate Conventional representation of standard machine components, welds, material etc.
CO2	Illustrate representation of limit, fits, and tolerance
CO3	Construct an assembly drawing of given machine parts
CO4	Make use of various Auto-CAD commands to develop sectional view.
CO5	Make use of various Auto-CAD commands to develop different views of assembly drawing of an object.
CO6	Make use of various Auto-CAD commands to construct 3-D model.

Experiments:

1. One full imperial drawing sheet on BIS conventions, free hand sketches consisting the drawing/ sketches of representation of standard components, symbols of pipe joints, weld joints, rivet joint etc.
2. One full imperial drawing sheet on Limit ,fits, tolerance
3. Draw orthographic sectional view of machine components by using AutoCAD
4. Draw Details using AutoCAD.
5. Draw Assembly using AutoCAD.
6. Draw 3-D model of one simple machine component using AutoCAD.

Note: Students are expected to complete all experiments listed above satisfactorily

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Mini Project-II

23ME2307	CEP	Mini Project-II	0-0-2	1 Credit

Teaching Scheme	Examination Scheme
Practical: 2 hrs/week	CA -I: - 25 Marks CA-II: -25 Marks

Pre-Requisites: Mini Project

About Ideathon

The project is a part of addressing societal and industrial needs. An Ideathon is a brief, intense event where students can work on some of the most important problems that the world is facing today. Ideathon's are brainstorming events where people with diverse knowledge backgrounds, skill sets and interests get together to predetermined problems, and come up with substantive, innovative and comprehensive solutions. An Ideathon's output might be ideas, a roadmap or an actionable plan. Teams leverage design thinking and cutting-edge techniques to brainstorm and collaborate on potential solutions within a given time frame.

Course Outcomes: At the end of the course, students will be able to

CO1	Identify problems based on societal /research needs
CO2	Apply Knowledge and interpersonal skills to solve societal problems in a group.
CO3	Outline the proper inferences from available results through theoretical/ experimental/simulations.
CO4	Analyze the impact of solutions in societal and environmental context for sustainable development.
CO5	Demonstrate capabilities of self-learning in a group, which leads to lifelong learning.
CO6	Demonstrate project management principles during project work.

Course Contents:

Week 1: Higher Education and Case Study Pedagogy • Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity. • Allocation of mentor	[2]

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Week 2: Topic Selection • Briefly interact with students to provide hand-holding for topic selection. • Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor • **Illustrative Examples : Any Industry or Societal Problem** • Finalization of Title.	[2]
Week 3: Case Study Design/Ideathon: Part 1 • If needed, provide hand-holding to students for finalizing objectives. • Review the objectives of the case study groups. • Identify what can be quantified related to your topic and how. • Decide objectives for your case study. • Continue reading especially recent work specific to your topic.	[2]
Week 4: Case Study Design/Ideathon: Part 2 • Prepare a roadmap of your case study, identify what is to be measured on the field. • Ensure student groups have finalized the objectives.	[2]
Week 5: Survey Design • Prepare a questionnaire and try it out with your group members as mock. • Decide sampling strategy.	[2]
Week 6: Analysis Phase-1 • Students in a group shall understand problem effectively, propose multiple solution. • The students have to work on different approaches and search for the different methodology to solve the problem in consultation with the project guide.	[2]
Week 7 Analysis Phase-2 • The students have to finalize the best methodology to solve the problem in consultation with the project guide. • 25% Presentation has to be conducted by mentor/guide based on above activity.	[2]
Week 8: Analysis-3 • Identify appropriate data visualization tools for your case study. • Analyze the data	[2]
Week 9: Analysis-4 • Identify appropriate data visualization tools for your case study. • Analyze the data	[2]
Week 10: Report writing Part:1 • Prepare an outline of the report and start organizing the write-up for the first draft.	[2]

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• Prepare and submit the first draft of the report to the course coordinator.	
Week 11: Report writing Part:2 • Make necessary corrections if any as per the suggestions of course coordinator. • Submit the final draft of the case study	[2]
Week 12: Final Presentation • 50% Presentation has to be conducted by mentor/guide based on above activity.	[2]

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Account and Finance Management

23ME2308	HSSM	Account and Finance Management	1-0-0	1 Credit

Teaching Scheme	Examination Scheme
Lecture: 1 hr/week	CA-I: 25 Marks CA-II: 25 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain basic terminology used in finance and accounts
CO2	Prepare and appraise Financial Statements and evaluate company in the light of different measurement systems.
CO3	Explain the working of capital management
CO4	Explain concept of Time Value of Money and Capital Budgeting

Course Contents:

Unit 1:Introduction to Financial Accounting, Book keeping and Recording Meaning, Scope and importance of Financial Accounting. Financial Accounting - concepts and conventions, classification of accounts	[3]
Unit 2: Financial Statement Preparation, analysis and Interpretation Preparation of financial statement and Profit and Loss Account, Balance Sheet, Ratio Analysis - classification of various ratios.	[3]
Unit 3: Working Capital Management Concept of working Capital, significance, types. Adequacy of working capital, Factors affecting working capital needs, Financing approaches for working capital	[3]
Unit 4:Time Value of Money and Capital Budgeting Concept of time value of money, Compounding and discounting; Future value of single amount and annuity, present value of single amount and annuity;. Capital budgeting - Nature and significance, techniques of capital budgeting –Pay Back Method, Accounting rate of return, Internal Rate of Return.	[3]

Text Books:

1. Financial, Cost and Management Accounting by Dr. P. Pariasamy, HH Publication.
2. Financial Management by Khan and Jain, Tata McGraw Hill.
3. Financial Management by Dr. P. C. Tulsian, S.Chand.
4. Financial Management by Ravi Kishore,Taxmann

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Modern Indian Language: Marathi

23MILE01	AEC	Marathi	2-0-0	2 Credits

Teaching Scheme	Examination Scheme
Lecture: 2 hrs/week	CA -I :25 Marks CA-II :25 Marks

Pre-Requisites: Nil

Course Outcomes: At the end of the course, students will be able to:

CO1	Develop the knowledge of local language/mother tongue and relate the same to daily life and social media.
CO2	Make use of rhetoric and verb to form sentences in Marathi Language
CO3	Identity Infinitive compounds in the given Marathi sentence.
CO4	Make use of Phrases and proverbs and form a sentence and Solve Prose Assessment/Summary Writing
CO5	Model a letter to appropriate end user in Marathi Language
CO6	Identity writing type of Marathi stanza and write appropriate writing.

Course Contents:

अध्याय 01: भाषा परीचय भाषा आणि व्यक्तिमत्व सहसंबंध, भाषा, जीवनव्यवहार आणि नवमाध्यमे व समाजमाध्यमे, चिन्ह व्यवस्था-विरामचिन्हे, संवाद कौशल्य (तोंडी परीक्षा), सर्वनाम-पुरुषात्मक, दर्शक, संबंधी, प्रश्नार्थक, सामान्य व आत्मवाचक सर्वनाम, विशेषण-गुण विशेषण, संख्या विशेषण, सार्वनामीक विशेषण	[4]
अध्याय 02: मराठी व्याकरण नाम, सर्वनाम, विशेषणे, क्रियापद, क्रियाविशेषण अव्यय, शब्दयोगी अव्यय, उभयान्वयी अव्यय, केवलप्रयोगी अव्यय, विभक्ती व त्याचे प्रकार, काळ व प्रकार	[4]
अध्याय 03: अलंकार व क्रियापदे अलंकार-शब्दलांकर- अनुप्रास, यमक, श्लेष उदाहरणे, अर्थालंकार-उपमा, उत्प्रेक्षा, व्यक्तिरेक, अपदुनती, रूपक, व्यक्तिरेक, अननव्य, अतिशयोक्ती उदाहरणे प्रयोग-कर्तरी, कर्मणी, भावे वाक्यप्रकार-केवल वाक्य, मिश्रवाक्य, संयुक्तवाक्य समास-अव्ययीभाव, तत्पुरुष, द्वंद्व, बहूवृही क्रियापदे- कर्ता व कर्म, क्रियापदाचे प्रकार- अकर्मक, सकर्मक, उभयविध, संयुक्त, क्रियाविशेषण-कालवाचक, स्थळवाचक, रितीवाचक, संख्यावाचक, प्रश्नार्थक, निषेधार्थक	[4]
अध्याय 04: वाक्प्रचार व म्हणी व गद्य आकलन/सारांश लेखन अर्थ सांगून वाक्यात उपयोग करणे (कमीत कमी ३० वाक्य प्रचार व म्हणी), गद्य आकलन - अपठित गद्य उतारा व त्यावरील प्रश्न उत्तरे (कमीत कमी ०५ उतारे व त्यावरील प्रश्न उत्तरे), सारांश आकलन	[5]

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अध्याय 05: लेखन प्रकार पत्रलेखन व त्याचे प्रकार-निमंत्रण, आभार, अभिनंदन, मागणी, कोटुंबिक, विनंती, तक्रार संधी -स्वरसंधी, व्यंजनसंधी, विसर्गसंधी, वृत्त लेखन, जाहिरात लेखन, कथा लेखन, अहवाल लेखन, आवेदन पत्र, अभिप्रायलेखन	[5]
अध्याय 05: कल्पनाविस्तार व मुलखात कल्पना विस्तार, मुलाखत कौशल्ये, मुलाखतीचे वैशिष्ट्ये, मुलाखतीचे स्वरूप, मुलाखत घेताना घ्यावयाची काळजी, मुलाखत देताना आवश्यक बाबी उदा.आत्मविश्वास, व्यक्तिमत्व विकास, भाषा कौशल्ये इ.	[4]

Text Books:

1. व्यावहारिक मराठी, डॉ.ल.रा.नसिराबादकर, फडके प्रकाशन, कोल्हापूर.
2. व्यावहारिक मराठी, डॉ.लीला गोविलकर, डॉ.जयश्री पाटणकर, स्नेहवर्धन प्रकाशन, पुणे
3. सुगम मराठी व्याकरण लेखन, मो.रा. वाळंबे, नितीन प्रकाशन पुणे

Reference Books:

1. अनिवार्य मराठी व्याकरण, लेखन व आकलन, डॉ. प्रल्हाद लुलेकर, केदार काळवणे, Pearson पब्लिकेशन्स
2. मराठी व इंग्रजी अत्यावश्यक निबंध, प्रा.विजयकुमार वेधपाठक, K'Sagar पब्लिकेशन
3. उपयोजित लेखन, मराठी, प्राची शेंडे, सावली म्हात्रे, टार्गेट पब्लिकेशन्स

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Modern Indian Language: Hindi

23MILE02	AEC	Hindi	2-0-0	2 Credits

Teaching Scheme	Examination Scheme
Lecture: 2 hrs/week	CA -I :25 Marks CA-II :25 Marks

Pre-Requisites: Nil

Course Outcomes: At the end of the course, students will be able to:

CO1	Develop the awareness of Hindi language and relate the same to daily life and social media.
CO2	Identity Infinitive compounds in the given Hindi sentence.
CO3	Make use of Phrases and proverbs and form a sentence in Hindi language.
CO4	Identity the mistakes in grammar of Hindi language and corrections in it
CO5	Make use of rhetoric to form sentences in Hindi Language
CO6	Illustrate the prose and verse in the given literature

Course Contents:

अध्याय 01: हिंदी भाषा परीचय हिन्दी भाषा और उसका विकास, हिन्दी साहित्य का इतिहास, भाषा के विभिन्न मौखिक भाषा, लिखित भाषा, रूप-वर्णमाला, विराम चिन्ह, शब्द रचना, अर्थ, वाक्य रचना, वर्णो का उच्चारण और वर्गीकरण	[5]
अध्याय 02: समास समास, क्रियाएँ, अनेकार्थी शब्द, विलोम शब्द, पर्यायवाची शब्द,	[5]
अध्याय 03: मुहावरे एवं लोकोक्ति मुहावरे एवं लोकोक्ति, तत्सम एवं तद्भव, देशज, विदेशी, वर्तनी, अर्थबोध	[4]
अध्याय 04: हिन्दी भाषा में प्रयोग होने वाली अशुद्धियाँ हिन्दी भाषा में प्रयोग होने वाली अशुद्धियाँ, अनेक शब्दों के लिए एक शब्द, रस	[5]
अध्याय 05: अलंकार अलंकार, छन्द, विशेषण और विशेष्य, भाषा-विज्ञान	[4]
अध्याय 06: भाषा-विज्ञान भाषा-विज्ञान, हिन्दी पद्य/गद्य रचना व रचनाकार, संज्ञा से अवयव तक, रिक्त स्थानों की पूर्ति, क्रमबद्धता.	[4]

Text Books:

1. हिंदी व्याकरण- पं कमताप्रसद गुरु, प्रकाशन संस्था, नई दिल्ली
2. हिंदी साहित्यिक का विद्वन्मानिक इतिहास-डॉ गणपतिचंद्र गुप्त, लोकभारती प्रकाशन, नई दिल्ली.

Reference Books:

1. हिंदी भाषा शिक्षण - संपा हिंदी अध्ययन मंडल, सावित्रीबाई फुले पुणे विश्विद्यालय पुणे, राजकमल प्रकाशन

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Aptitude Skill-I (Verbal Ability)

23HSSM01	VEC	Aptitude Skill- I	1-0-0	1 Credit

Teaching Scheme:	**Examination Scheme:**
Lecture: 1hr	CA-I : 25 Marks CA-II: 25 Marks

Pre-Requisites: Basic Mathematics

Course Outcomes: At the end of the course, students will be able to

CO1	Apply sentence formation rules to spot the error
CO2	Solve the questions based on the types of tenses
CO3	Solve the questions based on Direct/Indirect Speech and Passive/active voice and Substitution and Elimination
CO4	Make use of Proverbs, Idioms and phrases in sentence construction and the vocabulary

Course Contents:

Unit 1: Structure and Types of Sentences, Conditional Sentences	[3]
Unit 2: Present tense, Past tense, Future tense, Use of Tenses in Sentence forming	[3]
Unit 3 : Direct and Indirect Speech, Active and Passive Voice Use of Modal verbs in Sentence Forming, Substitution and Elimination	[3]
Unit 4: Use of Proverbs, Idioms and Phrases in Sentence Construction, Judgment and Inference Sentence Vocabulary Building in Various Situations	[3]

Text Books :

1. Raymond Murphy, Essential English Grammar with Answers, Murphy.
2. Objective General English by R.S. Aggarwal, S Chand Publishing; Revised edition (15 March 2017)

Reference Books:

1. Rao and D,V,Prasada, Wren & Martin High School English Grammar and Composition
2. Murphy, Intermediate English Grammar with Answers, Cambridge University Press;Second edition

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Language Skill- I

23HSSM02	VEC	Language Skill- I	0-0-2	1 Credit

Teaching Scheme	Examination Scheme
Lecture: - Practical: 2 hrs/week	CA-I: 25 Marks CA-II : 25 Marks

Pre-Requisites: Basics of Programming

Course Outcomes: At the end of the course, students will be able to

CO1	Develop flowchart and Algorithm to solve the given problem statements
CO2	Develops programs using Data Types and Operators
CO3	Make use of Decision Making and Looping Statements to develop conditional programs
CO4	Make use of Arrays to develop programs in C language

Experiment No.	Name of Experiment
1	Explain basics of C such as Editing, Compiling, Error Checking, executing, testing and debugging of Programs and Deign Algorithms and Flowcharts.
2	Explain basics of Variable, Data types and operators and develop programs on arithmetic Operators.
3	Develop programs on Conditional, logical and Bitwise Operators.
4	Develop programs on Sizeof () and typecasting operator.
5	Develop programs on increment and decrement operator.
6	Develop programs on simple if and if-else statement.
7	Develop programs on simple if-else ladder and Nested if-else.
8	Develop programs on Switch case statement.
9	Develop programs on For-loop & Nested For-loop.
10	Develop programs on while and do-while loop.
11	Develop programs on one dimensional array.
12	Develop programs on two dimensional array.
13	Develop programs on string handling functions.

Text Books :

1. C Programming Absolute Beginner's Guide, Que Publishing; 3rd edition (22 August 2013)
2. C Programming Language 2nd Edition, Peasrson Publication

Reference Books:

1. Programming in C Practical Approach by Ajay Mittal, Pearson
2. Let Us C, By Yashwat Kanetkar

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Multidisciplinary Minor Course: Fundamentals of Project Management

23MEMDA1	MDM	Fundamentals of Project Management	2-0-0	2 Credits

Teaching Scheme	Examination Scheme
Lecture: 2 hrs/week Tutorial: -	CA-I:10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: NA

Course Outcomes: At the end of the course, students will be able to

CO1	Explain the basic concepts of project management and its life cycle
CO2	Identify how organizational culture impacts a project
CO3	Plan a project and demonstrate importance of WBS to the management of project.
CO4	Explain different phases of project execution and the intricacies of project earned value analysis.
CO5	Identify key characteristics of project performance measurement, evaluation and understand project closure process
CO6	Illustrate approaches for risk identification, analysis and assessment.

Course Contents:

Unit 1: Introduction to Project Management What is project management, Why project management, Project Life Cycle, Project Management today, Types of Projects, Project selection and feasibility study, Benefits of project management, Future trends in project management.	[4]
Unit 2: Project in Organizational Structure: Introduction, Project in functional organization, , Project in composite organization, Project in matrix organization, Team structure, Team development process, Team building process, Human factors and project team.	[4]
Unit 3: Project Planning Introduction, Project Planning, Need of Project Planning, Steps in project Planning, Work Breakdown Structure (WBS), Organizational breakdown structure (OBS)	[4]
Unit 4: Project Execution Project initiation, Controlling and Reporting project objectives, Conducting project evaluation, Project evaluation criteria, Project evaluation measurement, Earned value analysis, Project management information system.	[4]
Unit 5: Performance Measurement and Evaluation Project control cycle, Monitoring project performance, Project evaluation techniques, Human factors in project evaluation and control, Project termination, Types of project terminations.	[4]
Unit 6: Project Risk Management Introduction, Risk management model, Responsibility, Risk identification, Risk qualification, Risk response, Risk mitigation, Risk control.	[4]

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Text Books:

1. Rory Burke, Project Management, Wiley
2. M R Gopalan, Samuel Mantel, Project Management, Wiley
3. Stanley E. Portny, Project Management, PMP, Wiley

Reference Books:

1. Meridith, Jack R, Project management, Wiley.
2. Kerzner, Herold, Project Management, Wiley
3. Burkey, Rory,, Project Management, Wiley

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Multidisciplinary Minor Course: Fundamentals of Combustion

23MEMDB1	MDM	Fundamentals of Combustion	2-0-0	2 Credits

Teaching Scheme	Examination Scheme
Lecture: 2 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Thermodynamics, Fluid mechanics, Heat transfer, Gas turbine

Course Outcomes: At the end of the course, students will be able to

CO1	Classify fuels and oxidizers
CO2	Explain thermodynamic behavior of combustion process
CO3	Explain Physical behavior of combustion process
CO4	Explain molecular chemistry behavior of combustion process
CO5	Explain premixed flame combustion process
CO6	Explain diffusion flame combustion process

Course Contents:

Unit 1: Thermodynamics of Combustion Induction to combustion, types of fuels and oxidizers, various combustion modes, scope of combustion	[4]
Unit 2: Thermodynamics of Combustion Thermodynamic properties, laws of thermodynamics, stoichiometry, thermochemistry, adiabatic flame temperature, chemical equilibrium.	[4]
Unit 3: Physics of Combustion Fundamental laws of transport phenomena such as Newton's law of viscosity, Fourier law of heat conduction, Fick's law of species diffusion, transport properties of gas mixture. Conservation equations such as the mass conservation equation, momentum equation, and species transport equation, and energy transport equation. Boundary layer concept and Transport in turbulent flow.	[4]
Unit 4: Chemistry of Combustion Basic reaction kinetics, Fundamentals of elementary reactions such as first order, second order, third order, and reverser reaction. Chain reactions, multistep reaction mechanism, simplification of reaction mechanism.	[4]
Unit 5: Premixed Flame One dimensional combustion wave, laminar premixed flame, burning velocity measurement method, effects of chemical and physical variables on burning velocity, flame extinction, ignition, turbulent premixed flame.	[4]
Unit 6: Diffusion Flame Gaseous jet flame, Liquid fuel combustion, and solid fuel combustion. Combustion and environment, and chemicals from combustion	[4]

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Text Books:

1. "Fundamentals of combustion" by D. P. Mishra.
2. " Fundamentals of Combustion Engineering " by Mukhopadhyay Achintya

Reference Books:

1. "Introduction to combustion" by Stefan R. Turns, Third edition
2. "Fundamentals and Technology of Combustion" by Fawzy El-Mahallawy and Saad El-Din Habik

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Multidisciplinary Minor Course: Introduction of Mechatronics

23MEMDC1	MDM	Introduction of Mechatronics	2-0-0	2 Credits

Teaching Scheme	Examination Scheme
Lecture: 2 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: NA

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain principles of Mechatronics system.
CO2	Make use of sensors and transducers for engineering applications.
CO3	Illustrate actuation systems.
CO4	Make use of smart materials for Mechatronics systems.
CO5	Explain programmable logical control.
CO6	Illustrate micro controller and applications of Mechatronics engineering.

Course Contents:

Unit: 1 Basic Mechatronics System Introduction, Need and Scope, Traditional v/s Mechatronics approach, Block diagram representation of general mechatronics system showing various components with suitable example, Control system – open and closed loop system, Basic elements of closed loop system.	[6]
Unit: 2 Sensors and Transducers **Sensors**: Introduction, Need of sensors, Contact and non-contact type of sensors, strain gauge elements, Capacitive elements, Eddy current sensors, Proximity sensors. **Transducers**: Introduction, Primary and secondary transducers, Working of primary and secondary transducers, Electrical transducers.	[6]
Unit: 3 Actuators Introduction and classification of actuators, Need and scope, Hydraulic actuation system, Linear hydraulic actuation system – Single and double acting, Pneumatic actuation system – Gear motors and vane motors.	[6]
Unit: 4 Microprocessor Introduction to 8086 – architecture – pin description – External memory interfacing – bus cycle –some important companion chips - Maximum mode bus cycle-memory interfacing - Minimum mode System configuration- Maximum mode system configuration – Interrupts processing – 8087 Numeric data processor - data types – architecture - instruction set.	[6]

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Unit: 5 Programmable Logical Controller: Introduction, Definition, principle of operation of PLC, Differentiate between PLC and computer controlled systems, Basic PLC functions, hardware components of PLC, PLC block diagram.	[6]
Unit: 6 Microcontroller and Applications of Mechatronics Systems Introduction, Microcontroller: Architecture, Pin configuration, Stack memory organization, Comparison of microprocessor and microcontroller, microcontroller based antilock brake system, microcontroller based pick & place robot, microcontroller based car park barrier system	[6]
Text Books: 1. R. K. Rajput, "A textbook of mechatronics, S. Chand & Company Private Limited. 2. Sami Franssila, "Introduction to micro fabrication" Wiley 2nd Edition. Yi Qin, "Micromanufacturing Engineering and Technology, Micro and nano Technology Series" Elsevier.	
Reference Books: 1. Mechatronics – W. Bolton, Pearson education. 2. Mechatronics – Mahalik, Tata Mcgraw Hill. 3. Introduction to PLC Programming, NIIT, P. 4. Programmable Logical Controller, Reis Webb, Prentice Hall. 5. Automated Manufacturing Systems, S. Brain Morris, Mcgraw Hill. 6. Mechatronics – Appu Kuttam, Oxford Publications. 4. Microprocessor 8085 - Gaokar	

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Numerical Methods for Mechanical Engineering

23ME2401	VSEC	Numerical Methods for Mechanical Engineering	2-0-0	2 Credits

Teaching Scheme	Examination Scheme
Lecture: 2 hrs/week	CA- I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Engineering Mathematics, Engineering Mechanics

Course Outcomes: At the end of the course, students will be able to

CO1	Solve system of equations by using various Numerical techniques.
CO2	Develop basic mathematical equations using Regression Curve Fitting methods
CO3	Analyze the numerical with different Interpolation Methods
CO4	Solve Numerical differentiation by different Methods
CO5	Solve Numerical integration by different Methods
CO6	Solve partial differential equation using various methods

Course Contents:

Unit 1: Roots of Equations **a) Error-**round-off, approximate and true error, truncation error, error propagation, importance of errors in computer programming. **b) Bracketing Methods -** Bisection Methods, False Position Method **c) Open Methods** – Newton-Rapson Method, Multiple Roots, System of non-linear Equations, Secant Method **d) Roots of polynomials** -Muller's Method	[6]
Unit 2: Curve fitting Least square regression-Linear regression, Polynomial Regression, fitting of exponential & logarithmic curve.	[4]
Unit 3: Interpolation Interpolation using Newton's forward, backward &central formulae, Newton's divided difference Method, and Lagrange's interpolation formula.	[4]
Unit 4: Numerical Differentiation Derivatives using Newton's Forward difference method, Derivatives using Newton's Backward difference method & Derivatives using Stirling's Central difference method	[4]
Unit 5: Numerical Integration Trapezoidal rule, Simpson's (1/3rd) rules , Simpson's (3/8th) rules, Integration unequal segments, Romberg's Integration, Gauss Quadrature Method,	[4]
Unit 6: Partial Differential Equation Classification of second order Partial differential equations - Elliptic, Parabolic and Hyperbolic, Laplace's method, explicit method, implicit method, Crank Nicolson Method.	[6]

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Text Books:

1. Steven C. Chapra, "Numerical Methods for Engineers", Tata McGraw Hill Publications, New Delhi, 5th Edition, 2007.
2. B. S. Grewal, "Numerical Methods in Engineering and Science with Programs in C and C++", Khanna Publications, New Delhi, 7th Edition, 2008.
3. "Numerical Methods", E Balguruswamy Tata McGraw-Hill Publication Company Ltd., 8th Edition, 2002.
4. "Numerical Methods", S. Arumugam, A. Thangapandi Isaac and A. Somasundaram, Scitech Publications India Pvt. Ltd., Chennai, 2nd Edition,2007.
5. "Numerical Methods", Dr. V.N.Vedamurthy, Vikas Publication

Reference Books:

1. J.N. Kapoor, "Mathematical Modeling", New Age Mumbai, first Edition, 2005.
2. Kreyszig, "Advanced Mathematics", Laurie Rosatone, USA, 2006.
3. Sigiresu S Rao, "Engineering Optimization", New Age International Publisher, 3rd Edition, 2010.
4. "Applied Numerical Methods with MATLAB for Engineers and Scientists", S.C.Chapra, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 3rd Edition, 2012.
5. "Numerical Analysis Theory and Applications", R.L.Burden and J.D.Faires, Cengage Learning India Pvt.Ltd., New Delhi,1st Edition,2005

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Fluid Mechanics and Hydraulic Machines

23ME2402	PCC	Fluid Mechanics and Hydraulic Machines	3-0-0	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Engineering physics, mathematics, thermal engineering

Course Outcomes: At the end of the course, students will be able to:

CO1	Recall fundamental concepts of fluid mechanics, such as properties of fluids, Bernoulli's equation, etc.
CO2	Interpret fluid flow behaviors, including laminar and turbulent flows, and describe the underlying mechanisms.
CO3	Determine different losses in pipes and study of boundary layer.
CO4	Explain construction and working of different types of pumps.
CO5	Determine the performance of hydraulic turbines.
CO6	Explain construction and working of various compressors.

Course Contents:

Unit 1: Introduction of Fluid and Fluid Properties Concept and classification of fluid; Properties of fluid-density, viscosity, surface tension, capillary effect, vapor pressure, compressibility and the bulk modulus; Newton's law viscosity; Pascal's Law, Introduction of Buoyancy, Metacenter and floatation.	[6]
Unit 2: Fluid Kinematics and Dynamics Different types of fluid flow; Description of fluid motion (Eulerian and Lagrangian viewpoints); Concept of Streamlines, streaklines, and pathlines; Velocity and acceleration field; Conservation of mass (continuity equation); Conservation of momentum (Navier-Stokes equations); Bernoulli's equation.	[7]
Unit 3: Flow through pipes and Boundary Layer Theory Energy losses through pipe-Major and Minor losses; Darcy-Weisbach and Chezy's equation, Study of different types of pipes; Boundary layer thickness and its characteristics; Laminar and turbulent Boundary layers; Displacement thickness; Momentum thickness; Energy thickness; Separation of Boundary layer and its control.	[7]
Unit 4: Hydraulic pumps Classification and types of pumps; Centrifugal; Reciprocating, Axial pump; Pump performance characteristics; Cavitation and net positive suction head (NPSH); Efficiencies of pump; Selection of pumps.	[6]
Unit 5: Hydraulic Turbines Principles and characteristics of hydraulic turbines used in hydroelectric power generation; Classification and types of turbines; Working principles and operational characteristics of turbines; Turbine efficiency, Governing and control mechanisms.	[6]

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Unit 6: Compressors and advances in turbo machinery Classification of compressors, Reciprocating, rotary and rotodynamic compressors; Multistage of compressor; Efficiencies of compressors; Performance of compressors; Challenges and considerations in designing efficient and reliable turbomachines; Introduction of advancements in materials.	[6]
Text Books: 1. "A Textbook of Fluid Mechanics and Hydraulic Machines" by R.K. Bansal. 2. "A Textbook of Hydraulics, Fluid Mechanics, and Hydraulic Mechanics" by Dr. R.S. Khurmi. 3. "Fluid Mechanics and Hydraulic Machines" by Dr. R. K. Rajput. 4. "Fluid Machinery" by Dr. D.S. Kumar.	
Reference Books: 1. "Fluid Mechanics" by Dr. P.N. Modi and Dr. S.M. Seth. 2. "Fluid Mechanics: Fundamentals and Applications" by Yunus A. Çengel and John M. Cimbala.	

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Kinematics of Machines

23ME2403	PCC	Kinematics of Machines	3-0-0	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Physics, Mathematics

Course Outcomes: At the end of the course, students will be able to:

CO1	Classify planer mechanism and determine the motion of mechanism.
CO2	Solve graphically problems of velocity and acceleration of planer mechanism using relative velocity, Kleins construction and Instantaneous center method.
CO3	Determine frictional torque in screw, pivot bearing, and clutch
CO4	Construct cam contour for given motion.
CO5	Determine the effect of angle of contact, initial tension, coefficient of friction and slip on power transmission of belt.
CO6	Explain the basics of Gear, Gear Geometry, laws and types of gear profiles

Course Contents:

Unit 1: Fundamentals of Kinematics and Mechanisms Definition of link, pair, kinematics chain, Inversions of single and double slider crank chain, kinematic diagrams of mechanisms, degree of freedom. Study of various mechanisms such as straight line mechanisms, pantograph, Geneva mechanism Steering gear mechanisms, and condition of correct steering, Hooke's joint. Ratio of driving velocities.	[6]
Unit 2: Velocity and Acceleration Analysis Basics of velocity and acceleration analysis, Velocity and acceleration diagrams using relative velocity method, Velocity and acceleration of slider crank mechanism by Klein's construction. Velocity analysis by Instantaneous center method.	[7]
Unit 3: Friction Dry friction, friction between nut and screw with different types of threads, Uniform wear theory and uniform pressure theory, Friction at pivot and collars, Friction circle and friction axis. Classification of Clutches, torque transmitting capacity of plate clutch and cone clutch.	[7]
Unit 4: Cams and Followers Types of cams and followers, Analysis of motion, Jump of cam, determination of cam profiles for a given follower motion, Circular arc cam.	[6]
Unit 5: Belts and Dynamometers Types of belt and rope drives, calculation of length and power transmitted, Belt tension ratio, Actual tension in a running belt, centrifugal and initial tension in belt, Slip and creep of belt. Classification of dynamometers, Study of rope brake absorption dynamometer and belt transmission dynamometer.	[7]

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Unit 6: Toothed gearing Geometry of motion, Gear geometry, Types of gear profile- involute and cycloidal, Theory of Spur gears, Interference in involute tooth gears and methods for its prevention, Path of contact, Contact ratio, Types of Gear trains - Simple, Compound, Reverted, Epicyclic gear train, Tabular method for finding the speeds of elements in gear train, Torques in gear train	[7]

Text Books:

1. S. S. Rattan, "Theory of Machines", Tata McGraw Hill, New Delhi.
2. A. Ghosh, A. K. Malik, "Theory of Mechanisms and Machines", Affiliated East-West Press Pvt. Ltd., New Delhi.
3. P.L.Ballany, Theory of Machines, Khanna Publication, New Delhi.
4. V.P. Singh, Theory of Machines, Dhanpat Rai and Sons.
5. Phakatkar, Theory of Machines I and II, Nirali Publication. Pune
6. Dr. R.K.Bansal, Theory of machines, Laxmi Publication.

Reference Books:

1. J. E. Shigely, J. J. Uicker, "Theory of Machines and Mechanisms", Tata McGraw Hill Publications, New York, International Student Edition, 1995.
2. Thomas Beven, "Theory of Machines", CBS Publishers and Distributors, Delhi.
3. Shigley, Theory of Machines and Mechanism, McGraw Hill, New York
4. G.S. Rao and R.V. Dukipatti, Theory of Machines and Mechanism, "New Age Int. Publications Ltd. New Delhi.
5. Shah and Jadhawani, Theory of Machines, Dhanpat Rai & Sons
6. Abdullah Shariff, Theory of Machines, McGraw Hill, New Delhi.

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Kinematics of Machines Laboratory

23ME2404	PCC	Kinematics of Machines Laboratory	0-0-2	1 Credit

Teaching Scheme	Examination Scheme
Lecture: - Practical: 2 hrs./week	CA- I: 25 Marks CA- II: 25 Marks

Pre-Requisites: Physics, Mathematics

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain the working of different mechanisms.
CO2	Analyze graphically velocity and acceleration of planer mechanism using Instantaneous Centre of rotation ,Klein's construction and Relative Velocity methods
CO3	Classify the cam and followers motions.
CO4	Examine effect of slip on power transmission of belt.
CO5	Determine the torque transmitted in epicyclic gear train.
CO6	Develop a computer program for calculation of velocity and acceleration of slider- crank mechanism.

Drawing Sheets and Experiments:

List of Drawing Sheets:
1. Demonstration of construction and working of basic mechanisms. 2. Graphical solution to problems on velocity acceleration in mechanism by relative velocity and Acceleration method. 3. Velocity analysis by instantaneous center method. 4. Klein's construction method for velocity and acceleration analysis of slider cranks mechanisms. 5. Construct cam profile for various types of followers motion.
Experiments
1. Experiment on measurement of belt Slip. 2. Experiment on torque measurement in epicyclic gear train. 3. Calculate velocity and acceleration of slider-crank mechanism by using suitable programming method.

Note: Students are expected to complete all drawing sheets and experiments listed above satisfactorily.

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Numerical Methods Laboratory

23ME2405	VSEC	Numerical Methods Laboratory	0-0-2	1 Credit

Teaching Scheme	Examination Scheme
Lecture: - Practical: 2 hrs./week	CA-I: 15 Marks CA-II: 15 Marks End Semester Exam: 20 Marks

Pre-Requisites: C Programming

Course Outcome: At the end of the course, students will be able to

CO1	Develop programs in C++/ MATLAB to solve problem based on Bisection & Newton-Raphson method.
CO2	Develop programs in C++/ MATLAB to solve problem based on curve fitting & linear algebraic equation.
CO3	Develop programs in C++/ MATLAB to solve problem based on Lagrange's interpolation& Numerical differentiation.
CO4	Develop programs in C++/ MATLAB to solve problem based on Numerical integration & Partial differentiation equation.

The students are expected to solve the problems in mechanical engineering (In area like Thermal, Design, FEA, etc.) using following methods by choosing appropriate software from C, C++, MATLAB.

1. Program on bisection and false position method.
2. Program on Newton-Raphson method.
3. Program on Linear algebraic equation.
4. Program on curve fitting.
5. Program on Lagrange's interpolation.
6. Program on Numerical differentiation.
7. Program on Numerical integration.
8. Program on Partial differentiation equation.

Note: Students are expected to complete all programs listed above satisfactorily

Text Books:

1. Steven C. Chapra, "Numerical Methods for Engineers", Tata McGraw Hill Publications, New Delhi, 5th Edition, 2007.
2. B. S. Grewal, "Numerical Methods in Engineering and Science with Programs in C and C++", Khanna Publications, New Delhi, 7th Edition, 2008.
3. "Numerical Methods", E Balguruswamy Tata Mcgraw Hill Publication Company Ltd.,8th Edition, 2002.
4. "Numerical Methods", S.Arumugam,A. Thangapandi Isaac and A. Somasundaram, Scitech Publications India Pvt. Ltd., Chennai, 2nd Edition,2007.

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5. "Numerical Methods", Dr. V.N.Vedamurthy. Vikas Publication.

Reference Books:

1. J.N. Kapoor, "Mathematical Modeling", New Age Mumbai, first Edition,2005.
2. Kreyszig, "Advanced Mathematics", Laurie Rosatone, USA, 2006.
3. Sigiresu S Rao, "Engineering Optimization", New Age International Publisher, 3rd Edition, 2010.
4. "Applied Numerical Methods with MATLAB for Engineers and Scientists", S.C.Chapra, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 3rd Edition, 2012.
5. "Numerical Analysis Theory and Applications", R.L.Burden and J.D.Faires, Cengage Learning India Pvt. Ltd., New Delhi, 1st Edition,2005.

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Fluid Mechanics and Hydraulic Machines Laboratory

23ME2406	PCC	Fluid Mechanics and Hydraulic Machines Laboratory	0-0-2	1 Credit

Teaching Scheme:	**Examination Scheme:**
Lecture: - Practical: 2 hrs./week	CA-I: 15 Marks CA-II: 15 Marks End Semester Exam: 20 Marks

Pre-Requisites: Engineering Physics, chemistry and mathematics, thermal engineering

Course Outcomes: At the end of the course, students will be able to

CO1	Determine the minor losses in pipe fittings.
CO2	Determine the rate of discharge through venturimeter, orifice meter.
CO3	Estimate the performance of hydraulic machines and turbo-machinery's.

Experiment List:

1. Determination of minor losses in pipe.
2. Verification of Bernoulli's Theorem.
3. Trial on Venturimeter/orifice meter
4. Trial on Pelton/Francis turbine.
5. Trial on centrifugal/reciprocating pump.
6. Trial on centrifugal blower.
7. Trial on reciprocating air-compressor
8. Demonstration of hydraulic ram system

Note: Students are expected to complete any six experiments listed above satisfactorily

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Environmental Science

23ME2407	VEC	Environmental Science	2-0-0	2 Credits

Teaching Scheme	Examination Scheme
Lecture: 2 hr/week	CA-I: 25 Marks CA-II: 25 Marks

Pre-Requisites: NA

Course Outcomes: At the end of the course, students will be able to

CO1	Explain nature of environmental studies
CO2	Explain various natural resources and associated Problems
CO3	Summarize various ecosystems
CO4	Explain the importance of conservation of biodiversity and its importance in balancing the earth.
CO5	Recognize various causes of environmental pollution along with various protection acts in India to limit the pollution
CO6	Interpret the information based on field study and prepare a report.

Course Contents

Unit 1: Nature of Environmental studies: Definition, scope and importance, Multidisciplinary nature of environmental studies. Need for public awareness.	[3]
Unit 2: Natural Resources and Associated Problems **Forest resources:** Use and over-exploitation, deforestation, dams and their effects on forests and tribal people. **Water resources:** Use and over-utilization of surface and ground water, floods, conflicts over water. **Mineral resources:** Usage and exploitation. Environmental effects of extracting and using mineral resources. **Energy resources:** Growing energy needs, renewable and nonrenewable energy resources, use of alternate energy sources. Solar energy, Biomass energy, Nuclear energy. **Land resources:** land degradation, man induced landslides, soil erosion and desertification. Role of individuals in conservation of natural resources.	[5]
Unit 3: Ecosystems Concept of an ecosystem, types of ecosystem, structure and function of an ecosystem, producers, consumer and decomposers. Energy flow in the ecosystem, food chain, food web and ecological pyramids, ecological succession. Different types of ecosystem a) Forest ecosystem b)Grassland ecosystem c)Desert ecosystem d)Aquatic ecosystem	[4]
Unit 4: Biodiversity Introduction-Definition: genetic, species and ecosystem diversity, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, Western Ghats as a biodiversity region Hot spot of biodiversity. Threats to biodiversity, man and wildlife conflicts. Conservation of biodiversity. In-situ conservation and Ex-situ conservation.	[4]

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Unit 5: Environmental Pollution and Environmental Protection Definition: Causes, effects and control measures of various types of pollution. Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution, Concept of sustainable development : From Unsustainable to Sustainable development. Environmental Protection Act. Air (Prevention and Control of pollution) Act. Water (Prevention and Control of pollution) Act. Forest conservation Act. Wildlife Protection Act. Human Rights.	[4]
Unit 6: Field work Visit to a local area to document Environmental assets-River ,Forest ,Grassland Visit to local polluted site Study of common plants, insects, birds Study of ecosystem river, ponds etc	[4]

Text Books :

1. P. N. Wartikar & amp; J. N. Wartikar, A Text Book of Applied Mathematics (Vol I & II), Pune Vidyarthi Griha Prakashan, Pune.
2. 2. N. P. Bali, A Text Book of Engineering Mathematics, Laxmi Publications, New Delhi.

Reference Books:

1. C. R. Wylie & L. C. Barrett, Advanced Engineering Mathematics, McGraw Hill Publishing Company Ltd.
2. B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publications, New Delhi.
3. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
4. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
5. Peter O" Neil, A Text Book of Engineering Mathematics, Thomson Asia Pvt. Ltd., Singapore.

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Mini Project-III

23ME2408	CEP	Mini Project- III	0-0-2	01 Credit

Teaching Scheme	Examination Scheme
Practical: 2 hrs/week	CA-I: 25 Marks CA-II:25 Marks

Pre-Requisites: Mini Project, Mini Project II

About Hackathon

The project is a part of addressing societal and industrial needs. Hackathon is one of the platforms where students will solve real world challenges. This Course focuses on the selection of methods/engineering tools/analytical techniques for problem solving.

Through this course, students will gain the understanding of engineering basics and ideas, gain practical experience, have the opportunity to display their skills and learn about teamwork, financial management, communication skills and responsibility

Course Outcomes: At the end of the course, students will be able to:

CO1	Select the appropriate method for solving the problem
CO2	Make use of various engineering techniques and tools to give a solution
CO3	Justify the methods /tools used to develop the solution
CO4	Design / simulate the model/ project work
CO5	Describe the solution with help of a project report and presentation
CO6	Conclude the outcomes of project.

Course Contents:

Week 1: Survey Design-1 • Ensure case study group students have made necessary communication and done a preparatory visit. • Watch the lecture on survey design and study the notes. • Prepare a questionnaire and try it out with your group members as mock.	[2]
Week 2: Survey Design-2 • Review survey questionnaire prepared by case study groups. • Decide sampling strategy. • Prepare a detailed schedule for fieldwork	[2]
Week 3: Fieldwork • Data Collection: Collect quantitative data (e.g., statistics, usage metrics) and qualitative data (e.g., user stories, testimonials). • Use data collection tools like questionnaires, observation checklists, and digital analytics. • Ensure data accuracy and reliability through proper sampling and recording methods.	[2]

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Week 4: Trails and Experimentation-1 • Initial Setup and Configuration • Concept Validation • Feasibility Testing	[2]
Week 5: Trails and Experimentation-2 • Prototyping • Functionality Testing	[2]
Week 6: Trails and Experimentation-3 • Bug Identification and Fixing • Integration Testing • Security Testing • 75% Presentation has to be conducted by mentor/guide based on above activity.	[2]
Week 7 : Results • Coordinator has to check and verify below points in term of result: • Functional Performance • Accuracy and Precision • Efficiency • Safety	[2]
Week 8: Validation • Coordinator has to check and verify below points in term of validation: • Testing and Verification • Compliance with Standards	[2]
Week 9: Integration Testing • Validate that the hardware integrates seamlessly with other systems or components as intended • Perform compatibility tests with software, other hardware, and network systems.	[2]
Week 10: Documentation and Reporting • Maintain comprehensive documentation of design, development, testing, and validation processes • Provide detailed reports on test results, issues found, and corrective actions taken.	[2]
Week 11: Final Presentation • 100% Presentation has to be conducted by mentor/guide based on above activity. • Prototype/Final Software solution is mandatory at the time of final presentation along with report	[2]
Week 12: Exhibition • Mini project exhibition will be schedule with interdepartmental evaluation.	[2]

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Constitution of India

23ME2409	MC	Constitution of India	2-0-0	Audit

Teaching Scheme	Examination Scheme
Lecture: 2 hrs/week	CA-I: 25 Marks CA-II: 25 Marks

Pre-Requisites: Nil

Course Outcomes: At the end of the course, students will be able to:

CO1	Define the meaning and features of Indian constitution and scheme of fundamental duties.
CO2	Illustrate federal structure of power, directive principles of state policy and emergency provisions in Constitution of India
CO3	Illustrate Amendment of the Constitutional Powers and emergency provisions in Constitution of India
CO4	Illustrate the local self-government and rights to certain freedom under article 19 and 21.

Course Contents:

Unit 1: Introduction to constitution Meaning of the constitution law and constitutionalism, Historical perspective of the Constitution of India, Salient features and characteristics of the Constitution of India, Scheme of the fundamental rights , The scheme of the Fundamental Duties and its legal status	[6]
Unit 2: Organization structures and their functions The Directive Principles of State Policy – Its importance and implementation , Federal structure and distribution of legislative and financial powers between the Union and the States , Parliamentary Form of Government in India – The constitution powers and status of the President of India	[6]
Unit 3: Constitutional Powers Amendment of the Constitutional Powers and Procedure , The historical perspectives of the constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency	[6]
Unit 4: Constitutional Schemes in India Local Self Government – Constitutional Scheme in India , Scheme of the Fundamental Right to Equality, Scheme of the Fundamental Right to certain Freedom under Article 19, Scope of the Right to Life and Personal Liberty under Article 21	[6]

Text Books:

1. Constitution of India Published by Government of India Ministry of Law and Justice (Legislative Department), 2020
2. Textbook on The Constitution of India by S R Bhansali Constitution of India by Bakshi P M,January 2014

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Aptitude Skill-II (Numerical Ability)

23HSSM03	VEC	Aptitude Skill- II	1-0-0	1 Credit

Teaching Scheme	**Examination Scheme**
Lecture: 1hr Tutorial: NA Practical: NA	CA-I: 25 Marks CA-II:25 Marks

Pre-Requisites: English Communication

Course Outcomes: At the end of the course, students will be able to:

CO1	Make use of multiplications, squares, square roots, cubes and cube roots to solve aptitude problems
CO2	Solve questions based on Number system
CO3	Solve questions based on percentage, average, ratio, proportion, Speed, Time and Distance
CO4	Solve questions based on Profit & Loss and mensurations.

Course Contents:

Unit 1: Speed Math Techniques Multiplication, Squares, Square roots, Cubes, Cube roots	[3]
Unit 2: Number System Types of Number System, Last Digit Method, BODMAS Calculation, HCF and LCM, Progressions	[3]
Unit 3: Basic Aptitude Percentage, Average, Ratio and Proportion, Fraction, Partnership **Speed- Time- Distance** Speed, Time, and Distance, Trains, Boats, Streams, Races	[3]
Unit 4: Business Aptitude Profit & Loss, Simple Interest, Compound Interest **Geometry and Venn Diagram** 2D and 3D Mensuration, Venn diagram	[3]

Text Books :

1. Arun Shrama - Quantitative aptitude for CAT.
2. RS Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S. Chand Publisher; 2016 edition

Reference Books:

1. Fast Track Objective Arithmetic Paperback, by Rajesh Verma – 2018
2. Teach Yourself Quantitative Aptitude, Arun Sharma
3. The Pearson Guide To Quantitative Aptitude For Competitive Examination by Dinesh Khattar

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Language Skill- II

23HSSM04	VEC	Language Skill- II	0-0-2	1 Credit

Teaching Scheme	Examination Scheme
Lecture: NA Tutorial: NA Practical: 2 hrs/week	CA-I: 25 Marks CA-II:25 Marks

Pre-Requisites: Language Skill 1

Course Outcomes: At the end of the course, students will be able to

CO1	Develop programs using Functions.
CO2	Make use of Structures & Union to develop programs in C language
CO3	Make use of Pointers to develop programs in C language
CO4	Develop programs to perform various operations on files using File Handling.

Experiment No.	Name of Experiment
1	Develop programs on using different built-in functions.
2	Develop programs on using function without argument and without return category.
3.	Develop programs on using function with argument and without return category.
4	Develop programs on using function without argument and with return category.
5	Develop programs on using function with argument and with return category.
6	Develop programs using more than one used defined functions.
7	Develop programs on recursion.
8	Develop programs on Structure using various entities and size of structure.
9	Develop programs on array of structure.
10	Develop programs on structures and functions and compare structure and union.
11	Develop programs to display different data type of data and their addresses using pointer
12	Develop programs on pointer to array, pointer to structure, pointer to functions and pointer expressions.
13	Develop program to read, write and append data from a file.

Text Books :

1. C Programming Absolute Beginner's Guide, Que Publishing; 3rd edition (22 August 2013)
2. C Programming Language 2nd Edition, Peasrson Publication

Reference Books:

1. Programming in C Practical Approach by Ajay Mittal, Pearson
2. Let Us C, By Yashwat Kanetkar

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Multidisciplinary Minor Course: Operation Research and Management

23MEMDA2	MDM	Operation Research and Management	3-0-0	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs/week	CA-I:10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Fundamentals of Project Management

Course Outcomes: At the end of the course, students will be able to:

CO1	Formulate and obtain the optimal solution for Linear Programming problems..
CO2	Determine the optimal solution for Assignment problems.
CO3	Determine the optimal solution for Transportation problems
CO4	Plan, Schedule and Control the given project by making the use of Network model
CO5	Explain fundamentals of Operations Management.
CO6	Define the primary activities of the value chain and to know the different support activities within the value chain.

Course Contents:

Unit1: Introduction to OR and Linear Programming Problems Introduction: History and development of OR, Applications, modeling in OR, OR models and their applications. Linear Programming Model: Terms used in Linear Programming, Formulation of problem, Graphical solution, Simplex Procedure for maximization and minimization.	[6]
Unit 2: Assignment Model Methods to solve balanced and unbalanced Assignment problems, Maximization problems, Assignment with restrictions, Traveling salesman problem.	[6]
Unit 3: Transportation Model Mathematical formulation, methods to obtain initial basic feasible Solution (IBFS), NWCR, Least Cost and VAM, Balanced Transportation problem,Conditions for testing optimality-MODI method	[6]
Unit 4: Network Model Objectives of CPM and PERT, Terms used in Network, Rules for network construction, critical path, Forward and backward path, Floats and their significance, PERT – Estimation of activity time, Construction of networks, Probability of completing projects by given date, Crashing the project duration and its relationship with cost of project, Difference between CPM and PERT	[6]
Unit 5: Introduction to Operation Management- Introduction to Operations Management - Process Planning - Plant Location - Plant Lay out	[6]

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Concept of Operation Management, Functions and challenges of operation Management, Functional areas of operational management, Scope and Significance of management, Levels of management, Management environment.	
Unit 6: Operations and the value Chain Introduction of Supply chain management, objectives, importance, Components, process and structure of supply chain, Performance of supply chain, supply chain drivers	[6]

Text Books:

1. "Operations Management, Theory and Practice", B. Mahadevan, Pearson India Publication
2. "Industrial Management", Dr. D. K.Bhattacharya.Vikas Publishing
3. "Industrial management and Operation Research", NandkumarHukkeri
4. " Operation Research, Theory and Applications", S.D.Sharma
5. "Operations Research", P. K. Gupta, D. S. Hira S. Chand and Company Ltd., New Delhi,1996.
6. "Quantitative Techniques for managerial Decisions", L. C. Jhamb, Vol. I and II, Everest Publishing House, Pune, 1994.
7. "Operation Research an Introduction", Hamdy A. Taha, Pearson, 9th Edition.
8. "Operations Research", J. K. Sharma, McMillan India Publication New Delhi,5th Edition.
9. "Production Operations Management", L.C. Jhamb, Everest Publishing House, 2009
10. "Production and Operations Management " , S.N. Chary, Tata McGraw Hill Ltd. 2004

Reference Books:

1. "Introduction to Operation Research", Paneer-Selvam, Prentice Hall of India publication, 2nd Edition.
2. "Operation Research", Pradeep J. Jha, Tata McGraw Hill Publication.
3. "Operation Research", S.R. Yadav, A.S. Mallik, Oxford University Press,(2014).
4. "Operation Research – Principle and Applications", Shriniwasan, Prentice Hall of India Publication, 2nd Edition.
5. "Operations Research–An Introduction", H. Taha, Maxwell Macmillan, New York.
6. "Production and Operations Management" Everett Adams & Ronald Ebert, Prentice Hall, 1992
7. "Production and Operations Management " Martin Kenneth Starr , Thomson Learning, 1993

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Multidisciplinary Minor Course: Air Craft Propulsion

23MEMDB2	MDM	Air Craft Propulsion	3-0-0	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Thermodynamics, Fluid mechanics, Heat transfer, Gas turbine

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain the basic principles of aircraft propulsion systems.
CO2	Recall the key components and functions of different types of aircraft engines (e.g., turbojets, turbofans, piston engines).
CO3	Explain the working principles of various propulsion systems used in aviation.
CO4	Apply thermodynamic principles to analyze and compare different rocket engine cycles.
CO5	Explain different Engine Control and Instrumentation
CO6	Explain Environmental Impact of Aircraft Propulsion

Course Contents:

Unit 1: Introduction to Aircraft Propulsion Overview of propulsion systems in aviation; Laws of thermodynamics as applied to propulsion; Thermodynamic cycles (e.g., Brayton cycle, Otto cycle) used in propulsion systems	[6]
Unit 2: Gas Turbine Engines Gas turbine engine components and their functions (compressors, combustion chambers, turbines, etc.); Jet propulsion principles and performance parameters (thrust, specific fuel consumption, etc.); Analysis of ideal and actual cycles in gas turbines.	[6]
Unit 3: Propeller Systems Propeller aerodynamics and design; Performance characteristics of propeller-driven aircraft; Propulsion efficiency and propeller selection; Airfoil selection and blade geometry considerations; Propeller geometry and terminology.	[6]
Unit 4: Rocket Propulsion Fundamentals of rocket propulsion; Rocket engine types (liquid-propellant rockets, solid-propellant rockets, hybrid rockets); Rocket performance parameters and equations; Future trends and developments in rocket propulsion; Types of rockets and their applications	[6]
Unit 5: Engine Control and Instrumentation Engine control systems and components; Monitoring and instrumentation techniques for aircraft propulsion systems; Sensors and measurement devices used in monitoring engine	[6]

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parameters (temperature, pressure, speed, etc.)	
Unit 6: Environmental Impact of Aircraft Propulsion Types of emissions produced by aircraft engines (NOx, CO_2, unburned hydrocarbons, particulate matter, etc.); Overview of emission reduction technologies (catalytic converters, lean-burn combustion, etc.); Role of alternative fuels in reducing emissions (biofuels, hydrogen, etc.); Concepts of sustainable aviation and its importance.	[6]
Text Books: 1. "Introduction to Aircraft Gas Turbine Engines" by B. H. K. Narayana 2. "Principles of Jet Propulsion and Gas Turbines" by D. P. Mishra 3. "Gas Turbine Theory" by G.F.C. Rogers and H. I. H. Saravanamuttoo	
Reference Books: 1. "Elements of Propulsion: Gas Turbines and Rockets" by J.D. Mattingly and H. von Ohain 2. "Aircraft Propulsion" by Saeed Farokhi 3. "Aircraft Gas Turbine Engine Technology" by Irwin E. Treager	

SHARAD INSTITUTE OF TECHNOLOGY COLLEGE OF ENGINEERING, YADRAV DEPT. OF MECHANICAL ENGINEERING

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Multidisciplinary Minor Course: Design of Mechatronics Systems

23MEMDC2	MDM	Design of Mechatronics Systems	3-0-0	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: NA

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain drives and actuators
CO2	Explain Signal Conditioning processes
CO3	Illustrate Digital circuits, Microprocessor and Microcontroller
CO4	Design of Electro-Pneumatic Logic Control Circuits.
CO5	Make use of Programmable Logic Controllers (PLC)
CO6	Design of case studies of Mechatronics systems.

Course Contents:

Unit 1: Drives and Actuators: Hydraulic and Pneumatic drives, Electrical Actuators such as servo motor and Stepper motor, Drive circuits, open and closed loop control; Embedded Systems: Hardware Structure, Software Design and Communication, Programmable Logic Devices, Automatic Control and Real Time Control Systems, applications of Arduino and Raspberry, Pi microcontroller, Applications of Microcontroller.	[6]
Unit 2: Signal Conditioning: Signal conditioning process, Operational amplifier (inverting amplifier, non-inverting amplifier, and summing, integrating amplifier), protection, filtering, and data acquisition, multiplexer, analog to digital converter (ADC), digital to analog converter (DAC). 555 timer, sample and hold, analog to digital and digital to analog converters, multiplexing. Interfacing input output ports, serial and parallel interfacing requirements, buffers, handshaking, polling and interrupts	[6]
Unit 3: Digital circuits, Microprocessor and Microcontroller: 8085 microprocessor: architecture, various types of registers and their functions in 8085μP, Instruction sets, interfacing, applications. 8081 microcontroller: architecture, Instruction sets, various pins and their functions interfacing, applications. Digital circuits: Digital logic, number systems, logic gates, Boolean algebra, application of logic gates, sequential logic, flip flop, D flip flop, JK flip flop, Master slave flip flop	[6]
Unit 4: Design and Operation of Electro-Pneumatic Logic Control Circuits: Electro-pneumatic systems, solenoid valves, different sensors, factory automation sensors, electrical sensors, process automation sensors and their interfaces as per application criteria, Electro pneumatic systems using relay logic circuits ,Direct control and Indirect control, Logic operations-OR circuit, AND circuit, Muti-track gravity Feed Magazine, Sorting devices,	[6]

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Circuit protection against high pressure and low pressure, Sequencing circuit /Cascade circuit-,Electro-hydraulic circuit Double acting cylinder with reed switch.	
Unit 5: Programmable Logic Controllers (PLC) Introduction, Definition, PLC system and components of PLC Input output module, PLC advantages and disadvantages. Ladder diagram and PLC programming fundamentals: Basic components and other symbols, Fundamentals of ladder diagram, Light control example, Internal relays, Disagreement circuit, Majority circuit, Holding (sealed or latches) contacts, Always ON always OFF contacts, Fail safe circuits, PLC timer counters functions and its industrial applications	[6]
Unit 6: Mechatronics Design Systems Traditional Vs Mechatronics Design, Case studies of Mechatronics systems designs, like piece counting system, Pick and place manipulator, Part loading / unloading system, Automatic tool and pallet changers etc. Fault finding and troubleshooting	[6]

Text Books:

1. Antony Espossito, "Fluid power with Applications ", Pearson, Sixth Edition., 2003.
2. W. Bolton, "Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering" - PrenticeHall - 2013 - 5 th Edition Singh, Shio Kumar.
3. Industrial Instrumentation & Control, Tata McGraw-Hill Education, 2010
4. Mikell P Groover, "Automation Production Systems and Computer- Integrated
5. Manufacturing"Pearson Education, New Delhi, 2001

Reference Books:

1. Mechatronics – W. Bolton, Pearson education
2. Mechatronics – Mahalik, TATA McGraw Hill
3. Mikell P Groover, "Industrial Robots – Technology Programmes and Applications" , McGraw Hill
4. New York, USA-2000
5. Mechatronics- Appu Kuttam, Oxford publications

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