Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and Technology, Baramati.

(An Autonomous Institute)

Faculty of Science and Technology

Board of Studies

Mechanical Engineering

Syllabus

Second Year B. Tech.
Mechanical Engineering
(Pattern 2024)
(w.e.f. AY: 2025-26)

Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and Technology
Board of Studies: Mechanical Engineering
Syllabus: Second Year (B. Tech.) Mechanical Engineering
2024 Pattern w.e.f. AY: 2025-2026

SEMESTER-III

Course Type	Course Code	Course Name	Teaching Scheme			Examination Scheme and Marks							Credits			
			TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
BSC	BS24204TH	Advanced Mathematics for Mechanical Engineering	3	-	-	10	30	60	-	-	-	100	3	-	-	3
PCC	ME24201TH	Engineering Metallurgy	3	-	-	10	30	60	-	-	-	100	3	-	-	4
PCC	ME24201PR	Engineering Metallurgy		2	-	-	-	-	-	-	30	30		1	-	
PCC	ME24202TH	Applied Thermodynamics	3	-	-	10	30	60	-	-	-	100	3	-	-	4
PCC	ME24202PR	Applied Thermodynamics	-	2	-	-	-	-	-	-	30	30	-	1	-	
PCC	ME24203TH	Mechanics of Material	3	-	-	10	30	60	-	-	-	100	3	-	-	4
PCC	ME24203PR	Mechanics of Material	-	2	-	-	-	-	-	30	-	30	-	1	-	
MDM	MD240XXTH	Multidisciplinary Minor	2	-	-	10	-	60	-	-	-	70	2	-	-	3
MDM	MD240XXPR	Multidisciplinary Minor	-	2	-	-	-	-	30	-	-	30	-	1	-	
AEC	HS24201TH	Public Speaking and Aptitude	1	-	-	10	-	-	30	-	-	40	1	-	-	2
AEC	HS24201PR	Public Speaking and Aptitude	-	2	-	-	-	-	-	-	30	30	-	1	-	
CEPFP	ME24204PR	Community Engagement Project	-	4	-	10	-	-	30	-	30	70	-	2	-	2
	Total		15	14	-	70	120	300	90	30	120	730	15	7	-	22

MDM Basket

AI24052	**Fundamentals of Programming Language**	IT24051	Cyber security
ET24053	Internet of Things	AI24051	Data Processing and Analysis

Academic Coordinator | Head of Department | Dean Academics | Principal

Head
Department of Mechanical Engineering
VPKBIET Baramati - 413133

Principal
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Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and Technology
Board of Studies: Mechanical Engineering
Syllabus: Second Year (B. Tech.) Mechanical Engineering
2024 Pattern w.e.f. AY: 2025-2026

SEMESTER-IV

Course Type	Course Code	Course Name	Teaching Scheme			Examination Scheme and Marks							Credits			
			TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
PCC	ME24211TH	Manufacturing Practices	3	-	-	10	30	60	-	-	-	100	3	-	-	4
PCC	ME24211PR	Manufacturing Practices	-	2	-	-	-	-	-	30	-	30	-	1	-	
PCC	ME24212TH	Theory of Machines	3	-	-	10	30	60	-	-	-	100	3	-	-	4
PCC	ME24212PR	Theory of Machines	-	2	-	-	-	-	-	-	30	30	-	1	-	
PCC	ME24213TH	Fluid Mechanics	2	-	-	10	-	60	-	-	-	70	2	-	-	3
PCC	ME24213PR	Fluid Mechanics	-	2	-	-	-	-	-	-	30	30	-	1	-	
MDM	MD240XXTH	Multidisciplinary Minor	3	-	-	10	30	60	-	-	-	100	3	-	-	4
MDM	MD240XXPR	Multidisciplinary Minor	-	2	-	-	-	-	30	-	-	30	-	1	-	
OE	OE240XXTH	Open Elective	2	-	-	10	-	60	-	-	-	70	2	-	-	2
VEC	HS24211TH	Environmental Studies	2	-	-	10	-	60	-	-	-	70	2	-	-	2
VSEC	ME24214TH	Computer Aided Geometric Modeling	1	-	-	10	-	-	30	-	-	40	1	-	-	2
VSEC	ME24214PR	Computer Aided Geometric Modeling	-	2	-	-	-	-	-	30	-	30	-	1	-	
	Total		16	10	-	70	90	360	60	60	60	700	16	5	-	21

MDM Basket

ET24052	Drone Technology	CO24052	Object Oriented Programming
BS24053	**Linear Algebra and Statistics**	ME24051	3D Printing

Open Elective Basket

OE24002	**Accounting and Finance**	OE24001	Digital Marketing

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BS24204- ADVANCED MATHEMATICS FOR MECHANICAL ENGINEERING		
Teaching Scheme:	**Credits:03**	**Examination Scheme:**
TH: 03 Hrs/Week	**Theory : 03**	**CAA: - 10 Marks**
		In-Semester Exam: 30 Marks
		End-Semester Exam: 60 Marks

Prerequisites: Differential & Integral calculus, Differential equations of the first order and first degree, Fourier series, Basics of Statistics: Collection, classification & representation of data, Vector algebra.

Objectives:

1. To familiarize the students with concepts and techniques in Ordinary & Partial differential equations, Statistics, Probability, Numerical Methods, Vector Calculus, and Applications of Partial Differential Equations.
2. The aim is to equip them with the techniques to understand advanced-level mathematics and its applications to enhance analytical thinking ability useful in their discipline.

Course Outcomes:

The students will be able to learn:

CO1: Solve higher-order linear differential equations using appropriate techniques to model and analyze mass-spring systems.

CO2: Analyze data using the concepts of dispersion, Skewness, and kurtosis.

CO3: Classify various probability distributions and apply them to analyze and interpret experimental data useful in their field.

CO4: Understand various numerical methods and apply them to solve systems of equations, and differential equations.

CO5: Understand the concepts of vector differentiation and integration, and apply them in their field.

CO6: Solve partial differential equations such as wave equations, heat equations, Laplace equation and its applications.

Course Contents

Unit-1: Linear Differential Equations (LDE) and Applications	**[07 Hrs.]**
Introduction, Solution of LDE, General method, short-cut method, Method of variation of parameters, Cauchy's, and Legendre's DE. Modeling of problems on mass-spring systems.	
Unit-2: Statistics	**[07 Hrs.]**
Measures of Dispersion, Moments, Skewness, and Kurtosis. Correlation and Regression Analysis: Least square method, Curve fitting: fitting of straight lines, and parabola.	
Unit-3: Probability and Probability Distributions	**[07 Hrs.]**
Probability, Theorems on probability, Random variables, Probability Mass function, Probability Density function, Mathematical Expectation. Probability distributions: Binomial, Poisson, and Normal, Test of hypothesis: Chi-square test.	
Unit-4: Numerical Methods	**[07 Hrs.]**
Roots of Equation: Newton-Raphson Method. **Solution of simultaneous equations:** Gauss Elimination Method with Partial pivoting, Gauss-Seidel Method. **Solutions of ordinary differential equations:** Euler's, Modified Euler's, Runge-Kutta 4th order methods.	
Unit-5: Vector Calculus	**[07 Hrs.]**
Vector differentiation, Directional derivative, Solenoidal, and Irrotational fields. Line, Surface, and Volume integrals, work done, Green's Lemma, Gauss's Divergence theorem, and Stoke's theorem.	
Unit-6: Applications of Partial Differential Equations (PDE)	**[07 Hrs.]**
Basic concepts, modeling of Vibrating String, Wave equation, One and two-dimensional Heat flow equations, Laplace Equation, Method of Separation of variables, use of Fourier series. Introduction to Fourier Transform (FT) and Laplace Transform.	

Text Books:

1. Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill).
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).
3. Numerical Methods in Engineering and Science by B.S. Grewal (Khanna Publication).

Reference Books:

1. Advanced Engineering Mathematics, 10e, by Erwin Kreyszig (Wiley India).

2. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education).

3. Advanced Engineering Mathematics, 7e, by Peter V. O'Neil (Cengage Learning).

4. Differential Equations, 3e by S. L. Ross (Wiley India).

5. Introduction to Probability and Statistics for Engineers and Scientists, 5e, by Sheldon M. Ross (Elsevier Academic Press).

6. Partial Differential Equations for Scientists and Engineers by S. J. Farlow (Dover Publications, 1993).

Guidelines for Activity (Any Two)

1. Test/ Quiz
2. Seminar
3. Presentation (PPT/Poster/Models)
4. Statistical Projects. (Data Analysis)
5. NPTEL Course/ MATLAB Course
6. Assignments.

ME24201- ENGINEERING METALLURGY		
Teaching Scheme:	**Credits:04**	**Examination Scheme:**
TH: 03 Hrs/Week	**Theory : 03** **Practical : 01**	**CAA: 10 Marks** **In-Semester Exam: 30 Marks** **End-Semester Exam: 60 Marks**
PR: 02 Hrs/Week		**OR Exam: 30 Marks**

Prerequisites:

Higher Secondary Science Courses, Engineering Physics, Engineering Chemistry.

Objectives:

1. To impart fundamental knowledge of material science and engineering.
2. To establish significance of structure property relationship.
3. To explain various characterization techniques.
4. To indicate the importance of heat treatment on structure and properties of materials.
5. To explain the material selection process.

Course Outcomes:

On completion of the course, learner will be able to

CO1. COMPARE crystal structures and ASSESS different lattice parameters.

CO2. CORRELATE crystal structures and imperfections in crystals with mechanical behaviour of materials.

CO3. DIFFERENTIATE and DETERMINE mechanical properties using destructive and nondestructive testing of materials.

CO4. IDENTIFY & ESTIMATE different parameters of the system viz., phases, variables, component, grains, grain boundary, and degree of freedom. etc.

CO5. ANALYSE effect of alloying element & heat treatment on properties of ferrous & nonferrous alloy.

CO6. SELECT appropriate materials for various applications.

Course Contents

Unit-1: Crystal Structures and Deformation of Materials	**[07 Hrs.]**
Crystal Structures: Study of Crystal structures BCC, FCC, HCP and lattice parameters & properties, Crystal imperfections, and Diffusion Mechanisms **Material Properties:** Mechanical (Impact, hardness, etc.), Electrical, optical and Magnetic properties **Deformation of Materials:** Elastic deformation, Plastic deformation: slip, twinning, work hardening, recovery, recrystallization and grain growth, Fracture: Types of fractures (brittle, ductile), Creep & Fatigue failures	
Unit-2: Material Testing and Characterization Techniques	**[06 Hrs.]**
Destructive Testing: Tensile Test, Impact test and Hardness test **Non-Destructive Testing:** Dye Penetrant Testing (DPT) Magnetic Particle Testing (MPT) Ultrasonic Testing (UT) Eddy Current Testing (ECT) Radiography Testing (RT) (Principle and Applications only) **Microscopic Techniques:** Sample Preparation and etching procedure, optical microscopy, Electronic microscopy - only SEM, TEM and X-ray diffraction (Principle and Applications only) **Macroscopy:** Sulphur printing, flow line observation, spark test	
Unit-3: Phase Diagrams and Iron-Carbon Diagram	**[08 Hrs.]**
Solid solutions: Introduction, Types, Humerothery rule for substitutional solid solutions **Solidification:** Nucleation & crystal growth, solidification of pure metals, solidification of alloys. **Phase Diagrams:** Cooling curves, types of phase diagrams, Gibbs phase rules **Iron-Carbon Diagram:** Iron-carbon equilibrium diagrams in detail with emphasis in the invariant reactions.	
Unit-4: Heat Treatments	**[07 Hrs.]**

Austenite transformation in steel: Time temperature transformation diagrams, continuous cooling transformation diagrams. Retained austenite and its effect Steps in Heat treatment and Cooling Medium

Heat Treatment Processes: Introduction, Annealing (Full annealing, Process annealing, Spheroidise annealing, isothermal annealing, stress relief annealing), Normalising, Hardening, Tempering, Austempering, Martempering, Sub-Zero Treatment, Hardenability

Surface Hardening: Classification, Flame hardening, Induction hardening, Carburising, Nitriding, Carbonitriding.

Unit-5: Ferrous Materials	**[08 Hrs.]**

Carbon Steel: Classification, types & their composition, properties and Industrial application

Alloy Steels: Classification of alloy steels & Effect of alloying elements, examples of alloy steels, (Stainless steel, Tool steel) sensitization of stainless steel.

Designation of carbon steel and alloy steels as per IS, AISI, SAE Standards

Cast Iron: Classification, types & their composition, properties and Industrial application of (White CI, Gray CI, SG CI, Malleable Cast and alloy Cast Iron). Microstructure and property relationship of various ferrous Materials

Unit-6: Non-Ferrous Materials	**[06 Hrs.]**

Classification of Non-Ferrous Metals: Study of Non-ferrous alloys with Designation, Composition, Microstructure.

Mechanical & other properties for Industrial Applications: Copper and its Alloys (Gilding Metal, Cartridge Brass, Muntz Metal, Tin Bronze, Beryllium Bronze), Aluminium and its Alloy (LM5, Duralumin, Y-Alloy, Hinduminum), Nickel and its Alloys (Invar, Inconel), Titanium and its Alloys (α Alloys, α-β Alloys), Cobalt and its Alloys (Stellite Alloys, Alnico), Bearing Alloys (Classification, lead based alloys, tin based alloys),

Composite Materials : Introduction: Definitions, Composites, Reinforcements and matrices, Types of reinforcements, Types of matrices, Types of composites, Carbon Fibre composites, Properties of composites in comparison with standard materials, Applications of metal, ceramic and polymer matrix composites.

Text Books:

1. Dr. V. D. Kodgire & S. V. Kodgire, “Material Science & Metallurgy For Engineers”, Everest Publication.
2. William D. Callister, “Materials Science and Engineering an Introduction”, Jr, John Wiley & Sons, Inc.

Reference Books:

1. A. K. Bhargava, C.P. Sharma, “Mechanical Behaviour & Testing of Materials”, P H I Learning Private Ltd.

2. Raghvan V., “Material Science & Engineering'', Prentice Hall of India, New Delhi.

3. Avner, S.H., “Introduction to Physical Metallurgy”, Tata McGraw-Hill.

4. Higgins R. A., “Engineering Metallurgy'', Viva books Pvt. Ltd.

5. George Ellwood Dieter, “Mechanical Metallurgy”, McGraw-Hill.

6. Smith, W.F, Hashemi, J., and Prakash, R., “Materials Science and Engineering in SI Units”, Tata McGraw Hill Education Pvt. Ltd.

Activity (Any Two)

1. Exploration of engineering Alloy (Name, composition, properties, microstructure, Heat treatment, Designation/ Specification & applications) - One student one Alloy or material

2. Examine aspects of component form material and manufacturing process point of view (Name, Material, Drawing, Manufacturing Process, properties, microstructure, Heat treatment, & specific applications) - For example spur gear, Needle etc. One student one component

3. Creep and Fatigue Test (Virtual Lab IIT Bombay)

4. Fluorescence Microscope (Virtual Lab IIT Bombay)

5. Industrial Visits to provide awareness and understanding of the course, Compulsory Industrial Visit must be arranged for the students. The Industrial Visit must be preferably to Material & Metallurgy related like Engineering Cluster, NDT Lab, and Nearby NABL lab or any manufacturing unit with material orientation Student must submit a properly documented Industrial Visit Report.

6. NPTEl Swayam course on Basics of Materials Engineering - Course

Guidelines for Lab /TW Assessment

Total 6 experiments from the following list must be performed.

1. Destructive testing - Hardness Testing Rockwell / Brinell Hardness test.

2. Vickers / Poldi Hardness Test

3. Impact Test for Steel, Aluminum, Brass and Copper (Charpy/Izod)

4. Non Destructive testing - Dye Penetrant Test/ Magnetic Particle test/ Ultrasonic Test

5. Steps for Specimen Preparation for microscopic examination & Demonstration of Optical Metallurgical microscope

6. Observation and Drawing of Microstructure of Steels, Cast Iron of various compositions

7. Observation and Drawing of Microstructure of Non Ferrous Metals of various compositions

8. Heat Treatment of steels based on relative hardness

9. Tensile test on Universal Testing Machine.

ME24202- APPLIED THERMODYNAMICS		
Teaching Scheme:	**Credits: 04**	**Examination Scheme:**
TH: 03 Hrs/Week	**Theory : 03** **Practical : 01**	**CAA: 10 Marks** **In-Semester Exam: 30 Marks** **End-Semester Exam: 60 Marks**
PR: 02 Hrs/Week		**Oral Exam: 30 Marks**

Prerequisites:

Engineering Mathematics - I and II, Engineering Physics, Engineering Chemistry, Basics of Thermodynamics

Objectives:

1. To understand the vapour power cycles and its performance.
2. To determine the performance of the boiler.
3. To understand working and construction IC Engine and air standard cyles .
4. To measure the performance of IC engines and emissions.
5. To understand the refrigeration cycles and Psychrometry.
6. To understand the working of a positive displacement compressor and determine the performance.

Course Outcomes:

On completion of the course, learner will be able to

CO1. DETERMINE the performance of vapour power cycle and DISCUSS the effect of steam properties on it

CO2. ANALYZE the performance of boilers.

CO3. DISCUSS basics of engine terminology, air standard, fuel air and actual cycles.

CO4. DETERMINE performance parameters of IC Engines and emission control.

CO5. CALCULATE COP of refrigeration system and EXPLAIN psychrometric processes.

CO6. DETERMINE performance of single and multi-stage reciprocating compressors and DISCUSS rotary positive displacement compressors

Course Contents

Unit-1: Steam Power Cycle	**[8 Hrs.]**
The steam formation in boiler, Review of steam properties and processes, Vapour Cycle: Rankine Cycle, Comparison of Carnot cycle and Rankine cycle, Introduction to Steam Power Plant, Efficiency of Rankine Cycle, Relative Efficiency, Effect of Varying operating parameters like Superheat, Boiler and Condenser Pressure on performance of Rankine cycle.	
Unit-2: Boiler Performance	**[6 Hrs.]**
Boiler Performance Calculations: Equivalent Evaporation, Boiler efficiency, Heat balance Sheet. Boiler Draught: Classification, Necessity of Draught, Natural draught, Determination of Height of chimney, Diameter of chimney, condition for maximum discharge, forced draught, Induced draught, Balanced draught, Draught losses.	
Unit-3: IC Engine Fundamentals	**[07 Hrs.]**
IC Engine: Components and Construction details, Terminology, Classification, Applications, Intake and exhaust system, Valves actuating mechanisms, Valve timing diagram. **Fuel, Air and Actual Cycle:** Air-standard cycles, fuel air cycles, and actual cycles, Effects of variables on performance, various losses, and Comparison of Air standard with Fuel and Actual cycle.	
Unit- 4: IC Engine Performance measurment and Emissions	**[07 Hrs.]**
Engine Testing: Engine Testing Procedure, Measurement of indicated power, Brake power, fuel consumption, Air Consumption, Measurement of friction power by Willan's Line Method and Morse Test, calculation of mean effective pressure, various efficiencies, specific fuel consumption, heat balance sheet of IC Engines and performance Characteristic curves. **Emission & Control:** Introduction to Indian Driving Cycle (IDC), European Driving Cycle (EDC), SI and CI Engines Emission and controlling methods, Methods to measure emission such as (Non Dispersive Infrared Red (NDIR), Flame Ionization Detector (FID), Chemiluminescent Analyzer, Smoke meter), Euro Norms and Bharat Stage Norms.	
Unit 5: Basics of Refrigeration and Psychrometry	**[07Hrs.]**

Refrigeration: Reversed Carnot Cycle, unit of refrigeration, Simple Vapour Compression Cycle (VCC), Refrigerating Effect, Compressor Power & COP. Simple Vapor Absorption Cycle (VAC), Comparison between VCC & VAC.

Psychrometry: Introduction, Psychrometry and Psychrometric Properties, Basic Terminologies & Psychrometric Relations, Psychrometric Processes, Psychrometric Chart.

Unit-6: Positive Displacement Compressor	**[7 Hrs.]**

Reciprocating Compressor: Applications of compressed air, single stage compressor (without clearance and with clearance volume), volumetric efficiency, isothermal efficiency, effect of clearance volume, free air delivery (FAD), Multi staging of compressor, optimum intermediate pressure, intercooler, after cooler.

Rotary Compressors: Roots blower, Vane type, Screw compressor and Scroll compressor.

Text Books:

1. Arora C. P., "Refrigeration and Air Conditioning", Tata McGraw-Hill, 4th Edition, ISBN- 978-9390385843, 2021.

2. V. Ganesan, "Internal Combustion Engines", Tata McGraw-Hill, 4th Edition ISBN: 1259006190 · 9781259006197, 2012.

3. M. L. Mathur and R.P. Sharma, "A course in Internal combustion engines", Dhanpat Rai Publication, ISBN: 100002973, 2017.

4. R. K. Rajput, "Engineering Thermodynamics", EVSS Thermo, Laxmi Publications ISBN: 9788131800584, 5th Edition 2016.

5. P. L Ballaney, "Thermal Engineering", Khanna Publishers, ISBN: 978-81-7409-031-7, 5th Edition 2010. Dhanpat Rai & Co., 2013.

Reference Books:

1. Dossat Ray J, "Principles of refrigeration, S.I. version", Pearson Publication, ISBN-13 : 978-0130272706, 5th edition, 2001.

2. Cengel and Boles, "Thermodynamics an Engineering Approach", McGraw Hill, ISBN-13: 978-9339221652, 8th Edition, 2017.

3 Heywood, John B., " Internal Combustion Engine Fundamentals", McGraw-Hill, ISBN: 9781260116106, 2018.

4. Colin R. Ferguson, Allan T. Kirkpatrick,, "Internal Combustion Engines: Applied Thermo sciences", 2nd Edition, ISBN 978-1-118-53331-4, Wiley, 2016 .

5. ASHRAE & ISHRAE handbook

6. Steam Tables/Data book

Web References (NPTEL)

1. **https://onlinecourses.nptel.ac.in/noc25_me77/preview**
2. **https://onlinecourses.nptel.ac.in/noc25_ae16/preview**
3. **https://onlinecourses.nptel.ac.in/noc25_me06/preview**
4. **https://onlinecourses.nptel.ac.in/noc25_me19/preview**
5. **https://nptel.ac.in/courses/112103262**

Course Activity (Minimum Two activities: Any one from 1-3 and one from 4-6)

1. NPTEL course certification on Applied Thermodynamics recommended by faculty
2. Case study on load calculation and selection of refrigeration system for applications like room cooling, computer lab cooling, car cooling, ice factory, domestic refrigerator etc
3. Development of software programs to analyze and predict the performance of any thermal system.
4. Presentation based recent literature study of Engines:(any one) on the following topics

   Homogeneous charge compression ignition (HCCI)/ Stratified charge engine/Variable valve timing (VVT)/Variable geometry turbocharger (VGT), etc.

5. Visit to cold storage/Ice factory for study of refrigeration systems.
6. Visit an automobile service station to see the IC Engine systems.

Guidelines for Lab /TW Assessment

Practical (Minimum 9 Practical must be performed)

1. Trial on boiler to determine boiler efficiency, equivalent evaporation and Energy Balance.
2. Morse Test on Petrol engine.
3. Trial on Diesel engine.
4. Trial on Petrol engine.
5. Trial on variable compression ratio engine.
6. Demonstration on Orsat Apparatus.
7. Trial on Vapour Compression System
8. Trial on Vapour Absorption System
9. Trial on Air-Conditioning Test Rig.
10. Trial on Positive Displacement Air Compressor
11. Energy and Exergy analysis of any thermal system.
12. Visit to any Industry having boilers to study the construction and working of boilers. Its presentation.

ME24203 - MECHANICS OF MATERIAL		
Teaching Scheme:	**Credits: 04**	**Examination Scheme:**
TH: 03 Hrs/Week	**Theory : 03** **Practical : 01**	**CAA: 10 Marks** **In-Semester Exam: 30 Marks** **End-Semester Exam: 60 Marks**
PR: 02 Hrs/Week		**PR Exam: 30 Marks**

Prerequisite Courses

Engineering Mathematics- I and II, Physics and Engineering Mechanics

Course Objectives

1. To acquire basic knowledge of stress, strain due to various types of loading.
2. To draw Shear Force and Bending Moment Diagram for transverse loading.
3. To determine Bending, Shear stress, Slope and Deflection on Beam.
4. To solve problems of Torsional shear stress for shaft and Buckling for the column.
5. To apply the concept of Principal Stresses and Theories of Failure.
6. To utilize the concepts of Solid Mechanics on application based combined mode of loading.

Course Outcomes

On completion of the course, learner will be able to

CO1. DEFINE various types of stresses and strain developed on determinate and indeterminate members.

CO2. DRAW Shear force and bending moment diagram for various types of transverse loading and support.

CO3. COMPUTE the bending stresses and shear stresses on a beam.

CO4. CALCULATE torsional shear stress in shaft and buckling on the column.

CO5. APPLY the concept of principal stresses and theories of failure to determine stresses on a 2-D element.

CO6. APPLY the concept of theories of failure to determine stresses on a 2-D element.

Course Contents

Unit I	**Simple stresses & strains**	**[07 Hr.]**
Simple Stress & Strain: Introduction to types of loads (Static, Dynamic & Impact Loading) and various types of stresses with applications, Hooke's law, Poisson's ratio, Modulus of Elasticity, Modulus of Rigidity, Bulk Modulus. Interrelation between elastic constants, Stress-strain diagram for ductile and brittle materials, factor of safety, Stresses and strains in determinate and indeterminate beam, homogeneous and composite bars under concentrated loads.		
Unit II	**Shear Force & Bending Moment Diagrams**	**[08 Hr.]**
SFD & BMD: Introduction to SFD, BMD with application, SFD & BMD for statically determinate beam due to concentrated load, uniformly distributed load, uniformly varying load, couple and combined loading, Relationship between rate of loading, shear force and bending moment, Concept of zero shear force, Maximum bending moment, point of contra-flexure.		
Unit III	**Bending stresses and Shearing Stresses**	**[08 Hr.]**
Bending Stress on a Beam: Introduction to bending stress on a beam with application, Theory of Simple bending, assumptions in pure bending, derivation of flexural formula, Moment of inertia of common cross section (Circular, Hollow circular, Rectangular, I & T), Bending stress distribution along the same cross-section Shear Stress on a Beam: Introduction to transverse shear stress on a beam with application, shear stress distribution diagram along the Circular, Hollow circular, Rectangular, I & T cross-section.		
Unit IV	**Torsion and Buckling**	**[08 Hr.]**
Torsion of circular shafts: Introduction to torsion on a shaft with application, Basic torsion formulae and assumption in torsion theory, Torsion in stepped and composite shafts, Torque transmission on strength and rigidity basis, Torsional Resilience Buckling of columns: Introduction to buckling of column with its application, Different column conditions and critical, safe load determination by Euler's theory. Limitations of Euler's Theory.		
Unit V	**Principal Stresses**	**[07 Hrs.]**

Principal Stresses: Introduction to principal stresses with application, Transformation of Plane Stress, Principal Stresses and planes (Analytical method and Mohr's Circle), Stresses due to combined Normal and Shear stresses.	
Unit VI Theories of Elastic failure	**[07 Hr.]**
Introduction to theories of failure with application, Maximum principal stress theory, Maximum shear stress theory, Maximum distortion energy theory, Maximum principal strain theory, Maximum strain energy theory.	

Text Books:

1. R. K. Bansal, "Strength of Materials", Laxmi Publication
2. S. Ramamurtham, "Strength of material", Dhanpat Rai Publication
3. S.S. Rattan, "Strength of Material", Tata McGraw Hill Publication Co. Ltd.
4. B.K. Sarkar, "Strength of Material", McGraw Hill New Delhi
5. Singer and Pytel, "Strength of materials", Harper and row Publication

Reference Books:

1. Egor. P. Popov, "Introduction to Mechanics of Solids", Prentice Hall Publication
2. G. H. Ryder, "Strength of Materials", Macmillan Publication
3. Beer and Johnston, "Strength of materials", CBS Publication
4. James M. Gere, "Mechanics of Materials", CL Engineering

Guidelines for Activities

The student shall complete the following activity

Self-learning Study Assignments and Presentations.

Following topics will be distributed among the group of 3-5 Students and groups need to present and also submit the slides/poster on TW file.

a. Experimental stress analysis, Strain Gauges rosette with case study.
b. Residual stresses and Fatigue life with case study.
c. Effect of heat treatment on the mechanical properties of a metal with case study.
d. Mechanical properties of materials, Stresses and Design of components with case study.
e. Failure Mode Analysis and Stresses with case study.

Guidelines for Laboratory Conduction

The Termwork shall consist of completion of Practicals, Practical examination will be conducted on the virtual lab.

Practical (Any 6 experiments out of experiment no 1 to 8 from the following list whereas experiment no. 9 is mandatory. Minimum One experiment must be performed on IoT platform-Virtual Lab):

1. Tension test for Ductile material on Universal Testing Machine.
2. Tension test for Brittle material on Universal Testing Machine.
3. Compression test for Brittle material on Universal Testing Machine.
4. Shear test of ductile material on Universal Testing Machine.
5. Measurement of stresses and strains using strain gauges.
6. Experimental verification of flexural formula in bending for cantilever, Simple supported beam.
7. Experimental verification of deflection of beam formula for simply supported beam
8. Experimental verification of torsion formula for circular bar using V Lab
9. Verification of results of any one from experiments no 1-8 using any FEA software tools.

AI24052: Fundamentals of Programming Language		
Teaching Scheme:	**Credits: 03**	**Examination Scheme:**
TH: 02 Hrs/Week	**Theory : 02**	**CAA: 10 Marks**
		End-Semester Exam: 60 Marks
PR: 02 Hrs/Week	**Practical : 01**	**Term-Work: 30 Marks**

Prerequisites: Basic Knowledge of Computers.

Course Objectives:

1. Learn the structural components of a C Program.
2. Develop Problem-Solving Skills Using C.
3. Learn data structures like arrays and structures to obtain solutions to solve the problems.
4. Learn concepts of modular programming to design the solutions to the problems

Course Outcomes (COs): The students will be able to

CO1. Develop C programs utilizing variables, operators and expressions effectively

CO2. Implement C programs using decision-making constructs, and looping mechanisms to solve computational problems efficiently.

CO3. Utilize arrays, strings, and structures in C programming to develop efficient and structured solutions.

CO4. Apply modular programming using function.

Course Contents

Unit I Introduction To C Programming	**[06 Hr.]**
Overview of C: History and importance of C, Structure of C program, executing a C program, Algorithms and flowcharts **Constants, Variable and Data Types:** Keywords and Identifiers, Constants, Variables, Data types, Declaration of variables, Assigning values to variables, Defining symbolic constants. **Input and Output Operations:** Input output statements, Formatted input, Formatted output. **Operators and Expressions:** Introduction, arithmetic, Relational, Logical, Assignment, Increment and Decrement and Bitwise operators, Arithmetic expressions, Evaluation of expressions, Precedence and Associativity of operators, Type conversions in expressions	
Unit II Control Structures	**[06 Hr.]**
Decision Making and Branching: Introduction, Decision making with IF statement, Simple IF statement, If-Else statement, Nested if-else statements, The Switch statement, The Conditional operator, The goto statement. **Decision Making and Looping:** Introduction, The for statement, The while Statement, The do-while statement, nested loops, break and continue statements	
Unit III Array And Structure	**[06 Hr.]**
Characteristics of an array, One dimension and two dimensional arrays, concept of multi-dimensional arrays. Array declaration and Initialization. Operations on Arrays. Character and String input/output and String related operations. Introduction and Features of Structures, Declaration and Initialization of Structures, array of structures.	
Unit IV Functions	**[06 Hr.]**
Concept and need of functions. **Library functions:** Math functions, String handling functions, **User defined functions** - function definition, functions declaration, function call, scope of variables - local variables, global variables. **Function parameters**: Parameter passing- call by value & call by reference.	

Reference Books:

1. Kernighan B.W and Dennis M. Ritchie, "The C Programming Language", 2nd Edition, 2015, Pearson Education India, ISBN: 978-93-3254-944-9.
2. Byron S. Gottfried," Schaum's outline of theory and problems of programming with C" 2nd Edition, McGRAW -HILL , ISBN 0-07-024035-3
3. Pradip Dey, Manas Ghosh, "Programming in C", 2nd Edition, 2018, Oxford University Press, ISBN: 978-01-9949-147-6.
4. Yashavant P. Kanetkar, "Let Us C", 16th Edition, 2019, BPB Publications, ISBN: 978-93-8728-449-4.
5. Jacqueline A Jones and Keith Harrow, "Problem Solving with C", Pearson Education. ISBN: 978-93-325-3800-9.

References :

- http://www.studytonight.com/c/overview-of-c.php
- https://www.tutorialspoint.com/cprogramming

MOOCs Courses link:

- http://nptel.ac.in/courses/106105085/2
- http://nptel.ac.in/courses/106104074/1
- https://nptel.ac.in/courses/106/105/106105171
- https://nptel.ac.in/courses/106/106/106106212/

Guidelines for Term Work Assessment :

Term work assessment will be based on overall performance of Laboratory assignments performed by a student. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, efficient codes, and punctuality.

Guidelines for Term Work submission:

Problem statements will be formed based on assignments and performance will be evaluated

by Internal and External Examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student‘s understanding of the fundamentals, effective and efficient implementation. All assignments are compulsory.

Guidelines for Laboratory Conduction :

Operating System recommended :- 64-bit Open source Linux or its derivative

Programming tools recommended: - C, Visual Studio Code

Lab Assignments

1. Write a program that takes a student's marks as input and assigns a grade based on the following criteria:
   Grade: Distinction If per>=75
   Grade: A If per>=60 and Per<75
   Grade: B If per>=55 and Per<60
   Grade: Pass >=40 and Per<55
   Grade: Fail if per<40
2. Write C Program to print following patterns using loops.

```
    *
   * * *
  * * * * *
 * * * * * * *
```

3. Write a program to check whether the number is a prime number or not.
4. Write C program to find the largest and smallest element from an array.
5. Write C program to perform addition, transpose and multiplication of two 3X3 matrices using Two Dimensional Array.
6. Create a structure called "Student" with members name, age, and total marks. Write a C program to input data for five students and display the information.
7. Write C program to perform following operations without using standard string functions.
   i) Calculate Length of given string
   ii) Print string in the reverse order.
   iii) Copy one string to other
   iv) Concatenation
8. Write a function to find the factorial of the number.
9. Write a function to search an element from the array.

HS24201 - PUBLIC SPEAKING AND APTITUDE		
Teaching Scheme:	**Credits: 02**	**Examination Scheme:**
TH: 01 Hrs/Week	**Theory : 01**	**CAA: 10 Marks**
		Term-Work: 30 Marks
PR: 02 Hrs/Week	**Practical : 01**	**OR Exam: 30 Marks**

Course Contents

Unit I	**Spoken English**	**[04 Hr.]**

Pre-Assessment, Vocabulary made easy, the Power of Words, Introduction to Word Accent, Introduction to Rhythm: Intonation, Rising Intonation, Falling Intonation, Introduction & Specific scenarios: Telephone Skills: Taking & Making Calls, Voice, Intonation, and Language, Conversations: The Role of Questions

Unit II	**Impactful Presentations**	**[04 Hr.]**

Body Language: Introduction, Mechanics and Style

Voice Modulation: Voice Projection, replacing Fillers, and Emphasis

Power of Pause: Pause to engage audience in Conversation, Combine Pause & Repetition Techniques, Demonstrate Confidence & Control, establish Presence

Empathy: Essential Human Quality, Practice Heartful Communication, Impact of Communication, How to deliver memorable speech.

Unit III	**General Aptitude for all Competitive Exams**	**[06 Hr.]**

Quantitative Aptitude

Data interpretation: data graphs (bar graphs, pie charts, and other graphs representing data), 2- and 3-dimensional plots, maps, and tables Numerical computation and estimation: ratios, percentages, powers, exponents and logarithms, permutations and combinations, and series Mensuration and geometry Elementary statistics and probability.

Analytical Aptitude

Logic: deduction and induction, Analogy, Numerical relations and reasoning.

Spatial Aptitude

Transformation of shapes: translation, rotation, scaling, mirroring, assembling, and grouping

paper folding, cutting, and patterns in 2 and 3 dimensions.

Text Books:

1. "A Course in Phonetics and Spoken English" – T. Balasubramanian
2. "Effective Technical Communication" – M. Ashraf Rizvi
3. "Quantitative Aptitude for Competitive Examinations" – R.S. Aggarwal

Reference Books:

1. "High School English Grammar & Composition" – Wren & Martin
2. "How to Speak, How to Listen" – Mortimer J. Adler
3. "Logical and Analytical Reasoning" – A.K. Gupta

NPTEL Course:

1. Mastering Speaking and Presentations: A case Based Approach by Prof. Seema Singh, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc25_hs96/preview

Lab Session Plan

Session 1: Vocabulary & Word Accent Mastery

- Pre-Assessment: Conduct a quick spoken test to evaluate pronunciation and fluency.
- Vocabulary exercises using flashcards & interactive word-building games.

Session 2: Intonation & Rhythm in Speech

- Introduction to rising and falling intonation with examples.
- Roleplay exercises for practicing intonation in different scenarios (expressing surprise, asking questions, etc.).
- Rhythm practice: Reading passages with proper pauses and stress patterns.

Session 3: Telephone Skills & Professional Conversations

- Practicing making and taking calls with simulated dialogues.
- Focus on voice modulation, clarity, and polite expressions.

Session 4: Body Language & Stage Presence

- Mirror exercises to improve facial expressions and gestures.
- Practicing posture, movement, and eye contact while speaking.

Session 5: Voice Modulation & Power of Pause

- Exercises on voice projection and eliminating fillers.
- Practicing pauses strategically to enhance speech impact.
- Repetition and emphasis techniques using speech excerpts.

Session 6: Empathy & Heartfelt Communication

- Interactive storytelling to practice emotional connection.
- Exercises on active listening and empathetic responses.
- Speech practice: delivering a short talk with an emotional appeal.

Session 7: Quantitative Aptitude – Data Interpretation & Computation

- Solving numerical problems based on bar graphs, pie charts, and tables.
- Quick estimation exercises using ratios, percentages, and logarithms.
- Group challenges on permutations and combinations.

Session 8: Analytical Aptitude – Logical & Numerical Reasoning

- Deduction and induction puzzles.
- Solving analogy-based reasoning questions.
- Speed tests for numerical relations and reasoning.

Session 09: Spatial Aptitude – Shape & Pattern Recognition

- Hands-on paper folding and cutting exercises.
- Visualization tasks for rotation, scaling, and mirroring of shapes.
- Solving pattern-based problems in 2D and 3D space.

Session 10 : Mock test from online test series of companies like TCS, Infosys employability tests like CoCubes, AMCAT etc.

ME24204 - COMMUNITY ENGAGEMENT PROJECT/ FIELD PROJECT		
Teaching Scheme:	**Credits:02**	**Examination Scheme:**
PR: 04 Hrs/Week	**Practical : 02**	**CAA: 10 Marks**
		Oral Exam: 30 Marks
		Term-Work: 30 Marks

Prerequisites: Basic knowledge of Mechanical Systems, along with problem-solving and project management skills relevant to community-based engineering solutions**.**

Objectives:

1. Identify real-world community challenges and develop engineering solutions.
2. Apply mechanical design, thermodynamics, and manufacturing principles.
3. Design cost-effective, sustainable, and scalable solutions.
4. Gain hands-on experience in prototyping and fabrication.
5. Promote sustainability and social responsibility in engineering.
6. Enhance teamwork, leadership, and project management skills.
7. Engage with the community for practical implementation.
8. Develop technical documentation and presentation skills.

Course Outcomes:

1. Identify and analyse real-world community challenges requiring mechanical engineering solutions.
2. Apply mechanical engineering principles to design and develop cost-effective, sustainable solutions.
3. Create and prototype designs using CAD modelling and appropriate manufacturing techniques.
4. Test and evaluate prototypes for performance, reliability, and community impact.
5. Implement solutions in real-world settings while engaging with stakeholders for feedback and improvement.
6. Demonstrate project management and communication skills through technical documentation and presentations.

Activity (10 Marks): "Identifying a Problem Statement for Community/Field Project through Survey & Literature Review"

Objective:

Students will conduct a survey and literature review to identify a relevant problem for a community or field project. This exercise emphasizes practical research skills and helps in formulating a problem statement for engineering solutions in real-world community settings.

Task:

1. **Community Survey – (4 Marks)**
    - Design and conduct a short survey (3-5 questions) to identify a specific engineering problem faced by the local community (e.g., water access, energy efficiency, waste management, etc.).
    - Interview at least 5-10 community members (either physically or via an online platform) to gather their feedback.
    - Summarize the results to highlight the most pressing issue.
2. **Literature Review – (4 Marks)**
    - Conduct a literature review to explore existing research, solutions, and technologies related to the identified issue.
    - Find at least 2-3 studies, articles, or reports on similar problems and solutions implemented in other communities.
    - Compare the results of the survey with findings from the literature to understand how the community's issue has been addressed elsewhere.
3. **Formulate a Problem Statement – (2 Marks)**
    - Based on the survey and literature review, write a concise problem statement.
    - The problem statement should clearly define the issue, its relevance to the community, and the need for a mechanical engineering solution.

Evaluation Criteria: (10 Marks)

✔ Effectiveness and relevance of the survey in identifying a community problem – 4 Marks

✔ Depth and quality of the literature review – 4 Marks

✔ Clarity and impact of the problem statement – 2 Marks

Guidelines for implementing Community Engineering Project/ Field Project:

1. **Project Selection & Problem Definition**

- **Identify a Real-World Community Need**: Choose a problem that has a clear impact on the community, such as waste management, water access, energy efficiency, or affordable transportation.
- **Define the Problem Clearly**: Create a well-defined problem statement, emphasizing the community's challenges and the scope of the solution.
- **Community Engagement**: Involve community members, stakeholders, or local organizations in identifying the issue and developing solutions.

2. **Research & Literature Review**

- **Conduct a Survey**: Gather data directly from the community through surveys or interviews.
- **Literature Review**: Investigate existing solutions or research to understand what has been done before and identify gaps that your project can fill.
- **Feasibility Study**: Analyze the technical, financial, and environmental feasibility of your proposed solution.

3. **Design & Prototyping**

- **Apply Engineering Principles**: Use mechanical design, thermodynamics, fluid mechanics, and material science to create a solution.
- **Prototyping**: Build functional prototypes using appropriate materials and technologies (e.g., 3D printing, traditional manufacturing, etc.).
- **Testing & Evaluation**: Test prototypes for performance, safety, and user-friendliness. Make improvements based on feedback and test results.

4. **Implementation & Community Impact**

- **Deploy Solution**: Implement your solution in a real-world setting, ensuring it aligns with community needs and expectations.
- **User Training**: Provide training to the community on how to use and maintain the solution.
- **Collect Feedback**: Gather feedback from the community to assess the solution's effectiveness and areas for improvement.

5. **Documentation & Reporting**

- **Document the Process**: Maintain thorough records of your project, including design processes, prototype testing, surveys, and feedback.
- **Final Report**: Write a clear and concise report summarizing the problem, design process, solution, and results.
- **Presentation**: Prepare a final presentation for stakeholders, including community members, faculty, and potential sponsors.

6. **Sustainability & Scalability**

- **Consider Long-Term Impact**: Evaluate the long-term sustainability of your solution (e.g., maintenance, cost, environmental impact).
- **Scalability**: Assess whether your solution can be scaled to other communities or areas with similar challenges.

Guidelines for TW Assessment (30 Marks):

1. Problem Identification and Research (5 Marks)

3 Marks: Clear, relevant problem statement supported by surveys and literature.

2 Marks: Effective research, including community input and background information.

2. Design and Concept Development (5 Marks)

3 Marks: Use of CAD or design tools for concept visualization.

2 Marks: Practicality in terms of cost, materials, and sustainability.

3. Prototyping and Testing (5 Marks)

3 Marks: Testing methods, results, and prototype improvements.

2 Marks: Documentation of prototyping process (photos, notes).

4. Implementation and Community Engagement (4 Marks)

2 Marks: Successful deployment with community interaction, training, and feedback.

2 Marks: Modifications based on community feedback.

5. Documentation and Report Writing (6 Marks)

4 Marks: Clear, organized, and accurate project report.

2 Mark: Proper citations and references.

6. Presentation and Communication (5 Marks)

3 Marks: Clear and engaging presentation to stakeholders.

2 Marks: Effective visual aids and response to questions.

Guidelines for OR Assessment (30 Marks):

1. Presentation Structure (10 Marks)

Clarity & Organization (5 Marks): Clear structure, logical flow from problem to solution.

Logical Flow (5 Marks): Well-organized content, smooth progression through key points.

2. Technical Understanding (8 Marks)

Engineering Concepts (4 Marks): Demonstrates deep understanding of applied engineering principles.

Problem-Solving (4 Marks): Clear explanation of solution and engineering approach.

3. Design & Prototyping (6 Marks)

Design Explanation (3 Marks): Clear explanation of design process and materials.

Prototype/Model Explanation (3 Marks): Functionality and testing outcomes of the prototype.

4. Community Engagement (4 Marks)

Community Involvement (2 Marks): Explains community feedback and participation.

Impact (2 Marks): Describes the solution's impact on the community.

5. Response to Questions (2 Marks)

Confidence & Accuracy (2 Marks): Clear, confident, and accurate answers to questions.

ME24211- MANUFACTURING PRACTICES		
Teaching Scheme:	**Credits: 04**	**Examination Scheme:**
TH: 03 Hrs/Week	**Theory : 03** **Practical : 01**	**CAA: 10 Marks** **In-Semester Exam: 30 Marks** **End-Semester Exam: 60 Marks**
PR: 02 Hrs/Week		**PR Exam: 30 Marks**

Prerequisites:

Engineering Physics, Material Science and Metallurgy.

Objectives:

- Describe various sand and permanent mold casting methods, procedure and mold design aspects
- Understand basics of metal forming processes, equipment and tooling.
- Understand sheet metal forming operations and die design procedures.
- Classify, describe and configure the principles of various welding techniques.
- Understand plastic processing techniques.
- To know about composites, its fabrication processes.

Course Outcomes:

On completion of the course, learner will be able to

CO1. SELECT appropriate moulding, core making and melting practice and estimate pouring time, solidification rate and DESIGN riser size and location for sand casting process

CO2. UNDERSTAND mechanism of metal forming techniques and CALCULATE load required for flat rolling

CO3. DEMONSTRATE press working operations and APPLY the basic principles to DESIGN dies and tools for forming and shearing operations

CO4. CLASSIFY and EXPLAIN different welding processes and EVALUATE welding characteristics

CO5. DIFFERENTIATE thermoplastics and thermosetting and EXPLAIN polymer processing techniques

CO6. UNDERSTAND the principle of manufacturing of fibre-reinforced composites and metal matrix composites

Course Contents

Unit-1: Casting Processes	**[07 Hrs.]**
Introduction to casting processes, Patterns: Pattern materials, types of pattern, allowances pattern design, Moulding sand, Properties of moulding sands, Core making, Melting practices and furnaces, Pouring and Gating system design, Numerical estimation to find mold filling time, Riser design and placement, Principles of cooling and solidification of casting, Directional and Progressive solidification Estimation of solidification rate, Cleaning and Finishing of casting, Defects and remedies, Principle and equipments of Permanent mould casting, Investment casting, Centrifugal casting, Continuous casting	
Unit-2: Metal Forming Processes	**[07 Hrs.]**
Plastic deformation. Stress-strain diagram for different types of material, Hot and Cold working, Factors affecting plastic deformation, Yield criteria, Concept of flow stress, Forming Limit diagram **Rolling Process:** Rolling terminology, Friction in rolling, Calculation of rolling load Forging: Open and closed die forging, Forging operations Extrusion: Types, Process parameter **Wire and Tube Drawing:** Wire and tube drawing process, Die profile Friction and lubrication in metal forming, Forming defects, causes and remedies for all forming processes	
Unit-3: Sheet Metal Forming	**[07 Hrs.]**
Types of sheet metal operations, Press working equipment and terminology, Types of dies, Clearance analysis, Estimation of cutting forces, Centre of pressure and blank size determination, Design of strip lay-out, Blanking die design, Introduction to Drawing, Bending dies, Methods of reducing forces, Formability and forming limit diagrams.	
Unit-4: Welding Processes	**[07 Hrs.]**
Classification of joining processes, Welding terminology and types of joints **Arc Welding Processes:** Principles and equipments of Single carbon arc welding, FCAW, TIG, MIG, SAW **Resistance Welding:** Spot, Seam and Projection weld process, Heat balance in resistance welding Gas Welding and Cutting, Soldering, brazing and braze welding Welding Metallurgy and Heat Affected Zone, Weld inspection, Defects in various joints and their remedies.	
Unit-5: Processing of polymers	**[07 Hrs.]**

Thermoplastics and Thermosetting, Processing of polymers, Thermoforming, Extrusion

Moulding: Compression moulding, Transfer moulding, Blow moulding, Rotation moulding, Injection moulding - Process and equipment

Extrusion of Plastic: Type of extruder, extrusion of film, pipe, Cable and Sheet – Principle Pressure forming and Vacuum forming

Unit-6: Manufacturing of Composites	**[07 Hrs.]**

Introduction to composites, Composite properties, Matrices, Fiber reinforcement

Composite Manufacturing Processes: Hand lay-up Process, Spray lay-up, Filament winding process, Resin transfer molding, Pultrusion, and Compression molding process, Vacuum impregnation process, Processing of metal matrix composites, Fabrication of ceramic matrix composites, Carbon-carbon composites, Polymer matrix and nano-composites.

Text Books:

1. P. N. Rao, "Manufacturing Technology Vol. I & II", Tata McGraw Hill Publishers.
2. P. C. Sharma, "Production Engineering", Khanna Publishers.

Reference Books:

1. R. K. Jain, "Production Technology", Khanna Publishers.
2. K. C. Chawala, "Composite Materials", Springer, ISBN 978-0387743646, ISBN 978-0387743653.
3. Brent Strong, "Fundamentals of Composites Manufacturing: Materials, Methods", SME Book series.

Activity (Any One):

1. Visit any foundry / casting industry to demonstrate various stages of casting and make a report on it. (To study and observe various stages of casting through demonstration of the sand casting process from pattern making, sand mold preparation and melting and pouring of metal.)
2. Visit to Sheet metal forming industry and prepare a report on it.
3. Visit the Rolling mill / Wire/Tube drawing unit / Forging plant and prepare a report on it.
4. Manufacturing a Product / Job using various manufacturing operations.
5. Virtual lab experiment based on course content.
6. NPTEL Swayam course on Fundamentals of manufacturing processes.

Guidelines for Lab

Practicals (Perform minimum Six Practicals out of 8)

1. Demonstration of arc welding technique TIG (Non-Consumable electrode)/ MIG (Consumable Electrode). A job drawing to be prepared by an instructor with details of welding process parameters, and weld joint design such as edge preparation, type and size of electrode used, welding current, voltage etc.

2. Demonstration of Resistance / Gas welding. A job drawing to be prepared by an instructor with details of welding process parameters, and weld joint design such as edge preparation, type and proportion of gas/electrodes used, types of gas / welding current, voltage etc.

3. Demonstration of by additive manufacturing process (Fused Deposition Modeling).

4. Demonstration of injection molding process on any one plastic component like bottle, bottle caps, machine handles etc. / by additive manufacturing process.

5. Demonstration on cylindrical grinding/surface grinding operations, measurement of surface roughness produced and estimation of machining time.

6. Demonstration of Machining operations on Lathe.

7. Demonstration of Machining Operations on Milling Machine and Demonstration of indexing mechanism.

8.Term work includes one job of Carpentry Introduction to woodworking, kinds of woods, hand tools & machines, Types of joints, wood turning. Pattern making, types of patterns and its allowances.

9. One job involving fitting / Turning / welding / sheet metal Operations

<table>
<tr><th colspan="3">ME24212- THEORY OF MACHINES</th></tr>
<tr><td>Teaching Scheme:</td><td>Credits: 04</td><td>Examination Scheme:</td></tr>
<tr><td rowspan="2">TH: 03 Hrs/Week</td><td rowspan="3">Theory : 03
Practical : 01</td><td>CAA: 10 Marks</td></tr>
<tr><td>In-Semester Exam: 30 Marks</td></tr>
<tr><td>PR: 02 Hrs/Week</td><td>End-Semester Exam: 60 Marks</td></tr>
<tr><td></td><td>OR Exam: 30 Marks</td></tr>
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Prerequisites:

Engineering Mathematics - I and II, Engineering Physics, Engineering Mechanics, Geometric Modeling & Drafting

Objectives:

- To make the students conversant with kinematic analysis of mechanisms applied to real life and industrial applications.
- To develop the competency to analyze the velocity and acceleration in mechanisms using analytical and graphical approach.
- To develop the skill to propose and synthesize the mechanisms using graphical and analytical techniques.
- To develop the competency to understand & apply the principles of gear theory to design various applications.
- To develop the competency to design a cam profile for various follower motions.

Course Outcomes:

On completion of the course, learner will be able to

CO1. APPLY kinematic analysis to simple mechanisms

CO2. ANALYZE velocity and acceleration in mechanisms by vector and graphical method

CO3. SYNTHESIZE a four bar mechanism with analytical and graphical methods

CO4. APPLY fundamentals of gear theory as a prerequisite for gear design

CO5. CONSTRUCT cam profile for given follower motion

Course Contents

Unit-1: Fundamentals of Mechanism	**[07 Hrs.]**
Kinematic link, Types of links, Kinematic pair, Types of constrained motions, Types of Kinematic pairs, Kinematic chain, Types of joints, Mechanism, Machine, Degree of freedom, Mobility of Mechanism, Inversion, Grashoff's law, Four-Bar Chain and its Inversions, Slider crank Chain and its Inversions, Double slider crank Chain and its Conversions, Mechanisms with Higher pairs, Equivalent Linkages and its Cases - Sliding Pairs in Place of Turning Pairs, Spring in Place of Turning Pairs, Cam Pair in Place of Turning Pairs	
Unit-2: Kinematic Analysis of Mechanisms: Analytical Method	**[07 Hrs.]**
Analytical methods for displacement, velocity and acceleration analysis of slider crank Mechanism, Velocity and acceleration analysis of Four-Bar and Slider crank mechanisms using Vector and Complex Algebra Methods. Computer-aided Kinematic Analysis of Mechanism like Slider crank and Four-Bar mechanism, Analysis of Single and Double Hook's joint	
Unit-3: Kinematic Analysis of Mechanisms: Graphical Method	**[08 Hrs.]**
Displacement, velocity and acceleration analysis mechanisms by Relative Velocity Method (Mechanisms up to 6 Links), Instantaneous Centre of Velocity, Kennedy's Theorem, Angular Velocity ratio Theorem, Analysis of mechanism by ICR method (Mechanisms up to 6 Links), Coriolis component of Acceleration (Theoretical treatment only)	
Unit-4: Synthesis of Mechanisms	**[07 Hrs.]**
Steps in Synthesis: Type synthesis, Number Synthesis, Dimensional synthesis, Tasks of Kinematic synthesis - Path, function and motion generation (Body guidance), Precision Positions, Chebychev spacing, Mechanical and structural errors Graphical Synthesis: Inversion and relative pole method for three position synthesis of Four-Bar and Single Slider Crank Mechanisms Analytical Synthesis: Three position synthesis of Four-Bar mechanism using Freudenstein's equation, Blotch synthesis	
Unit-5: Kinematics of Gears	**[08 Hrs.]**

Gear: Classification

Spur Gear: Terminology, law of gearing, Involute and cycloidal tooth profile, path of contact, arc of contact, sliding velocity, Interference and undercutting, Minimum number of teeth to avoid interference, Force Analysis (theoretical treatment only)

Helical and Spiral Gears: Terminology, Geometrical Relationships, virtual number of teeth for helical gears

Bevel Gear & Worm and Worm Wheel: Terminology, Geometrical Relationships

Gear Train and Gear boxes: Types of gear train and gear box, Analysis of Epicyclic gear Trains, Holding torque - simple, compound and Epicyclic gear Trains, Torque on Sun and Planetary gear Train, compound Epicyclic gear Train

Unit-6: Cam, Followers & Governors	**[07 Hrs.]**

Introduction, Classification of Followers and Cams, Terminology of Cam Displacement diagram for the Motion of follower as Uniform velocity, Simple Harmonic Motion (SHM), Uniform Acceleration and Retardation Motion (UARM), Cycloid motion, Cam Profile construction for Knife-edge Follower and Roller Follower, Cam jump Phenomenon

Governors- Introduction, Types and applications of governors (Centrifugal Governor, Watt Governors, Porter Governor, Proell Governor) Theoretical treatment only

Text Books:

1.S. S. Rattan, “Theory of Machines”, Third Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi.

2. Bevan T, “Theory of Machines”, Third Edition, Longman Publication

3. G. Ambekar, “Mechanism and Machine Theory”, PHI

4. J. J. Uicker, G. R. Pennock, J. E. Shigley, “Theory of Machines and Mechanisms”, Fifth Edition, International Student Edition, Oxford

Reference Books:

1. Paul E. Sandin, "Robot Mechanisms and Mechanical Devices Illustrated", Tata McGraw Hill Publication
2. Stephen J. Derby, "Design of Automatic Machinery", 2005, Marcel Dekker, New York
3. Neil Sclater, "Mechanisms and Mechanical Devices Sourcebook", Fifth Edition, Tata McGraw Hill Publication
4. Ghosh Malik, "Theory of Mechanism and Machines", East-West Pvt. Ltd.
5. Hannah and Stephans, "Mechanics of Machines", Edward Arnolde Publication
6. R. L. Norton, "Kinematics and Dynamics of Machinery", First Edition, McGraw Hill Education (India) P Ltd. New Delhi
7. Sadhu Singh, "Theory of Machines", Pearson
8. Dr. V. P. Singh, "Theory of Machine", Dhanpatrai and Sons
9. C. S. Sharma & Kamlesh Purohit, "Theory of Machine and Mechanism", PHI
10. M.P. Groover, "Automation, production systems and computer-integrated manufacturing", Prentice-Hall of India Pvt. Ltd, New Delhi

Web References

1. https://nptel.ac.in/courses/112104121/ (NPTEL1, Kinematics of Machines, Prof. Ashok K Mallik, IIT Kanpur)
2. https://nptel.ac.in/courses/112/106/112106270/ (NPTEL2, Theory of Mechanism, Prof. Sujatha Srinivasan, IIT Madras)
3. https://nptel.ac.in/courses/112/105/112105268/ (NPTEL3, Kinematics of Mechanisms and Machines, Prof. Anirvan DasGupta, IIT Kharagpur)
4. https://nptel.ac.in/courses/112/105/112105236/ (NPTEL4, Mechanism and Robot Kinematics, Prof.Anirvan DasGupta, IIT Kharagpur)

Guidelines for Lab /TW Assessment

The student shall complete the following activity as a Term Work
Total 10 experiments from the following list must be performed. Term Work of the Student is evaluated based on the completion of Practical, Assignments using Drawing Aids, Assignments using Software & Programming Languages, Assignments using Virtual Laboratory.

Practical

1. Speed and torque analysis of epicyclic gear train to determine holding torque.
2. To study and verify cam jump phenomenon.
3. To study manufacturing of gear using gear generation with rack as a cutter and to generate an

involute profile.

4. To study various types of gearboxes.

Assignments using Drawing Aids

Do following graphical assignments on Half Imperial drawing sheet:

1. To solve two problems on velocity and acceleration analysis using relative velocity and acceleration method.

2. To solve two problems on velocity analysis using the ICR method.

3. To draw a conjugate profile for any general type of gear tooth.

4. To draw cam profile for any two problems with combination of various follower motion with radial and off-set cam.

Assignments using Software (Any Three Assignments - Minimum one computer programming based and Minimum one based on use of software)

Do following assignments by using Software or by using Coding/Programming Languages:

1. To design a simple Planer Mechanism by using any software (Geogebra, SAM, Working Model, any 3D Modelling Software, etc.)

2. To do computer programming (using software/programming languages like C, Python, Scilab, Matlab etc.) for Kinematic Analysis of Slider Crank Mechanism using Analytical Method

3. To do computer programming (using software/programming languages like C, Python, Scilab, Matlab etc.) for Kinematic Analysis of Hooke's joint Mechanism using Analytical Method

4. To generate a Cam Profile using any Modelling Software (Mech Analyser, any 3D Modelling Software)

5. To synthesize the Four-Bar and Slider Crank Mechanism (Geogebra, SAM, any 2D/3D Modelling Software)

6. To do computer programming (using software/programming languages like C, Python, Scilab, Matlab etc.) for the Synthesis of Mechanism using Chebychevs spacing, Freudensteins equation and function generation

Assignments using Virtual Laboratory (minimum Two experiments)

Please visit the virtual labs of various IITs and NITs for following experiments to study the simulation.

1. Position analysis of slider crank mechanism
2. Velocity analysis of slider crank mechanism
3. Acceleration analysis of slider crank mechanism

Activity (Any one of the following):

1. Identify mechanisms in real life and Analyze for types and number of links, pairs, obtain degrees of freedom. Submit the model and working video of the mechanism.
2. To make a model of any mechanism by using waste material by the group of 4 to 6 students and to give a presentation using PPTs.
3. Design a simple Mechanism in real life application by using any 3D Modelling Software.

ME24213 - FLUID MECHANICS		
Teaching Scheme:	**Credits: 03**	**Examination Scheme:**
TH: 02 Hrs/Week	**Theory : 02** **Practical : 01**	**CAA: 10 Marks**
		End-Semester Exam: 60 Marks
PR: 02 Hrs/Week		**Oral Exam: - 30 Marks**

Prerequisites Courses: Engineering Mathematics - I, Engineering Mathematics - II, Engineering Mechanics, Engineering Physics

Objectives:

1. To understand basic properties of fluids and to learn to establish relation between flow parameters.
2. To learn fluid statics and basics of flow visualization
3. To understand Bernoulli's theorem and its applications.
4. To understand losses in flow, drag and lift forces.

Course Outcomes:

On completion of the course, learner will be able to

CO1. CONSTRUCT mathematical correlation considering dimensionless parameters, also DETERMINE various properties of fluid

CO2. APPLY the laws of fluid statics, UNDERSTAND the concepts of buoyancy and IDENTIFY types of fluid flow and terms associated in fluid kinematics

CO3. APPLY principles of fluid dynamics to laminar flow

CO4. ESTIMATE friction and minor losses in internal flows and DETERMINE boundary layer formation over an external surface

Course Contents

Unit I: Properties of Fluids & Dimensional Analysis	**[07 Hr.]**
Properties of Fluid: Definition of fluid, concept of continuum, density, specific weight, specific gravity, viscosity, viscosity laws, types of fluid and rheology, measurement of viscosity, application based numerical on viscosity-flow through pipe, lubrication, bearing, brake fluids, parallel plates, rotating shafts etc., vapor pressure surface tension, capillarity, compressibility. **Dimensional Analysis:** Introduction, system of dimensions, Dimensional homogeneity,	

Buckingham-Pi Theorem, repeating variables, dimensionless numbers and their physical significance. **Similitude & Model Testing:** Model & prototype, similarity, model laws, application of model studies.

Unit II: Fluid Statics & Kinematics	**[07 Hr.]**
Laws of fluid statics: forces acting on a fluid element, pascal's law, hydrostatics law, hydraulic ram. Pressure measurement: pressure scale, piezometer, barometer, manometer - simple, inclined, differential, micro manometer, inverted **Forces acting on surfaces immersed in fluid**: total pressure and center of pressure on submerged plane surfaces, curved surface submerged in liquid. **Buoyancy**: flotation, stability of bodies **Fluid Kinematics:** Flow description methods, types of flows, velocity and acceleration fields, continuity equation in 1D & 3D flow, flow visualization (path line, stream line and streak line), Introduction to stream tube, angularity, vorticity, stream function and velocity potential function, flow net.	

Unit III: Fluid Dynamics	**[07Hr.]**
Euler's equation of motion differential form and Navier Stokes equation, Euler's equation of motion along streamline, Bernoulli's theorem and modified Bernoulli's theorem, stagnation pressure, HGL, TEL **Flow measurement**: venturimeter, orifice meter, pitot tubes, static pitot tube, introduction to coriolis flow meter, introduction to orifices, notches & weirs **Laminar flow**: Entrance region theory, velocity and shear Stress distribution for laminar flow through pipe, Couette flow, velocity profile of turbulent flow	

Unit IV Internal & External Flow	**[07 Hr.]**
Internal Flow: Losses - major & minor losses, hydro dynamically smooth and rough boundaries, Moody's chart, compounding of pipes & equivalent pipe, siphons, transmission of power **External Flow**: Boundary layer formation over a flat plate, boundary layer thickness, displacement thickness, momentum thickness and energy thickness, boundary layer separation and methods to control separation, drag and lift concepts, types of drag, drag & lift coefficient, aerofoil, bluff body, streamline body	

Text Books:

1. R. K. Bansal,"Fluid Mechanics & Hydraulic Machines", Laxmi Publication, 9th Edition.
2. Modi P. N. and Seth S. M, "Hydraulics and Fluid Mechanics", Standard Book House 9th Edition.
3. Cengel & Cimbla, "Fluid Mechanics", TATA McGraw-Hill, 10th Edition.

Reference Books:

1. Sukumar Pati, "Fluid Mechanics and Hydraulics Machines", TATA McGraw Hill, 1st Edition.
2. Munson, Young and Okiishi, "Fundamentals of Fluid Mechanics", Wiley India, 9th Edition.
3. Potter Wiggert, " Mechanics of Fluids", Cengage Learning, 4th Edition.
4. Fox, Pichard, "Introduction to Fluid Mechanics", McDonald- Wiley
5. F. M. White, "Fluid Mechanics", TATA McGraw-Hill, 10th Edition.
6. Kundu, Cohen, Dowling, "Fluid Mechanics", Elsevier India.
7. Chaim Gutfinger David Pnueli, "Fluid Mechanics" Cambridge University press.
8. Edward Shaughnessy, Ira Katz James Schaffer, "Introduction to Fluid Mechanics", Oxford University Press

Web References

1. https://nptel.ac.in/courses/112/105/112105171/
2. https://nptel.ac.in/courses/112/104/112104118/
3. https://nptel.ac.in/courses/112/105/112105269/
4. http://www.efluids.com/efluids/books/efluids_books.htm
5. http://web.mit.edu/hml/ncfmf.html
6. http://www.efluids.com/efluids/pages/edu_tools.htm
7. https://spoken-tutorial.org/tutorial-search/?search_foss=OpenFOAM&search_language=

Guidelines for Laboratory Conduction

The student shall complete the following experiments as a Term Work

The Student is evaluated based on the completion of Practical, Assignments and Detailed Mini project / Industrial Visit Report/Simulation of fluid flow / Programming using any suitable software.

Practical

1. Determination of pressure using manometers (minimum two)
2. Determination of fluid viscosity and its variation with temperature.

3. Determination of Metacentric height of floating object.

4. Determination of Reynolds number and flow visualization of laminar and turbulent flow using Reynolds apparatus.

5. Verification of modified Bernoulli's equation.

6. Calibration of Orifice meter/ Venturi Meter /Notch.

7. Determination of minor/major losses through metal/non-metal pipes.

8. Mini project/Industrial visit/Simulation of fluid flow/Programming using any suitable software such as Scilab, OpenFOAM, ANSYS, etc

Activity (Any One):

1. Visit any industry involving fluid flow process to understand the piping system and various losses in energy of the fluid during flow.

2. Poster presentation by group on any topic related to advanced fluid mechanics or computational fluid dynamics.

3. Simulation of any real life fluid flow process using any suitable software such as Scilab, OpenFOAM, ANSYS, etc.

BS24053 - LINEAR ALGEBRA AND STATISTICS		
Teaching Scheme:	**Credits: 04**	**Examination Scheme:**
TH: 03 Hrs/Week	**Theory : 03**	**CAA: 10 Marks**
		In-Semester Exam: 30 Marks
	Practical : 01	**End-Semester Exam: 60 Marks**
PR: 02 Hrs/Week		**Term-Work: 30 Marks**

Prerequisites:

Basics of Determinants, Linear Algebra, Rank of Matrices, Set theory, Measures of Central Tendency.

Course Objectives:

The aim of teaching this course is to learn the new concepts of linear algebra and statistics and apply them in various fields of computer Science, including data science, Machine learning, and Artificial Intelligence.

Course Outcomes (COs): The students will be able to

CO1: Acquire the knowledge of vector spaces and use it in their field.

CO2: Learn the concept of inner product spaces and the Gram-Schmidt method and apply them in various computing processes.

C**O3:** Learn various concepts of regression models and apply these techniques to analyze relationships among the variables.

CO4: Apply multiple linear regression analysis techniques to real-world data sets from various domains to solve in their field.

CO5: Analyze the outcome of a hypothesis test and determine whether to accept or reject the null hypothesis.

CO6: Learn and operations Research methods to solve real-world engineering problems.

Course Contents

Unit I Vector Space	**[07 Hr.]**
Vector space, subspace, Linear combination, Spanning set, Linear Dependence & Independence of vectors, Basis & dimension of a vector space, Row space, Column Space & null space of a matrix. Linear transformation, Rank nullity theorem.	

Unit II Inner Product Spaces	**[07 Hr.]**
Inner product spaces, Orthogonality, Orthogonal Complement, Gram-Schmidt orthogonalization process and its applications.	
Unit III Simple Linear Regression	**[07 Hr.]**
Simple Linear Regression Model: $y = \beta_0 + \beta_1 x + \epsilon$, Assumptions, Estimation of the parameters β_0 and β_1 by the method of least squares, normal equations and their solution, Standard Error of estimators, Hypothesis testing for Regression Coefficient, Standard Error of prediction.	
Unit IV Multiple Linear Regression	**[07 Hr.]**
Multiple linear regression model y=β_0+β_1 x_1+β_2 x_2+⋯+β_p x_p+ϵ, residuals, Least-Squares Estimation of the Regression Coefficients, Significance of the Least-Squares Estimators, and applications.	
Unit V Testing of Hypothesis	**[07 Hrs.]**
Hypothesis, Type I and Type II errors, Level of significance (α) and power of the test, Large Sample Test for single population mean, two population means (known population variance/s), t-test for single population mean, paired t-test, Chi-Square test for goodness of fit, Chi-Square test for independence of attributes.	
Unit VI Linear Programming Problem	**[07 Hr.]**
Formulation of LP problems, Graphical solution method, Simplex method, Big -M method, Duality theory and sensitivity analysis. Applications in Engineering	

Text Books:

1. Matrix and Linear Algebra (aided with MATLAB), Kanti Bhushan Datta, Eastern Economic 1st Edition.
2. Introduction to Linear Algebra, Serge Lang, Springer, 2nd edition.
3. Applied Regression analysis, Draper, N. R. and Smith, H. John Wiley, Third Edition 1998.
4. Statistical Methods, S.P. Gupta, Sultan Chand and Sons, New Delhi, 10th Edition 2009.
5. Introduction to Linear Regression Analysis, Douglas Montgomery, Elizabeth A. Peck, and G. Geoffrey Vining, 5th edition, Wiley-Eastern publication.

6. Operations Research: An Introduction, Hamdy A. Taha, Eighth Edition, Pearson Prentice Hall.

Reference Books:

1. Linear Algebra and its Applications, David C. Lay, Pearson 3rd Edition 2006.
2. Linear Algebra and its Applications, Gilbert Strang, Cengage Learning, 4th edition.
3. Fundamentals of Mathematical Statistics, S. C. Gupta and V. K. Kapoor, Sultan Chand & Sons 12th Edition 2020.
4. Linear Algebra Done Right, Sheldon Axler, Springer Fourth Edition 2024.

e-Books:

Support Vector Machines for Classification and Regression by Steve R. Gunn (https://meandmyheart.files.wordpress.com/2009/02/svm_gunn1.pdf)

Learning Resources:

https://onlinecourses.nptel.ac.in/noc24_ma11 (Applied Linear Algebra in AI and ML)

https://onlinecourses.nptel.ac.in/noc24_cs68/preview (Python for Data Science)

Guidelines for Tutorial, Term Work:

1. Tutorial for the subject shall be engaged in a minimum of three batches per division (Batch size of 23 students maximum)
2. Term work shall consist of six assignments on each unit and is based on Performance and continuous internal assessment.

HS24211 - ENVIRONMENTAL STUDIES		
Teaching Scheme:	**Credits: 02**	**Examination Scheme:**
TH: 02 Hrs/Week	**Theory : 02**	**CAA: 10 Marks**
		End-Semester Exam: 60 Marks

Prerequisites: Fundamentals of the environment.

Course Objectives:

1. Understand the fundamental concepts of environmental science and its relevance to engineering.
2. Analyze the environmental impact of various engineering industries.
3. Learn about sustainable engineering practices, pollution control, and waste management.
4. Study environmental laws in India and global initiatives for environmental conservation.

Course Outcomes:

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

CO-1: Understand the components of the environment and types of energy resources.
CO-2: Analyze the impact of engineering industries on the environment.
CO-3: Learn sustainable engineering solutions for mitigating environmental damage.
CO-4: Aware of Indian and global initiatives for environmental protection.

Course Contents

Unit-1: Introduction to Environmental Studies	**[06 Hrs.]**
Importance of Environmental Studies, Components of the Environment: Atmosphere, Hydrosphere, Lithosphere, and Biosphere, Ecosystems and Biodiversity: Types, Importance, and Conservation, Sustainable Development Goals (SDGs) and Role of Engineers in Sustainability, Renewable and Non-Renewable Resources, Water Resources: Overuse, Pollution, and Engineering Solutions, Energy Resources: Fossil Fuels, Nuclear Power, and Renewable Energy Alternatives, Land Resources: Soil Degradation, Deforestation, and Urbanization.	
Unit-2: Impact of Engineering Industries on Environment	**[07 Hrs.]**

Manufacturing & Automobile Industry: Air pollution, Carbon emissions, Waste disposal, Chemical & Pharmaceutical Industry: Water and soil contamination, Hazardous waste, Construction & Infrastructure: Land degradation, Dust pollution, Waste generation, Electronics & IT Industry: E-waste, Energy consumption, Semiconductor waste, Power Generation (Thermal, Hydropower, Nuclear): Pollution, Waste heat, Radiation hazards, Causes and Effects of Climate Change, Global Warming and Greenhouse Effect.

Unit-3: Engineering Solutions for Environmental Mitigation and Sustainable Practices	**[07 Hrs.]**

Carbon Capture and Storage (CCS), Eco-friendly Materials, Sustainable Design & Life Cycle Assessment (LCA), Energy-efficient Technologies & Smart Grids, Case Studies on Successful Pollution Reduction **Waste Management Strategies:** Solid Waste and Biomedical Waste Management, E-Waste: Sources, Impact, and Recycling, Hazardous Waste Handling and Treatment, Circular Economy and Zero-Waste Technologies **Sustainable Engineering Practices:** Renewable Energy Technologies (Solar, Wind, Biomass, Hydropower) Green Buildings and Sustainable Architecture, Electric Vehicles and Smart Transportation Systems, Sustainable Agriculture and Water Conservation Technologies.

Unit- 4: Environmental Initiatives in India and Worldwide	**[06 Hrs.]**

National Initiatives: Swachh Bharat Abhiyan, Namami Gange, National Green Tribunal (NGT), Corporate Social Responsibility (CSR) & Environmental Compliance, Environmental Activism and the Role of NGOs, Environmental Laws and Policies in India, The Environmental Protection Act, 1986, Role of Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCB), International Environmental Agreements (Kyoto Protocol, Paris Agreement, COP Summits), Global Initiatives: UNEP, IPCC, World Bank Environmental Policies.

Books & Other Resources:

Text Books:

1. Benny Joseph, Environmental Studies, McGraw Hill Education, 3rd Edition, 2021. Anubha Kaushik & C.P. Kaushik, Environmental Studies, New Age International Publishers, 5th Edition, 2022.

Reference Books:

1. R. Rajagopalan, Environmental Studies: From Crisis to Cure, Oxford University Press, 3rd Edition, 2021.
2. Erach Bharucha, Textbook of Environmental Studies for Undergraduate Courses, University Press, 3rd Edition, 2021.
3. Suresh K. Dhameja, Environmental Science and Engineering, S.K. Kataria & Sons, 2nd Edition, 2020.

Additional Reports & Resources:

- Government of India - Ministry of Environment, Forest & Climate Change (MoEFCC) Reports (Website)
- United Nations Environment Programme (UNEP) Reports (Website)
- IPCC Climate Change Reports (Website)
- Central Pollution Control Board (CPCB) Reports (Website)

List of Activities for reference:

Perform any two activities of the following.

1. **Ecosystem Study Report –** Visit a local park, water body, or forested area and document its ecosystem components (flora, fauna, food chains).
2. **Sustainability Case Study** – Choose one of the Sustainable Development Goals (SDGs) and prepare a report on its implementation in India.
3. **Renewable vs. Non-Renewable Resources** – Prepare a comparative chart listing sources, usage, and sustainability factors.
4. **Water Conservation Survey** – Conduct a survey in your neighborhood or campus to assess water consumption and suggest conservation strategies.
5. **Industrial Impact Assessment –** Select an engineering industry (automobile, chemical, IT, etc.) and analyze its environmental impact.
6. **Carbon Footprint Calculation** – Calculate the carbon footprint of your daily activities (electricity, transportation, food, etc.) and suggest ways to reduce it.

7. **Climate Change Awareness Video** – Create a short video (2–3 min) explaining global warming and its impact.
8. **Case Study on Pollution Control Failures** – Research a real-world incident of industrial pollution (e.g., Bhopal Gas Tragedy, Minamata Disease) and analyze the causes and consequences.
9. **Waste Management Audit –** Conduct a waste audit in your college or home, classify the waste generated, and propose a waste management plan.
10. **E-Waste Collection Drive** – Organize a drive to collect and safely dispose of e-waste in your locality. Submit a report on the amount collected and its disposal method.
11. **Renewable Energy Model** – Create a working or conceptual model of a solar panel, wind turbine, or biomass plant.
12. **Green Building Analysis** – Identify a green building in your city (or college) and analyze its energy-efficient features.
13. **Report on National Environmental Policies –** Summarize key environmental laws in India and their effectiveness.
14. **International Climate Agreements Presentation** – Prepare a presentation on major agreements like the Paris Agreement, Kyoto Protocol, and their impact on India.
15. **NGO/CSR Initiative Study** – Research an NGO or corporate social responsibility (CSR) initiative focused on environmental protection and prepare a report.
16. **Swachh Bharat Implementation Review** – Visit a local area, document cleanliness conditions, and suggest improvements under Swachh Bharat Abhiyan.

Evaluation Criteria (10 Marks Total)

- Depth of Analysis (3 Marks)
- Presentation & Clarity (3 Marks)
- Creativity & Practical Application (2 Marks)
- Timely Submission (2 Mark)

ME24214- COMPUTER AIDED GEOMETRIC MODELING		
Teaching Scheme:	**Credits:02**	**Examination Scheme:**
PR: 02 Hrs/Week	**Practical : 01** **Tutorial : 01**	**CAA: 10 Marks**
TUT: 01 Hrs/Week		**PR Exam: 30 Marks**
		Term-Work: 30 Marks

Prerequisites: Systems in Mechanical Engineering, Engineering Graphics.

Objectives:

1. To develop an ability to Create 2-D Sketches and Edit Dimensions.
2. To apply basic concepts of 3D modeling, viewing and evaluate mass properties of components
3. To develop an ability to Create assembly models of simple machine components
4. To develop an ability to Create surface models of simple machine components

Course Outcomes:

CO1- APPLY basic concepts of geometric modeling

CO2 - CONSTRUCT solid models using various modeling techniques

CO3 - CONSTRUCT assemblies of part models using proper assembly mating conditions

CO4 -UTILIZE knowledge of curves and surfacing features and methods to create complex solid geometry

CO5 -UNDERSTAND basics of CAD customization

The student shall complete the following activity as a Term Work Journal

PRACTICAL:

The student shall complete the following Practical in laboratory using suitable CAD modeling software.

1. Two assignments on 2-D sketching with geometrical and dimensional constraints.
2. Four assignment on Solid modeling for simple mechanical component.
3. Two assemblies of machine components like knuckle joint, coupling, Plummer block etc. and one assembly Modeling by importing parts/components from free online resource.
4. One assignment on surface modeling.
5. Demonstration on CAD Customization.

Activity:

1. Modeling of any mechanical component used in real life application and its manufacturing

using additive manufacturing (This activity is to be carried out in a group of 4-6 students)

Text Books:

1.Bhat N. D., “Machine Drawing”, Charotar Publications, New Delhi 2014

2. Ajeet Siingh, “ Machine Drawing”, Mc Graw Hill Publications, New Delhi 2012

Reference Books:

1. Ostrowsky, O., Engineering Drawing with CAD Applications, ELBS, 1995

2. Vukašinovic, Nikola and Duhovnik, Jože, (2019), "Advanced CAD Modeling: Explicit, Parametric, Free-Form CAD and Re-engineering", Springer, ISBN-13: 978-3030023980

3. Bucalo, Joe and Bucalo, Neil, (2007), “Customizing SolidWorks for Greater Productivity”, Sheet Metal Guy, LLC, ISBN-13: 978-0979566608

4. Programming Manuals of Softwares.