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 2025)

(w.e.f. AY: 2026-27)

Vidya Pratishthan's

Kamalnayan Bajaj Institute of Engineering and Technology, Baramati.

Vision

To achieve Academic Excellence through Persistent and Synergic Collaborations amongst all Stakeholders.

Mission

1. To ensure holistic development of students as lifelong learners and problem solvers through value-based quality education.
2. To motivate faculty to attain the state-of-the-art knowledge and wisdom in their domain and be a facilitator towards cocreation of knowledge.
3. To frame and deploy conducive and empowering policies for multifaceted growth of students, faculty and staff to make them contributors towards excellence.
4. To partner with industry for mutually beneficial relations to generate employable and deployable workforce.
5. To fulfill the aspirations of alumni, parents, society, region and nation at large by generating technically competent and contributing manpower.

Department of Mechanical Engineering,

VPKBIET Baramati

Vision

To inculcate learning culture in students and faculties to meet the current and future technological challenges of industry and society

Mission

1. To impart the students with fundamental knowledge of mechanical engineering.
2. To provide practical exposure by promoting students for training and internship in related industries.
3. Holistic development of the students by inculcating ethical and moral values towards the society and environment.
4. To develop association with premier educational institutions, industries and alumni for enhancement of faculty skill.

Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and Technology
Board of Studies: Mechanical Engineering
Syllabus: Second Year (B. Tech.) Mechanical Engineering
2025 Pattern w.e.f. AY: 2026-2027

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	BS25204TH	Advanced Mathematics For Mechanical Engineering	3	-	-	10	30	60	-	-	-	100	3	-	-	3
PCC	ME25201TH	Engineering Metallurgy	3	-	-	10	30	60	-	-	-	100	3	-	-	4
PCC	ME25201PR	Engineering Metallurgy	-	2	-	-	-	-	-	-	30	30	-	1	-	
PCC	ME25202TH	Applied Thermodynamics	3	-	-	10	30	60	-	-	-	100	3	-	-	4
PCC	ME25202PR	Applied Thermodynamics	-	2	-	-	-	-	-	-	30	30	-	1	-	
PCC	ME25203TH	Mechanics of Material	3	-	-	10	30	60	-	-	-	100	3	-	-	4
PCC	ME25203PR	Mechanics of Material	-	2	-	-	-	-	-	30	-	30	-	1	-	
VSEC	ME25204TH	Computer Aided Geometric Modelling	1	-	-	40	-	-	-	-	-	40	1	-	-	2
VSEC	ME25204PR	Computer Aided Geometric Modelling	-	2	-	-	-	-	-	30	-	30	-	1	-	
CEP	ME25205PR	Community Engagement Project	-	4	-	-	-	-	40	-	30	70	-	2	-	2
MDM	XXXXXXXTH	Multidisciplinary Minor	2	-	-	10	-	60	-	-	-	70	2	-	-	3
MDM	XXXXXXXPR	Multidisciplinary Minor	-	2	-	-	-	-	30	-	-	30	-	1	-	
Total			15	14	-	90	120	300	70	60	90	730	15	7	-	22

List of Multi-Disciplinary Minor

Code	MDM	Code	MDM
AI25052	Fundamentals of Programming Language	ET25053	Internet of Things

Dr. S. C. Mahadik	Dr. M. S. Lande	Dr. S. M. Bhosle	Dr. A. H. Kolekar
Academic Coordinator	**Head of Department**	**Dean Academics**	**Controller of Examination**

KBIET BARAMATI Affiliated to S.P.P.U. Pune

Dr. S. B. Lande
Principal
Principal

Vidya Pratishthan's Kamalnayan Bajaj Institute of Engineering & Technology, Baramati Vidyanagari, Baramati-413133

Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and Technology
Board of Studies: Mechanical Engineering
Syllabus: Second Year (B. Tech.) Mechanical Engineering
2025 Pattern w.e.f. AY: 2026-2027

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	ME25211TH	Manufacturing Practices	3	-	-	10	30	60	-	-	-	100	3	-	-	4
PCC	ME25211PR	Manufacturing Practices	-	2	-	-	-	-	-	30	-	30	-	1	-	
PCC	ME25212TH	Theory of Machines	3	-	-	10	30	60	-	-	-	100	3	-	-	4
PCC	ME25212PR	Theory of Machines	-	2	-	-	-	-	-	-	30	30	-	1	-	
PCC	ME25213TH	Fluid Mechanics	2	-	-	10	-	60	-	-		70	2		-	3
PCC	ME25213PR	Fluid Mechanics	-	2	-	-	-	-	-	-	30	30	-	1	-	
MDM	XXXXXXXTH	Multidisciplinary Minor	3	-	-	10	30	60	-	-	-	100	3	-	-	4
MDM	XXXXXXXPR	Multidisciplinary Minor	-	2	-	-	-	-	30	-	-	30	-	1	-	
OE	OE25XXXTH	Open Elective	2	-	-	10	-	60	-	-	-	70	2	-	-	2
VEC	HS25211TH	Environment Studies	2	-	-	10	-	60	-	-	-	70	2	-	-	2
AEC	HS25212TH	Public Speaking and Aptitude	1	-	-	40	-	-	-	-	-	40	1	-	-	2
AEC	HS25212PR	Public Speaking and Aptitude	-	2	-	-	-	-	-	-	30	30	-	1	-	
Total			**16**	**10**	**-**	**100**	**90**	**360**	**30**	**30**	**90**	**700**	**16**	**5**	**-**	**21**

List of Electives, Multi-Disciplinary Minor and Open Elective

Code	MDM	Code	OE
BS25053	**Linear Algebra And Statistics**	OE25001	Digital Marketing
AI25053	Artificial Intelligence and Machine Learning	**OE25002**	**Accounting and Finance**

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Academic Coordinator	**Head of Department**	**Dean Academics**	**Controller of Examination**

VPKBIET BARAMATI Affiliated to S.P.P.U. Pune Id No./PU/PN/Engg./152/2000 PUNE (MS.)

Dr. S. B. Lande

Principal

Vidya Pratishthan's
Kamalnayan Bajaj Institute of
Engineering & Technology, Baramati
Vidyanagari, Baramati-413133

BS25204- 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:

Course Outcomes (COs): 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 Hours]**
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 Hours]**
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 Hours]**
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 Hours]**
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 Hours]**
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)	**[08 Hours]**

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.

ME25201- ENGINEERING METALLURGY		
Teaching Scheme:	**Credits:04**	**Examination Scheme:**
TH: 03 Hrs/Week **PR : 02 Hrs/Week**	**Theory : 03** **Practical: 01**	**CAA: - 10 Marks** **In-Semester Exam: 30 Marks** **End-Semester Exam: 60 Marks** **Oral Exam: 30 Marks**

Prerequisites:

Higher Secondary Science Courses, Engineering Physics, and Engineering Chemistry.

Objectives:

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

Course Outcomes:

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

CO1. COMPARE crystal structures and ASSESS different lattice parameters.

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

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

CO4. IDENTIFY & ESTIMATE different parameters of the system, viz., phases, variables, components, grains, grain boundaries, and degrees of freedom. etc.

CO5. ANALYSE the effect of alloying elements & heat treatment on the properties of ferrous & nonferrous alloys.

CO6. SELECT appropriate materials for various applications.

Course Contents

Unit-1: Crystal Structures and Deformation of Materials	**[07 Hrs.]**

***Crystal Structures*:** Concept of crystal lattice, unit cell, and lattice parameters, Crystal structures of metals: BCC, FCC, and HCP; Coordination number and Atomic Packing Factor (APF); Examples of metals with each structure; Influence of crystal structure on mechanical properties

Crystal Imperfections and Diffusion: Types of crystal defects, Point defects: vacancy, interstitial, substitutional atoms, Line defects: dislocations (edge and screw), Surface defects: grain boundaries, Diffusion in solids, Vacancy diffusion, Interstitial diffusion,

Factors affecting diffusion.

Properties of Engineering Materials: Overview of Mechanical properties: hardness, toughness, impact strength, Electrical properties: conductivity and resistivity, Magnetic properties: diamagnetism, paramagnetism, ferromagnetism, Brief note on optical properties.

***Deformation Mechanisms in Materials*:** Elastic deformation and stress–strain behavior, Plastic deformation mechanisms, Slip, Twinning, Work hardening (strain hardening).

Fracture and Failure of Materials: Types of fracture: ductile and brittle fracture, Basic concept of fatigue failure, Introduction to creep failure.

Recovery, recrystallization, and grain growth (conceptual introduction): slip, twinning, work, hardening, recovery, recrystallization, and grain growth. Elastic deformation, Plastic deformation.

Unit-2: Material Testing and Characterization Techniques	**[06 Hrs.]**

***Destructive Testing of Materials*:** Introduction to mechanical testing methods used to determine material properties. Tensile Test **-**Principle, stress–strain curve, determination of yield strength, ultimate tensile strength, and ductility. Impact Test-Principle of Charpy and Izod tests, concept of impact energy, and ductile–brittle transition. Hardness Testing Principles and applications of common hardness tests: Brinell hardness test, Rockwell hardness test, Vickers hardness test.

Non-Destructive Testing (NDT) Methods: *(Principle, Advantages, Limitations, and applications*

only) Dye Penetrant Testing (DPT), Magnetic Particle Testing (MPT), Ultrasonic Testing (UT), Eddy Current Testing (ECT), Radiography Testing (RT), Applications of NDT in defect detection, quality control, and safety assessment of engineering components.

***Microscopic Characterization Techniques*: Sample Preparation for Metallography-** Sectioning, mounting, grinding and polishing, etching procedure and purpose Optical Microscopy **-** Principle and applications in microstructure observation, Electron Microscopy *(Principle and applications only)*- Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), X-Ray Diffraction (XRD), Principle of diffraction, Basic concept of phase identification and crystal structure analysis.

***Macroscopic Examination Techniques*:** Sulphur Printing – detection of sulphur distribution in steel, Flow Line Observation – identification of forging patterns and defects, Spark Test – identification of ferrous materials based on spark characteristics

Unit-3: Phase Diagrams and Iron–Carbon Diagram	**[08 Hrs.]**

***Solid Solutions in Metals*:** Introduction to solid solutions, Types of solid solutions: Substitutional solid solutions, Interstitial solid solutions. Applications of solid solutions in engineering alloys.

***Solidification of Metals and Alloys*:** Concept of nucleation and crystal growth**,** Types of nucleation, Homogeneous nucleation, Heterogeneous nucleation, Solidification of pure metals**,** Solidification of alloys, Formation of grain structures during solidification, Importance of solidification in casting and microstructure development.

***Phase Diagrams and Phase Rule*:** Definition of phase, component, and degree of freedom, Gibbs Phase Rule and its application in metallurgical systems, Cooling curves and their interpretation, Types of phase diagrams, Unary phase diagrams, Binary phase diagrams, Significance of phase diagrams in alloy design and heat treatment.

***Iron–Carbon Equilibrium Diagram*:** Detailed study of the Fe–C equilibrium diagram with emphasis on: Phases present in iron–carbon system, Ferrite (α), Austenite (γ), Cementite (Fe_3C), Critical temperatures and composition limits, Microstructures in steels and cast irons, Invariant reactions in Fe–C system: Eutectic reaction, Eutectoid reaction, Peritectic reaction**,** Formation of pearlite, ledeburite, and proeutectoid phases, Classification of steels and cast irons based on carbon content.

Unit-4: Heat Treatment of Steels	**[08 Hrs.]**

***Fundamentals of Heat Treatment*:** Objectives and importance of heat treatment, Basic heat treatment cycle: heating, soaking, and cooling, Critical temperatures in steels (A_1, A_3, Acm), Effect of heat treatment on microstructure and mechanical properties of steels

***Heat Treatment Processes of Steels*:** Annealing - Full annealing, Process annealing, Spheroidizing, Purpose and applications. Normalizing - Process and microstructural changes, Differences between annealing and normalizing. Hardening - Austenitizing and quenching process, Quenching media: water, oil, brine, air, Effect of cooling rate on hardness. Tempering - Purpose of tempering, Stages of tempering, Effect on hardness, toughness, and ductility

***Isothermal Transformation Diagrams (TTT Diagram)*:** Concept of Time–Temperature – Transformation (TTT) diagrams, Formation of microstructures: Pearlite, Bainite, Martensite. Significance of TTT diagrams in heat treatment process design

***Surface Hardening Processes*:** Heat treatment processes used to improve surface hardness while maintaining a tough core. Carburizing, Nitriding, Cyaniding, Flame hardening, Induction hardening, Applications in gears, shafts, cams, and machine components.

Unit-5: Ferrous Alloys	**[06 Hrs.]**

***Introduction to Ferrous Alloys*:** Definition and classification of ferrous alloys, Importance of iron-based materials in engineering applications, Effect of alloying elements on properties of steels, Carbon, manganese, chromium, nickel, molybdenum, silicon.

***Plain Carbon Steels*:** Classification of steels based on carbon content: Low carbon steels, Medium carbon steels, High carbon steels, Microstructure and properties of each category, Typical applications in engineering components.

***Alloy Steels*:** Introduction and purpose of alloying in steels, Classification of alloy steels -Low alloy steels, High alloy steels, Examples of important alloy steels: Stainless steels (austenitic, ferritic, martensitic), Tool steels, High speed steels, Engineering applications of alloy steels.

***Cast Irons*:** Introduction and composition of cast irons, Types of cast irons: Grey cast iron, White cast iron, Malleable cast iron, Ductile (nodular) cast iron, Microstructure and properties, Applications in machine components and structures.

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

***Introduction to Non-Ferrous Metals and Alloys*:** Definition and importance of non-ferrous alloys, Advantages over ferrous materials: Corrosion resistance, Electrical conductivity, Lightweight properties, Applications in engineering industries.

***Aluminum and Its Alloys*:** Properties of aluminum, Classification of aluminum alloys, wrought aluminum alloys, Cast aluminum alloys, Important aluminum alloy systems, Applications in aerospace, automotive, and structural components.

***Copper and Its Alloys*:** Properties of copper, Important copper alloys: Brass, Bronze, Phosphor bronze, Applications in electrical and mechanical engineering.

***Magnesium and Titanium Alloys*:** Properties and applications of magnesium alloys, Properties and applications of titanium alloys, Importance in aerospace, biomedical, and lightweight structures.

Text Books:

1. Kodgire, V. D., and Kodgire, S. V., *Material Science and Metallurgy for Engineers*, Everest Publishing House, Pune.
2. Callister, William D., Jr., *Materials Science and Engineering: An Introduction*, John Wiley & Sons, Inc.

Reference Books:

1. Bhargava, A. K., and Sharma, C. P., *Mechanical Behavior and Testing of Materials*, PHI Learning Private Limited.
2. Raghavan, V., *Materials Science and Engineering*, Prentice Hall of India, New Delhi.
3. Avner, S. H., *Introduction to Physical Metallurgy*, Tata McGraw-Hill Publishing Company.
4. Higgins, R. A., *Engineering Metallurgy*, Viva Books Private Limited.
5. Dieter, George Ellwood, *Mechanical Metallurgy*, McGraw-Hill Education.
6. Smith, W. F., Hashemi, J., and Prakash, R., *Materials Science and Engineering in SI Units*, Tata McGraw-Hill Education Private Limited.

Suggested Activities (Any Two):

Students shall perform **any two of the following activities** to enhance conceptual understanding and practical exposure to materials and metallurgy concepts.

1. Study of Engineering Alloys: Students shall explore an engineering alloy or material and prepare a technical report covering:

- Name of alloy/material
- Chemical composition
- Mechanical and physical properties
- Microstructure characteristics
- Heat treatment processes
- Standard designation/specification (IS/ASTM/AISI etc.)
- Typical engineering applications

Each student shall select one unique alloy or material.

2. Component Study from Material and Manufacturing Perspective: Students shall examine a mechanical component from material and manufacturing viewpoints.

The report shall include:

- Component name
- Material used
- Basic drawing or schematic of component
- Manufacturing process used
- Mechanical properties required
- Microstructure characteristics
- Heat treatment (if applicable)
- Typical applications

Examples: spur gear, bearing, cutting tool, shaft, needle, spring, bolt, turbine blade.
Each student shall study one component.

3. Virtual Laboratory Experiments (IIT Bombay Virtual Labs)

Students shall perform virtual experiments related to materials testing such as:

- Creep test simulation
- Fatigue test simulation

Students must submit a brief experimental report with observations and conclusions.

4. Microscopy and Characterization Virtual Lab: Students shall perform Fluorescence Microscopy or related microscopy experiments using IIT Bombay Virtual Labs and submit a short report explaining:

- Principle of the technique
- Observations and interpretation of microstructure.

5. Industrial Visit and Report: An industrial visit shall be arranged to provide exposure to practical applications of materials engineering. Suitable industries may include:

- Metallurgy or material testing laboratories
- NDT laboratories
- NABL accredited testing laboratories
- Engineering manufacturing clusters
- Heat treatment or casting industries

Students must submit a properly documented Industrial Visit Report covering process observations and materials used.

6. NPTEL / SWAYAM Online Learning: Students may complete a relevant NPTEL SWAYAM course, such as: "Basics of Materials Engineering", Students must submit the course completion certificate or learning summary report.

List of Experiments:

1. **Destructive Testing – Hardness Testing:** Perform hardness testing using Rockwell or Brinell hardness testing machines and compare hardness values of different materials.
2. **Hardness Testing using Vickers / Poldi Hardness Test:** Study the principle and operation of Vickers or Poldi hardness test and determine hardness of selected engineering materials.
3. **Impact Testing:** Conduct Charpy or Izod impact test on materials such as steel, aluminum, brass, and copper to evaluate impact strength.
4. **Non-Destructive Testing (NDT):** Demonstration and study of defect detection methods using one or more of the following techniques:
    - Dye Penetrant Testing (DPT)
    - Magnetic Particle Testing (MPT)
    - Ultrasonic Testing (UT)
5. **Metallographic Specimen Preparation:** Study the steps involved in specimen preparation for microscopic examination, including sectioning, mounting, grinding, polishing, and etching. Demonstration of optical metallurgical microscope.
6. **Microstructure Observation of Ferrous Metals:** Observation and drawing of microstructures of steels and cast irons of different compositions using an optical metallurgical microscope.
7. **Microstructure Observation of Non-Ferrous Metals:** Observation and drawing of microstructures of non-ferrous metals and alloys such as aluminum alloys, brass, and bronze.

8. **Heat Treatment of Steels:** Perform heat treatment processes such as annealing, normalizing, or hardening, and compare relative hardness before and after heat treatment.
9. **Tensile Testing:** Conduct tensile test using Universal Testing Machine (UTM) and determine properties such as yield strength, ultimate tensile strength, and percentage elongation.

Assessment Guidelines: The Term Work (TW) assessment shall be based on the following:

- Completion of minimum six experiments
- Quality and regularity of laboratory journal
- Understanding of experimental procedures
- Interpretation of results and observations
- Viva-voce conducted during laboratory sessions

ME25202- APPLIED THERMODYNAMICS		
Teaching Scheme:	**Credits: 04**	**Examination Scheme:**
TH: 03 Hrs./Week	**Theory : 03** **Practical : 01**	**Course Activity: 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 IC engine terminology and DETERMINE performance parameters of IC Engines.

CO4. CALCULATE parameters such as refrigerating effect, compressor power, and COP of refrigeration system.

CO5. EXPLAIN psychrometric properties and processes using the psychrometric chart.

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

Course Contents

Unit-1: Steam Power Cycle	**[08 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	**[06 Hrs.]**
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. Emissions: Sources of emissions and their effect on environment. Need for emission control and regulations.	
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, Air-standard cycles, various losses, and Comparison of Air standard with Actual cycle. **Performance Parameters:** Indicated power, Brake power, fuel consumption, Air Consumption, Mean effective pressure, various efficiencies, specific fuel consumption, heat balance sheet of IC Engines.	
Unit- 4: Basics of Refrigeration	**[07 Hrs.]**
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.	
Unit-5: Psychrometry and Air Conditioning	**[07Hrs.]**
Introduction, Psychrometry and Psychrometric Properties, Basic Terminologies & Psychrometric Relations, Psychrometric Processes, Psychrometric Chart.	

Sensible, latent heat, SHF, ADP, Cooling load estimation; comfort conditions

Unit-6: Positive Displacement Compressor	**[07 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 : .2001 ,th edition5 ,0130272706

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 IC Engines 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 any cold storage/Ice factory for study of refrigeration systems. Its presentation.
6. Visit any automobile service station to see the IC Engine systems. It's a presentation.

Guidelines for Lab /TW Assessment

Practical (Minimum 8 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.

ME25203- MECHANICS OF MATERIAL		
Teaching Scheme:	**Credits:04**	**Examination Scheme:**
TH: 03 Hrs./Week **PR : 02 Hrs./Week**	**Theory : 03** **Practical: 01**	**CAA: - 10 Marks** **In-Semester Exam: 30 Marks** **End-Semester Exam: 60 Marks** **Practical Exam: 30 Marks**

Prerequisites:

Engineering Mathematics- I and II, Physics and Engineering Mechanics

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 1: 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 2: 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 3: 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 4: 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 5: Principal Stresses	**[07 Hr.]**
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 6: 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.

ME25204- COMPUTER AIDED GEOMETRIC MODELLING		
Teaching Scheme:	**Credits:02**	**Examination Scheme:**
TH: 01 Hrs./Week	**Theory : 01**	**CAA: 40 Marks**
PR : 02 Hrs./Week	**Practical: 01**	**Practical Exam: 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:

The students will be able to learn:

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.

Course Contents

Unit 1: Fundamentals of Geometric Modeling and 2D Sketching	**[06 Hr.]**
Introduction to Computer Aided Geometric Modeling: Concept of CAD and geometric modeling, role of CAD in product design and development, advantages of CAD in engineering applications. **Types of Geometric Modeling:** Wireframe modeling, surface modeling and solid modeling – concepts, advantages and limitations. **Coordinate Systems and Geometric Transformations:** World coordinate system, local coordinate system, translation, rotation and scaling transformations. **2D Sketching Concepts:** Geometric entities (line, circle, arc, spline etc.), geometric constraints and dimensional	

constraints, sketch editing and modification techniques.

Parametric Modeling:

Concept of parametric design, feature-based modeling and design intent in CAD systems.

Unit 2: Solid Modeling, Assembly Modeling and Surface Modeling	**[06 Hr.]**

Solid Modeling Techniques:

Introduction to solid modeling, constructive solid geometry (CSG), boundary representation (B-Rep), feature-based modeling.

Basic Solid Modeling Operations:

Extrude, revolve, sweep, loft, fillet, chamfer and shell operations used in modeling of mechanical components.

Assembly Modeling:

Concept of assembly modeling, mating conditions and assembly constraints, bottom-up and top-down assembly approaches.

Surface Modeling:

Concept of curves and surfaces, creation of basic surfaces, surface trimming and surface editing.

CAD Customization:

Introduction to CAD customization, macros, templates and user interface customization in CAD software.

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.

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)

ME25205 - COMMUNITY ENGAGEMENT PROJECT		
Teaching Scheme:	**Credits:02**	**Examination Scheme:**
PR : 04 Hrs./Week	**Practical: 02**	**Termwork: 40 Marks**
		OR Exam: 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:

The students will be able to learn:

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.

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 (40 Marks):

1. **Problem Identification and Research (7 Marks)**

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

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

2. **Design and Concept Development (7 Marks)**

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

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

3. **Prototyping and Testing (7 Marks)**

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

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

4. **Implementation and Community Engagement (7 Marks)**

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

   3 Marks: Modifications based on community feedback.

5. **Documentation and Report Writing (7 Marks)**

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

   3 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.

AI25052: 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.

ME25211- MANUFACTURING PRACTICES		
Teaching Scheme:	**Credits:04**	**Examination Scheme:**
TH: 03 Hrs/Week **PR : 02 Hrs/Week**	**Theory : 03** **Practical: 01**	**CAA: - 10 Marks** **In-Semester Exam: 30 Marks** **End-Semester Exam: 60 Marks** **Practical Exam: 30 Marks**

Prerequisites:

Basic knowledge of Engineering Physics and Materials Science and Metallurgy, particularly concepts related to material properties, crystal structures, and behavior of engineering materials during manufacturing processes.

Objectives:

The objectives of this course are to enable students to:

1. Describe various sand casting and permanent mold casting methods, including procedures, mold design considerations, and casting defects.
2. Understand the fundamentals of metal forming processes, including the working principles, equipment, and tooling used in rolling, forging, extrusion, and drawing operations.
3. Explain sheet metal forming operations such as bending, deep drawing, and punching, along with basic concepts of die and tooling design.
4. Classify and describe different welding processes, including their principles, equipment, advantages, limitations, and applications in manufacturing industries.
5. Understand polymer and plastic processing techniques, such as injection molding, extrusion, compression molding, and blow molding.
6. Introduce composite materials, their types, properties, and common fabrication processes used in engineering applications.

Course Outcomes:

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

CO1: Select appropriate molding, core making, and melting practices for sand casting and estimate pouring time and solidification rate, and design riser size and location for sand casting processes.

CO2: Understand the mechanism of metal forming processes and calculate the load required for flat rolling operations.

CO3: Demonstrate press working operations and apply fundamental principles to design dies and tools for forming and shearing operations.

CO4: Classify and explain various welding processes, and evaluate their characteristics, advantages, limitations, and applications.

CO5: Differentiate thermoplastic and thermosetting polymers, and explain various polymer processing techniques used in manufacturing.

CO6: Understand the manufacturing principles of composite materials, including fiber-reinforced composites and metal matrix composites.

Course Contents

Unit-1: Metal Casting Processes	**[07 Hrs.]**
Introduction to Casting Processes: Introduction to metal casting process, steps involved in casting process, advantages, limitations and applications of casting in manufacturing industries. **Patterns and Pattern Design:** Pattern materials, types of patterns such as single piece pattern, split pattern, match plate pattern and loose piece pattern, pattern allowances including shrinkage allowance, draft allowance, machining allowance and distortion allowance, basic principles of pattern design. **Moulding Sand and Core Making:** Constituents of moulding sand, properties of moulding sand such as permeability, strength, refractoriness, plasticity and collapsibility, preparation of moulding sand, core making, core prints and core boxes. **Melting Practices and Furnaces:** Basic melting practices used in foundries, types of furnaces such as cupola furnace, crucible furnace, electric arc furnace and induction furnace. **Pouring and Gating System Design:** Functions and elements of gating system such as	

pouring basin, sprue, runner and gate, types of gating systems, principles of gating design, numerical estimation of mould filling time.

Riser Design and Solidification of Castings: Functions and types of risers, basic principles of riser design and placement, principles of cooling and solidification of casting, directional and progressive solidification, estimation of solidification rate.

Cleaning, Finishing and Casting Defects: Cleaning and finishing operations of castings (fettling), common casting defects such as blowholes, shrinkage cavities, cold shuts and misruns, causes and remedies.

Permanent Mould Casting Processes: Principles and applications of permanent mould casting, investment casting, centrifugal casting, and continuous casting.

Unit-2: Metal Forming Processes	**[07 Hrs.]**

Plastic Deformation and Material Behavior: Plastic deformation of metals, stress–strain diagram for different types of materials, concept of yield point and strain hardening, hot working and cold working processes, advantages and limitations of hot and cold working, factors affecting plastic deformation, yield criteria, concept of flow stress, introduction to forming limit diagram.

Rolling Process: Introduction to rolling process, rolling terminology, types of rolling mills, friction in rolling, calculation of rolling load, basic defects in rolling, and their causes.

Forging Process: Introduction to forging process, open die forging and closed die forging, common forging operations such as upsetting, drawing down, bending and punching, and applications of forging.

Extrusion Process: Introduction to extrusion, types of extrusion such as direct and indirect extrusion, basic process parameters, advantages, and applications of extrusion.

Wire and Tube Drawing: Wire drawing and tube drawing processes, drawing equipment, die profile, and materials used for drawing dies.

Friction, Lubrication, and Forming Defects: Role of friction and lubrication in metal forming processes, common forming defects in rolling, forging, extrusion, and drawing, causes and remedies of forming defects.

Unit-3: Sheet Metal Forming	**[07 Hrs.]**

Introduction to Sheet Metal Forming: Introduction to sheet metal forming processes, classification of sheet metal operations such as cutting operations (blanking, punching, piercing, notching, trimming) and forming operations (bending, drawing, flanging, embossing), applications of sheet metal forming in manufacturing industries.

Press Working Equipment and Terminology: Press working equipment, types of presses such as mechanical and hydraulic presses, press working terminology including punch, die, bolster plate, stripper, shut height, and stroke length.

Types of Dies and Clearance Analysis: Types of dies such as simple dies, compound dies, progressive dies, and combination dies, die components and construction, concept of clearance between punch and die, effect of clearance on cutting operation.

Cutting Force and Centre of Pressure: Estimation of cutting forces in sheet metal operations, determination of center of pressure, blank size determination for sheet metal components.

Strip Layout and Blanking Die Design: Design of strip layout for efficient material utilization, calculation of scrap allowance, principles of blanking die design, and basic die design considerations.

Drawing and Bending Operations: Introduction to drawing process, drawing dies and drawing operations, bending operations and bending dies, springback in bending, and methods to reduce it.

Formability and Force Reduction Methods: Concept of sheet metal formability, forming limit diagram, methods of reducing forming forces, common defects in sheet metal forming, and their remedies.

Unit-4: Welding Processes	**[07 Hrs.]**

Introduction to Joining Processes: Classification of joining processes, welding terminology, types of welded joints such as butt joint, lap joint, corner joint, edge joint, and tee joint, advantages, limitations, and applications of welding.

Arc Welding Processes: Principles and equipment of arc welding processes, including single carbon arc welding, Flux Cored Arc Welding (FCAW), Tungsten Inert Gas (TIG) welding, Metal

Inert Gas (MIG) welding, and Submerged Arc Welding (SAW), basic operating principles, and applications.

Resistance Welding: Principles and applications of resistance welding processes such as spot welding, seam welding, and projection welding, concept of heat generation and heat balance in resistance welding.

Gas Welding and Allied Processes: Principles and equipment of gas welding and gas cutting processes, basic principles of soldering, brazing, and braze welding, advantages and applications of these joining methods.

Welding Metallurgy and Heat Affected Zone: Introduction to welding metallurgy, microstructural changes during welding, concept and significance of heat-affected zone (HAZ).

Weld Inspection and Defects: Methods of weld inspection, common welding defects such as cracks, porosity, slag inclusion, lack of fusion, and incomplete penetration, causes and remedies of welding defects.

Unit-5: Processing of Polymers	**[07 Hrs.]**

Introduction to Polymer Materials: Thermoplastics and thermosetting plastics, basic differences in structure, properties, and applications, importance of polymers in engineering applications.

Processing of Polymers: Introduction to polymer processing techniques, characteristics of polymer materials during processing, advantages and limitations of polymer processing methods.

Thermoforming Processes: Principle of thermoforming process, heating and forming of thermoplastic sheets, applications of thermoforming in manufacturing industries.

Molding Processes: Principles and equipment of molding processes, including compression molding, transfer molding, blow molding, rotational molding, and injection molding, process steps, advantages, and applications.

Extrusion of Plastics: Principle of the extrusion process, types of extruders such as single screw and twin screw extruders, extrusion of plastic products such as films, pipes, cables, and sheets.

Pressure Forming and Vacuum Forming: Principles of pressure forming and vacuum forming processes, equipment used, advantages, and applications in plastic product manufacturing.

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

Introduction to Composites: Introduction to composite materials, advantages and applications of composites, basic composite properties, constituents of composites such as matrix and reinforcement, types of matrices and fiber reinforcements.

Composite Manufacturing Processes: Hand lay-up process and spray lay-up process, principles, steps involved, and applications in the manufacturing of fiber-reinforced polymer components.

Advanced Composite Fabrication Processes: Filament winding process, resin transfer molding (RTM), pultrusion process, and compression molding process, principles, equipment, and applications.

Impregnation and Processing Techniques: Vacuum impregnation process, importance of proper fiber–matrix bonding and curing during composite fabrication.

Manufacturing of Advanced Composites: Processing of metal matrix composites (MMC), fabrication of ceramic matrix composites (CMC), carbon–carbon composites, introduction to polymer matrix composites and nano-composites, applications in aerospace, automotive, and structural engineering.

Text Books:

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

Reference Books:

1. R. K. Jain, *Production Technology*, Khanna Publishers.
2. K. K. Chawla, *Composite Materials: Science and Engineering*, Springer, ISBN: 978-0387743646 / 978-0387743653.
3. Brent Strong, *Fundamentals of Composites Manufacturing: Materials, Methods and*

Applications, SME Book Series.

Technical Activities for CAA Assessment (Any One):

1. **Industrial Visit to Foundry / Casting Industry:** Visit a foundry or casting industry to observe the various stages of casting. Students should study and document the sand casting process including pattern making, mould preparation, melting of metal, pouring, solidification and finishing operations. A detailed report describing the process and observations should be submitted.
2. **Industrial Visit to Sheet Metal Forming Industry:** Visit a sheet metal forming industry and observe operations such as blanking, punching, bending, drawing and press working. Students should prepare a report describing the machines used, tooling, materials processed and applications.
3. **Industrial Visit to Metal Forming Industry:** Visit a rolling mill, wire drawing unit, tube drawing plant or forging industry. Students should observe the manufacturing process, equipment used, material flow and applications, and submit a report summarizing their observations.
4. **Manufacturing of a Simple Product in Workshop:** Students shall manufacture a simple component or product using basic manufacturing operations available in the workshop such as marking, cutting, drilling, turning, welding or sheet metal forming. Examples include a small tool holder, sheet metal tray, clamp, hook, or simple mechanical component.
5. **Virtual Laboratory Experiment:** Perform a virtual laboratory experiment related to manufacturing processes such as casting, metal forming or welding using available online simulation platforms. Students should submit a short report including objective, procedure and observations.
6. **NPTEL / SWAYAM Online Course:** Students may enroll in an NPTEL SWAYAM course such as *Fundamentals of Manufacturing Processes* and submit the course completion certificate or a summary report of learning outcomes.

7. **Casting Process Demonstration Study:** Demonstration of a sand casting process in the workshop or laboratory. Students should observe pattern making, mould preparation and pouring process and document the steps involved.
8. **Sheet Metal Product Fabrication:** Fabrication of a simple sheet metal component such as a tray, funnel or box using operations like cutting, bending and riveting.
9. **Welding Practice and Joint Preparation:** Students perform basic welding practice (arc or gas welding) and study different types of welded joints such as butt joint, lap joint and corner joint.
10. **Machining Operation Study:** Perform basic machining operations on a lathe or drilling machine such as turning, facing or drilling and study cutting parameters and surface finish.
11. **Defect Identification Activity:** Students examine manufactured components or welded joints to identify possible manufacturing defects and discuss causes and remedies.

These activities help students gain hands-on exposure to manufacturing processes and improve practical understanding of the subject**.**

List of Practical's (Minimum Six):

1. **Demonstration of CNC Machining:** Introduction to CNC machine tools, basic CNC components, part programming concepts (G-code and M-code), demonstration of CNC turning or CNC milling operations for simple components.
2. **Demonstration of Additive Manufacturing (3D Printing):** Demonstration of additive manufacturing process using Fused Deposition Modeling (FDM). Students should study working principle, machine components, slicing software, materials used and applications in rapid prototyping.
3. **Demonstration of Arc Welding Process:** Demonstration of MIG / TIG welding process. Students should study welding equipment, welding parameters, types of joints, edge preparation and electrode specifications.

4. **Demonstration of Resistance or Gas Welding:** Demonstration of spot welding or gas welding process including equipment setup, welding parameters, safety precautions and applications.
5. **Demonstration of Polymer Processing:** Demonstration of injection moulding or thermoforming process for manufacturing simple plastic components such as bottle caps, handles or small housings.
6. **Demonstration of Machining Operations on Lathe:** Study and demonstration of basic lathe operations such as facing, straight turning, taper turning, drilling and knurling.
7. **Demonstration of Milling Machine and Indexing Mechanism:** Demonstration of basic milling operations such as slot milling and gear cutting along with study of indexing mechanism.
8. **Demonstration of Grinding Process and Surface Measurement:** Demonstration of cylindrical grinding or surface grinding operations. Measurement of surface finish using surface roughness tester and estimation of machining time.
9. **Introduction to Robotics / Automated Manufacturing:** Demonstration of industrial robot or robotic arm used in manufacturing for material handling, welding or pick-and-place operations. Basic understanding of robot components and applications in smart manufacturing.
10. **Manufacturing of a Simple Workshop Job:** Fabrication of a simple product using workshop operations such as fitting, turning, welding or sheet metal work (example: tool holder, sheet metal tray, clamp, bracket etc.).
11. **Carpentry and Pattern Making:** Introduction to woodworking operations, types of woods, carpentry hand tools and machines, wood joints and pattern making with allowances used in casting.

Term Work Assessment: Term work shall be based on:

- Completion of minimum six practicals
- Properly maintained laboratory journal

- Understanding of manufacturing processes and equipment
- Demonstration / fabrication of workshop job

Viva-voce conducted during practical sessions.

ME25212- THEORY OF MACHINES		
Teaching Scheme:	**Credits:04**	**Examination Scheme:**
TH: 03 Hrs./Week **PR : 02 Hrs./Week**	**Theory : 03** **Practical: 01**	**CAA: - 10 Marks** **In-Semester Exam: 30 Marks** **End-Semester Exam: 60 Marks** **Oral Exam: 30 Marks**

Prerequisites:

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

Objectives:

1. To make the students conversant with kinematic analysis of mechanisms applied to real life and industrial applications.
2. To develop the competency to analyze the velocity and acceleration in mechanisms using analytical and graphical approach.
3. To develop the skill to propose and synthesize the mechanisms using graphical and analytical techniques.
4. To develop the competency to understand & apply the principles of gear theory to design various applications.
5. 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	**[07 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 (NPTEL)

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.

ME25213- FLUID MECHANICS		
Teaching Scheme:	**Credits:03**	**Examination Scheme:**
TH: 02 Hrs./Week **PR : 02 Hrs./Week**	**Theory : 02** **Practical: 01**	**CAA: - 10 Marks** **End-Semester Exam: 60 Marks** **OR Exam: 30 Marks**

Prerequisites:

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 1: 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 2: 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 3: Fluid Dynamics	**[07 Hr.]**

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 4: 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 (NPTEL)

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.

BS25053 - 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.

OE25002- ACCOUNTING AND FINANCE		
Teaching Scheme:	**Credits:02**	**Examination Scheme:**
TH: 02 Hrs./Week	**Theory : 02**	**CAA: - 10 Marks**
		End-Semester Exam: 60 Marks

Prerequisites: Basic Mathematics.

Objectives:

1. To introduce students to the fundamental concepts, scope, principles, and standards of accounting, enabling them to understand the role of accounting in business decision-making and financial reporting.
2. To familiarize students with the double entry system of accounting and the complete accounting cycle, including journalizing, posting, trial balance preparation, and final accounts of sole proprietorships.
3. To develop an understanding of accounting practices followed by non-trading organizations and to introduce methods for error identification, rectification, and bank reconciliation.
4. To equip students with knowledge of hire purchase accounting, interest and cash price calculations, and to introduce negotiable instruments such as bills of exchange and related accounting concepts.

Course Outcomes:

After completing this course, students will be able to:

CO1: Explain the meaning, need, and development of accounting, distinguish between bookkeeping and accounting, identify various branches and users of accounting information, and demonstrate a basic understanding of accounting principles and accounting standards in India and at the international level.

CO2: Apply the rules of debit and credit, record business transactions through journal entries and ledgers, prepare trial balances and cash books, and **construct final accounts of sole trading concerns** with logical accuracy.

CO3: Prepare receipt and payment accounts, income and expenditure accounts, and balance sheets for non-trading concerns, classify and rectify accounting errors using suspense accounts, and prepare bank reconciliation statements for simple cases.

CO4: Differentiate between hire purchase and installment systems, compute cash price and interest using the asset accrual method, and **apply accounting treatments**

for bills of exchange, including accommodation bills, average due date, and account current.

Course Contents

Unit-1: Introduction to Accounting	**[07 Hrs.]**
Meaning and Scope of Accounting: Need, development, and Definition of Accounting - Bookkeeping and Accounting - Persons interested in accounting – Disclosures - Branches of Accounting - Objectives of Accounting - Accounting Principles International Accounting Standards (only outlines) - Accounting principles - Accounting Standards in India.	
Unit-2: Double Entry System and Final Accounts of Sole Trading Concern	**[07 Hrs.]**
Double Entry system and Book Keeping - Rules of debit and credit - Accounting Cycle transactions - Journal - Compound journal entry - Opening entry – Relationships - Ledger – Journal vs Ledger - Rules regarding posting - Preparation of Trial Balance - Preparation of Final Accounts of Sole Traders – Preparation of Cash Book.	
Unit-3: Non-Trading Accounts	**[07 Hrs.]**
Non-Trading Concerns' Accounts – Capital Vs. Revenue Accounts - Preparation of Receipt and Payment Account - Income & Expenditure Account and Balance sheet (simple problems) - Classification of Errors - Rectification of errors- Preparation of Suspense Account - Bank Reconciliation Statement (Only simple problems)	
Unit-4: Hire Purchase Accounting and Bill of Exchange	**[07 Hrs.]**
Meaning and Definition of Hire Purchase and Installment Purchase System- the difference between Hire Purchase and Installment Purchase – Importance – Hire Purchase Agreement – Hire Purchase Price – Cash Price – Hire Purchase Charges – Net Hire Purchase Price – Net Cash Price – Calculation of Interest – Calculation of Cash Price (Asset Accrual Method only) - Bills of exchange – Accommodation bills - Average due date – Account current.	
Text Books: 1. S.P. Jain & K.L. Narang, "Advanced Accounting", Kalyani publishers New Delhi, Delhi, Volume – I, 18th Revised Edition. 2. T. S. Reddy and A. Murthy, "Financial Accounting", Margam publications, Chennai – 600 017, 7th revised edition.	

3. R.L. Gupta and Radhasamy, “Advanced accounting” S. Chand & Company Ltd., New Delhi, edition.
4. Dr M.A. Arulanandam & Dr K.S. Raman, “Advanced Accountancy” Himalaya publications, New Delhi, 1st edition.

Reference Books:

1. M.C. Shukla, T.S. Grewal & S.C. Gupta, “Advanced accounts”, Sultan & Chand publications, New Delhi.
2. P.L. Nagarajan N.Vinayagam, Mani P. L., “Principles of Accountancy”, S. Chand & Company Ltd, New Delhi.
3. T.S. Grewal, “Introduction to Accountancy”, S. Chand & Company Ltd, New Delhi.
4. P.L. Tulsian – Advanced Accountancy – Tata MC Grow Hill companies.

Guidelines for Activity - Report / PPT on (Any one)

1. “Role of Accounting in Modern Organizations”
2. “Complete Accounting Cycle of a Sole Trader”
3. “Accounting System of a Non-Profit Organization”
4. “Hire Purchase and Bills of Exchange – Practical Applications”

HS25211 - 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)

HS25212 - PUBLIC SPEAKING AND APTITUDE		
Teaching Scheme	**Credits: 02**	**Examination Scheme**
Theory 1 Hr. / Week	Theory Credit: 1	CAA: 40 Marks
Practical 2 Hr. / Week	Practical Credit: 1	Oral: 30 Marks

Course Objectives:

1. To develop effective public speaking styles through conversational and communication skills and also enhance speaking skills by focusing on body language and understanding the situational requirements for effective public speaking
2. To develop students' quantitative, logical and analytical abilities required to solve aptitude-based problems commonly encountered in competitive examinations and also enhance their problem-solving speed, decision-making ability and logical reasoning skills

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

1. Communicate effectively in various public speaking situations and deliver organised and engaging speeches with appropriate body language, voice modulation and confident speech techniques

2. Apply appropriate quantitative, logical, and reasoning strategies to efficiently solve numerical aptitude, data interpretation, and logical reasoning problems with improved speed and accuracy in placement and competitive examination contexts and apply rapid analytical, logical and decision-making strategies to solve time-bound problems with improved accuracy and efficiency

Course Contents:

Unit 1: Essentials and Art of Public Speaking (6 Hours)

Sentence Mastery (Sentence Structure + Subject–Verb Agreement), Verb Tense Control (Past / Present / Future Tenses), Functional Usage (Prepositions + Common Errors & Correct Usage), Verbal & Non-Verbal Communication, Active Listening Skills, Public Speaking & Presentation Skills, Confidence Building, Interpersonal Skills & Relationship Building, Teamwork & Collaboration, Body Language & First Impression, Professional Email, Message & Business Writing,

Time Management & Prioritization, Interview Skills & Group Discussion, Workplace Etiquette & Professional Behavior, Emotional Intelligence & Anxiety Control, Stress Management & Work-Life Balance, LinkedIn Profile & Resume Writing, Mock Interviews & Feedback
Unit 2: Quantitative Aptitude (6 Hrs) Number System, Percentages, Ratio & Proportion, Profit, Loss & Discount, Averages, Time, Speed & Distance, Time & Work + Pipes, Simple & Compound Interest (Basic), Data Interpretation (DI), Data Sufficiency, Seating Arrangement (Linear & Circular), Blood Relations, Coding–Decoding, Syllogisms, Statement–Assumption / Argument

Textbooks & Other Resources:

1. King, Dale. Effective Communication Skills: The Nine-Keys Guidebook for Developing the Art of Persuasion through Public Speaking, Social Intelligence, Verbal Dexterity, Charisma, and Eloquence, Hamatea Publishing Studio, 2020
2. King, Patrick. How to Speak Effectively: Master Communication Skills, Public Speaking and Influence | Improve Conversations, Confidence, and Social and Professional Presentations, and Making an Impact on People, Penguin, 2024
3. Tuhovsky, Tuhovsky. *Communication Skills: A Practical Guide to Improving Your Social Intelligence, Presentation, Persuasion and Public Speaking: 9 (Positive Psychology Coaching),* Createspace Independent Publishing, 2015
4. Aggarwal. R.S., Quantitative Aptitude for Competitive Examinations, S Chand and Company Ltd. 2025