ANNA UNIVERSITY, CHENNAI

UNDERGRADUATE CURRICULUM (NON-AUTONOMOUS AFFILIATED INSTITUTIONS)

Programme: B.E., Mechanical Engineering (specialised in Smart Mfg.) **Regulations:** 2025

Abbreviations:

HUM – Humanities (Languages, Management, Heritage, and others)

BS – Basic Science (Mathematics, Physics, Chemistry)

ES – Engineering Science (General (**G**), Programme Core (**PC**), Programme Elective (**PE**) & Emerging Technology (**ET**))

SD – Skill Development

SL – Self Learning

CDP – Capstone Design Project

OE – Open Elective

L – Laboratory Course

T – Theory

LIT – Laboratory Integrated Theory

PW – Project Work

IPW – Internship cum Project Work

DIC – Department Introductory Course

TCP – Total Contact Period(s)

Program Outcomes

1. **Engineering Knowledge**: Apply math, science, and engineering fundamentals to complex problems.
2. **Problem Analysis**: Identify and analyze complex problems using research and sustainability principles.
3. **Design Solutions**: Design systems and processes considering health, safety, cost, culture, and environment.
4. **Investigations**: Use experiments, modelling, and data analysis to reach valid conclusions.
5. **Engineering Tools**: Apply modern tools for modelling and problem-solving, recognizing their limits.
6. **Society & Environment**: Assess societal, legal, and environmental impacts of engineering solutions.
7. **Ethics**: Commit to ethics, human values, diversity, and legal compliance.
8. **Teamwork**: Work effectively as an individual and in multidisciplinary teams.
9. **Communication**: Communicate clearly in reports, presentations, and documentation across diverse groups.
10. **Management & Finance**: Apply management and economic principles in projects and teamwork.

11. **Lifelong Learning**: Engage in continuous learning, adapt to new technologies, and think critically.

Program Specific Outcomes:

PSO1 Design, develop, and implement smart manufacturing systems integrating mechanical engineering principles with digital technologies.

PSO2 Use modern tools in pace with rapid development in the fields of Smart Manufacturing for addressing complex problems.

PSO3 Demonstrate research aptitude, teamwork, ethical practices for continuous self-learning and professional growth throughout their careers.

Semester – I							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.	MA25C01	Applied Calculus	T	3-1-0	4	4	BS
2.	ME25C03	Introduction to Mechanical Engineering	T	2-1-0	3	3	ES (PC) – DIC
3.	ME25C01	Engineering Drawing	LIT	2-0-4	6	4	ES (G)
4.	PH25C01	Applied Physics – I	LIT	2-0-2	4	3	BS
5.	CY25C01	Applied Chemistry – I	LIT	2-0-2	4	3	BS
6.	UC25H01	தமிழர் மரபு / Heritage of Tamils	T	1-0-0	1	1	HUM
7.	EN25C01	English Essentials – I	T	2-0-0	2	2	HUM
8.	CS25C02	Computer Programming: Python	LIT	2-0-2	4	3	ES (PC)
9.	ME25C04	Makerspace	L	0-0-4	4	2	SD
10	UC25A01	Life Skills for Engineers – I	---	1-0-2	3	1	HUM
11	UC25A02	Physical Education – I	---	0-0-4	4	1	HUM
12		NCC / NSS / NSO/ YRC	---	---	---	---	---
			Total Credits		**39**	**27**	

Semester – II							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.	MA25C02	Linear Algebra	T	3-1-0	4	4	BS
2.	ME25C02	Engineering Mechanics	T	3-1-0	4	4	ES (G)
3.	EE25C01	Basic Electrical and Electronics Engineering	T	3-0-0	3	3	ES (G)
4.	PH25C05	Applied Physics (ME) – II	T	2-1-0	3	3	BS
5.	CY25C03	Applied Chemistry (ME) – II	T	2-0-0	2	2	BS
6.	UC25H02	தமிழர்களும் தொழில்நுட்பமும் / Tamils and Technology	T	1-0-0	1	1	HUM
7.	ME25C05	Re-Engineering for Innovation	L	0-0-4	4	2	SD
8.	EN25C02	English Essentials – II	LIT	1-0-2	3	2	HUM
9.	UC25A03	Life Skills for Engineers – II	---	1-0-2	3	1	HUM
10.	UC25A04	Physical Education – II	---	0-0-4	4	1	HUM
11.		Foreign Language^	LIT	1-0-2	3	1	HUM
			Total Credits		**34**	**24**	

^ Deutsch / Japanese / Korean

Semester – III							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.	MA25C09	Computational Differential Equations	T	3-1-0	4	4	BS
2.	ME25C07	Applied Engineering Mechanics	T	3-0-0	3	3	ES (PC)
3.	ME25C11	Applied Thermodynamics	T	3-1-0	4	4	ES (PC)
4.	ME25C14	Mechanical Behaviour of Materials	LIT	3-0-2	5	4	ES (PC)
5.	MF25C01	Casting, Forming and Welding	LIT	3-0-2	5	4	ES (PC)
6.	EC25C17	Embedded Systems	T	3-0-0	3	3	ES (G)
7.	EN25C03	English Communication Skills Laboratory – I	L	0-0-2	2	1	HUM
8.		Skill Development Course – I	LIT	1-0-2	3	2	SD
			Total Credits		**29**	**25**	

Semester – IV							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.	CS25C16	Applied Data Science	T	3-0-0	3	3	ES (ET)
2.	ME25C09	Kinematics and Dynamics of Machines	LIT	3-0-2	5	4	ES (PC)
3.	CE25C12	Fluid Mechanics and Machinery	LIT	3-0-2	5	4	ES (PC)
4.	MF25C02	Machine Tools and Machining	LIT	2-0-2	4	3	ES (PC)
5.	ME25C15	Metrology and Measurements	LIT	2-0-2	4	3	ES (PC)
6.	ME25C10	Standards in Mechanical Engineering	T	1-0-0	1	1	ES (PC)
7.	EN25C04	English Communication Skills Laboratory – II	L	0-0-2	2	1	HUM
8.		Skill Development Course – II	LIT	1-0-2	3	2	SD
				Total Credits	**27**	**21**	

Semester – V							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.		Design of Machine Elements	T	3-0-0	3	3	ES (PC)
2.		Metallurgy and Materials Science	T	3-0-0	3	3	ES (PC)
3.		CNC Machining and Programming	LIT	3-0-2	5	4	ES (PC)
4.		Computer Aided Design and Analysis	LIT	3-0-2	5	4	ES (PC)
5.		Open Elective	T	3-0-0	3	3	---
6.		Programme Elective – I	T	3-0-0	3	3	ES (PE)
7.		Skill Development Course – III	LIT	1-0-2	3	2	SD
8.		Industry Oriented Course - I	LIT	1-0-2	3	1	SD
				Total Credits	**28**	**23**	
For Honours Degree							
1.		Capstone Design Project-Level I	CDP	0-0-12	12	6	SD
OR							
1.		Honours Elective – I	T	3-0-0	3	3	
2.		Honours Elective – II	T	3-0-0	3	3	

For Minor Degree							
1.		Minor Elective – I	T	3-0-0	3	3	
2.		Minor Elective – II	T	3-0-0	3	3	
Semester – VI							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T-P	**TCP**		
1.		Computer Integrated Manufacturing	LIT	3-0-2	5	4	ES (PC)
2.		Manufacturing Planning and Control	T	3-0-0	3	3	ES (PC)
3.		Additive Manufacturing	LIT	3-0-2	5	4	ES (PC)
4.		Programme Elective – II	T	3-0-0	3	3	ES (PE)
5.		Programme Elective – III	T	3-0-0	3	3	ES (PE)
6.		Virtual Manufacturing Systems Laboratory	L	0-0-4	4	2	ES (PC)
7.		Self-Learning Course	---	---	0	1	---
8.		Industry Oriented Course - II	LIT	1-0-2	3	1	SD
				Total Credits	**26**	**21**	
For Honours Degree							
1.		Capstone Design Project – Level II	CDP	0-0-12	12	6	SD
OR							
1.		Honours Elective – III	T	3-0-0	3	3	
2.		Honours Elective – IV	T	3-0-0	3	3	
For Minor Degree							
1.		Minor Elective – III	T	3-0-0	3	3	
2.		Minor Elective – IV	T	3-0-0	3	3	

Semester – VII							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T-P	**TCP**		
1.		Engineering Entrepreneurship Development	LIT	2-0-2	4	3	HUM
2.		Climate Change and Sustainability	T	2-0-0	2	2	HUM
3.		Industrial Robotics and Automation	LIT	2-0-2	4	3	ES (PC)
4.		Programme Elective – IV	T	3-0-0	3	3	ES (PE)
5.		Programme Elective – V	T	3-0-0	3	3	ES (PE)
6.		Project Management	T	2-0-0	2	2	HUM
7.		Industrial Training	---	---	---	1	SD
Total Credits					**18**	**17**	
For Honours Degree							
1.		Capstone Design Project – Level III	CDP	0-0-12	12	6	SD
OR							
1.		Honours Elective – V	T	3-0-0	3	3	
2.		Honours Elective – VI	T	3-0-0	3	3	
For Minor Degree							
1.		Minor Elective – V	T	3-0-0	3	3	
2.		Minor Elective – VI	T	3-0-0	3	3	

Semester – VIII							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T-P	**TCP**		
1		Project Work / Internship cum Project Work	PW / IPW	0-0-16	16	8	SD
Total Credits					**16**	**8**	

Total Credits:166

PROGRAMME ELECTIVE COURSES – STREAMS

Manufacturing Technologies	Automation and Control	Product Development	Materials	Industrial & Systems Engineering
Advanced CNC Machining and Programming	PLC and SCADA Systems	Computer-Aided Manufacturing and Prototyping	Advanced Materials for Manufacturing	Optimisation Techniques
Micro and Nano Manufacturing	Machine Vision	Tool Design	Surface Engineering and Coatings	Lean Manufacturing and Six Sigma
Robotics in Manufacturing	Flexible Manufacturing systems	Product Lifecycle Management	Heat Treatment Processes	Supply Chain Analytics
Precision Manufacturing	Cyber-Physical Systems and Industry 5.0	Design for Manufacturing and Assembly	Composite Materials and Manufacturing	Quality Engineering and Reliability
Composite Materials and Processes	Control Systems Engineering	Digital Twin	Non-Destructive Testing (NDT) and Evaluation	Total Productive Maintenance

Semester I

MA25C01	Applied Calculus	L	T	P	C
		3	1	0	4

Course Objectives:

- To provide technical competence of modelling engineering problems using calculus.
- To apply the calculus concepts in solving engineering problems using analytical methods and computational tools.

Differential Calculus: Functions, graph of functions, New functions from old functions, Limit of a function, Continuity, Limits at infinity, Derivative as a function, Maxima and Minima of functions of single variable, Mean value theorem, Effect of derivatives on the shape of a graph.

Activities: Visualization of the functions, Maxima and Minima of a function using open-source software, Solving of Competitive Examination questions (Ex. GATE).

Functions of Several Variables: Partial derivatives, Chain rule, Total derivative, Maxima and minima of functions of two variables, Method of Lagrange's Multipliers, Application problems in engineering.

Activities: Partial Derivatives with two or three variables, Maxima and Minima of a function using open-source software, Solving of Competitive Examination questions (Ex. GATE).

Integral Calculus: Fundamental theorem of Calculus, Indefinite integrals and the Net Change Theorem, Improper integrals, Arc Length, Area of Region, Area of surface of revolution.

Activities: Definite and Indefinite Integrals, Determination of Area, Solving of Competitive Examination questions (Ex. GATE).

Multiple Integrals: Iterated integrals and Fubini's theorem, Evaluation of double integrals, change of order of integration, change of variables between Cartesian and polar co-ordinates, evaluation of triple integrals-change of variables between Cartesian and cylindrical and spherical co-ordinates.

Activities: Double integrals and triple integrals using open-source software, Solving of Competitive Examination questions (Ex. GATE).

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignments (20%), Solution to application-oriented problems using software (20%), Solving of GATE questions (20%), Internal Examinations (40%).

References:

1. Anton, H., Bivens, I. C., & Davis, S. (2021). Calculus: Early transcendentals. John Wiley & Sons.
2. Ron Larson and David C. Falvo,(2013), Calculus: an Applied Approach. Cengage Learning.
3. Stewart, J., Clegg, D., & Watson, S. (2019). *Calculus: Early transcendentals*.
4. Thomas, G. B., Jr., Weir, M. D., Hass, J., & Heil, C. (2018). *Thomas' calculus: Early transcendentals*. Pearson.
5. Singh, K. (2019). *Engineering mathematics through applications*. Bloomsbury Publishing.
6. Grewal, B. S. (2012). *Higher engineering mathematics.* Khanna Publishers.

E-resources:

1. https://math.libretexts.org/Bookshelves/Calculus/Map%3A_Calculus__Early_Transcendentals_(Stewart)/
2. https://openstax.org/books/calculus-volume-1/
3. https://tutorial.math.lamar.edu/Classes/CalcII/CalcII.aspx
4. SCILAB, https://www.scilab.org/

	Description of CO	**PO**	**PSO**
CO1	Explain the meaning of derivative, integral, and their geometric and physical interpretations.	---	---
CO2	Apply differentiation and integration techniques to compute maxima, minima, and area.	PO1(3)	PSO1(2) PSO2(2)
CO3	Analyze the behavior of single and multivariable functions using derivatives and partial derivatives.	PO2(3)	PSO1(2) PSO3(1)
CO4	Utilize modern computational software and online platforms to deepen understanding, perform complex calculations, and visualize mathematical concepts.	PO5(2) PO11(1)	PSO2(3) PSO3(1)

ME25C03	Introduction to Mechanical Engineering	L	T	P	C
		2	1	0	3

Course Objectives:

- To impart the fundamental concepts and principles of various fields such as Manufacturing, Materials, Mechanics, thermal engineering in Mechanical Engineering.

Engineering: History and evolution of mechanical engineering, Basic mechanical engineering principles (force, motion, energy, work, power), Units and dimensions, SI system, Ethics and professionalism in engineering.

Activities: Interactive quiz, Conversion between SI and other unit systems.

Mechanics of Materials and Structures: Stress and strain, types of stresses (tensile, compressive, shear), Elasticity and plasticity, Mechanical properties of materials (strength, toughness, hardness), Introduction to bending, torsion, and axial loading, Simple structural analysis and design concepts.

Activities: Demonstration of Simple truss or beam problems solved using software.

Energy Interactions: System, Energy Transfer, Conduction, convection, and radiation, Working principle of Heat Engines, Refrigeration and HVAC systems.

Activities: Demonstration of working model of internal combustion engine & refrigerator, Virtual demonstration of Thermodynamic cycles.

Machine Elements: Gears, bearings, shafts, fasteners, couplings, Selection of machine components, Quality control and safety in mechanical engineering.

Activities: Demonstration of working of Gears, bearings, etc. in a mechanical system.

Manufacturing Processes: Casting, forming, machining & joining processes, CNC and additive manufacturing, overview of smart manufacturing.

Activities: Demonstration of various machining processes, 3D printing of simple parts.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (10%), Assignments (40%) and Internal Examinations (50%)

References:

1. Wickert, J., & Lewis, K. (2016). An Introduction to Mechanical Engineering. Cengage Learning.
2. Rajput, R. K., (2017). Fundamentals of Mechanical Engineering, Laxmi Publications.

E-resources:

1. MIT OpenCourseWare – Mechanical Engineering https://ocw.mit.edu

2. PhET Simulations – University of Colorado Boulder
   https://phet.colorado.edu
3. LibreTexts Engineering https://eng.libretexts.org

	CO Description	PO	PSO
CO1	Explain core mechanical engineering concepts.	---	---
CO2	Apply basic engineering calculations in mechanical systems.	PO1(3)	PSO1(3) PSO2(2)
CO3	Identify common manufacturing processes for engineering applications.	PO2(2)	PSO3(2)

ME25C01	Engineering Drawing	L	T	P	C
		2	0	4	4

Course Objectives:

- To impart knowledge on dimensions and drawing standards.
- To explore the orthographic projection of lines and solids.
- To provide the understanding of orthographic, isometric and perspective views.

Fundamentals: Drawing instruments, Drawing standards (BIS), Lettering in engineering, Sheet layout, elements of dimensioning, Systems of dimensioning. Free hand sketching of 2D & 3D objects, Conics – Ellipse, Parabola and Hyperbola.

Activities: Virtual Demonstration of Conics and Cycloids.

Orthographic Projection: First angle projection, Projection of points, straight lines and planes.

Projection of Solids: Simple Solids, Section of Solids, Development of Surfaces

Activities: Development of models of various solids and virtual demonstration of sectioning, CAD modelling of 2D objects.

Isometric Projection: Isometric Scale, Projection of Simple solids.

Activities: Conversion of 3D into 2D orthographic views, CAD modelling of 3D objects.

Perspective Projection: Simple solids projection

Activities: Virtual demonstration of perspective views.

Project: Development of 2D objects and 3D objects using CAD tools.

Weightage:
Continuous Assessment: 50%
End Semester Examinations: 50%

Assessment Methodology:
Project – 10%, Models - 5%, Assignments - 35% and Internal Examinations - 50%

References:

1. Natarajan, K. V. (2025). A Text Book of Engineering Graphics. Dhanalakshmi Publisher.
2. Venugopal, K., & Prabhu Raja, V. (2022). Engineering Drawing + AutoCAD. New Age International Publishers.

E-Resources:

1. CAD Software – https://www.freecadweb.org/
2. Engineering Drawing and Computer Graphics, Prof. Rajaram Lakkaraju (IIT Kharagpur) – https://onlinecourses.nptel.ac.in/noc22_me105/preview

3. MIT Design Handbook: Engineering Drawing and Sketching – https://ocw.mit.edu/courses/2-007-design-and-manufacturing-i-spring-2009/pages/related-resources/drawing_and_sketching/

	CO Description	PO	PSO1
CO1	Explain the advantages of engineering drawing in engineering applications	---	
CO2	Apply the concepts of projections in formulating various solid parts in engineering systems.	PO1(3)	PSO1(2)
CO3	Analyse the various view and interpret the engineering drawings.	PO2(3)	PSO1(2)
CO4	Use CAD tools for creation of various models.	PO3(1)	PSO2(2)
CO5	Critically think and develop innovative models.	PO11(1)	PSO3(1)

PH25C01	Applied Physics – I	L	T	P	C
		2	0	2	3

Course Objective(s):

- To impart knowledge and expose the essentials of physics in various engineering applications.

Properties of Matter: Elasticity, Cantilever, Young's modulus (non-uniform bending), Girders: Bridges and buildings, Viscosity: Stokes method, Surface tension: drop weight method, Thermal expansion, Thermal stress, Bimetallic strips, Expansion joints

Practical: Non-Uniform bending, Young's modulus of the material, Torsional pendulum, Rigidity modulus of the wire and moment of inertia of the disc.

Activities: Virtual demonstration of thermal stress.

Oscillations: Simple Harmonic motion, Torsional pendulum, Couple per unit twist, Damped and Forced Oscillation

Waves: Waves on a stretched string, Energy and Power, standing waves, Ultrasonics, piezo, electric method, Acoustic grating, Electromagnetic waves: Maxwell equation, Production of EM waves by dipole antenna, Propagation of EM waves in free space , wave equation, Cell phone reception

Practical: Melde's string experiment – Frequency of an electrically vibrating metal tip.

Activities: Virtual demonstration of propagation of EM waves

Quantum Mechanics: Black body radiation, Photoelectric effect, de Broglie hypothesis, Schrodinger Wave equation, Particle in a box (infinite potential well - three-dimensional box), Barrier penetration and quantum tunnelling.

Practical: Photo-electric effect, Determination of Planck's constant.

Activities: Virtual demonstration of Scanning Transmission Electron Microscope

Applied Optics: Interference: Air wedge, Michelson's Interferometer, Fiber optics: Structure of a fiber, Fiber Optic Communication System, Fiber Sensors (Virtual demo), Displacement, pressure sensor and Temperature sensor, Einstein Co-efficient, Nd:YAG laser, CO_2 laser (construction, functioning and applications), dye laser

Practical: Ruling width of Compact disc using Laser, Thickness of a thin sheet/wire using Air wedge Method.

Activities: Demonstration of sensors and applications of Lasers

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%

Assessment Methodology: Quiz (5%), Assignments (20%), Flipped Class (5%), Practical (30%), Internal Examinations (40%)

References:

1. Young, H. D., & Freedman, R. A. (2020). University physics with modern physics. Pearson.
2. Gaur, R. K., & Gupta, S. L. (2022). Engineering physics. Dhanpat Rai Publications.
3. Mathur, D. S. (2010). Elements of properties of matter. S. Chand Publishing.
4. Griffiths, D. J. (2018). Introduction to quantum mechanics. Cambridge University Press.
5. Silfvast, W. T. (2008). Laser fundamentals (2nd ed.). Cambridge University Press.

E-Resources:

1. Barrier penetration problem and Quantum tunnelling: https://archive.nptel.ac.in/courses/115/104/115104096/
2. EM waves and wireless channelling: https://onlinecourses.nptel.ac.in/noc24_ee31/preview
3. CO2 Laser: https://onlinecourses.nptel.ac.in/noc25_ph03/preview
4. Bimetallic Strips _ https://www.youtube.com/watch?v=WZQ8lvxdzDk
5. Cell phone Reception_ https://www.youtube.com/watch?v=1JZG9x_VOwA
6. Dipole Antenna_ https://www.youtube.com/watch?v=4xF1Fq2wB1I
7. Optical Sensors_ https://auece.digimat.in/nptel/courses/video/108106173/L02.html
8. Scanning Tunnelling Electron Microscope_ https://www.youtube.com/watch?v=XNYZYbXNWQA

	Description of CO	**PO**	**PSO**
CO1	Explain the physics concepts in various applications.	---	---
CO2	Apply the principles of wave optics and laser physics in practical systems.	PO1(3)	PSO1(2) PSO2(2)
CO3	Analyse the behaviour of materials under different conditions.	PO2(2)	PSO1(2) PSO3(1)
CO4	Conduct experiments in groups and interpret the data.	PO4(3) PO8(1)	PSO1(2) PSO2(2)

CY25C01	**Applied Chemistry – I**	L	T	P	C
		2	0	2	3

Course Objectives:

- To provide students with a solid understanding of the chemical principles for engineering applications.
- To introduce the chemical properties of materials and how these properties influence the selection and use of materials in engineering systems.
- To impart practical applications of chemistry in commonly used engineering devices

Water Technology: Water quality parameters and standards. Industrial feed water, Remediation. Municipal water treatment. Desalination.

Practical: Analysis of alkalinity, hardness and dissolved oxygen.

Activity: Coagulation of water sample using Alum

Nano-chemistry: Classification, Size, dependent properties. Preparation of nanomaterials, Top-down and Bottom-Up approaches, Applications (Flipped classroom).

Practical: Preparation of nanoparticles by Sol-Gel method.

Electrochemistry: Electrochemical cell, Electrode potential., Redox reaction. Conductivity of electrolytes, Factors.

Practical: Conductometric titrations

Activity: Electrochemical cell demonstration

Corrosion & Control: Chemical and electrochemical corrosions, galvanic series, factors influencing corrosion, Electrochemical protection. Organic and Inorganic coating.

Practical:

- Corrosion study by weight loss and salt spray method.
- Potentiometry/UV-visible spectrophotometer.

Activities: Case Study on Corrosion in Pipelines and Electronics, Control measures for a corroded metal

Batteries: Conventional, Contemporary and Emerging battery storage technologies, Primary & Secondary Batteries, Battery Pack, Battery Materials, Performance Parameters, Testing, Safety aspects.

Practical: Measurement of EMF, Internal Resistance, Charge and Discharge Characteristics.

Activities: Demonstration of battery pack in e-vehicles.

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%

Assessment Methodology: Quiz (5%), Assignments (20%), Flipped Class (5%), Practical (30%), Internal Examinations (40%)

References:

1. Jain, P. C., & Jain, M. (2015). Engineering Chemistry (17th ed.). Dhanpat Rai Publishing Company (P) Ltd.
2. Dara, S. S. (2004). A Textbook of Engineering Chemistry. Chand Publications.
3. Sachdeva, M. V. (2011). Basics of Nano Chemistry. Anmol Publications Pvt Ltd.
4. Friedrich, E. (2014). Engineering Chemistry. Medtech.

E-Resources:

1. Water and Wastewater Engineering (Prof. Ligy Philip, IIT Madras) – https://nptel.ac.in/courses/105106202.
2. Electrochemical Energy Systems (Prof. S. Mitra, IIT Madras) – https://nptel.ac.in/courses/113106028.
3. Corrosion (Prof. Kallol Mondal, IIT Kanpur) – https://nptel.ac.in/courses/112104088
4. Chemistry of Battery Systems (Prof. V. R. Marathe, IIT Madras) – https://nptel.ac.in/courses/115106130
5. Resource on all battery types, testing, and safety – https://batteryuniversity.com/articles

	Description of CO	PO	PSO
CO1	Understand the importance of chemistry applications with underlying mechanisms.	---	
CO2	Apply the chemistry concepts in widely used devices.	PO1(3)	PSO1(2) PSO2(2)
CO3	Analyse the effect of various chemical parameters on performance of engineering systems.	PO2(2)	PSO1(2) PSO2(1)
CO4	Perform experimentations as a group and interpret the results.	PO4(3) PO8(1)	PSO2(2) PSO3(2)
CO5	Communicate findings through case studies and reports	PO9(1)	PSO2(2) PSO3(3)

UC25H01	தமிழர் மரபு	L	T	P	C
		1	0	0	1

மொழி மற்றும் இலக்கியம்: இந்திய மொழிக் குடும்பங்கள், திராவிட மொழிகள், தமிழ் ஒரு செம்மொழி, தமிழ் செவ்விலக்கியங்கள், சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை, சங்க இலக்கியத்தில் பகிர்தல் அறம், திருக்குறளில் மேலாண்மைக் கருத்துக்கள், தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம், பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள், சிற்றிலக்கியங்கள், தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி, தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை:நடுகல் முதல் நவீன சிற்பங்கள் வரை, ஐம்பொன் சிலைகள், பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் , தேர் செய்யும் கலை, சுடுமண் சிற்பங்கள், நாட்டுப்புறத் தெய்வங்கள், குமரிமுனையில் திருவள்ளுவர் சிலை, இசைக் கருவிகள், மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம், தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

தமிழர்களின் திணைக் கோட்பாடுகள்: தமிழகத்தின் தாவரங்களும், விலங்குகளும், தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள், தமிழர்கள் போற்றிய அறக்கோட்பாடு, சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும், சங்ககால நகரங்களும் துறை முகங்களும், சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி, கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு: இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு, இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் , சுயமரியாதை இயக்கம் இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு, கல்வெட்டுகள், கையெழுத்துப்படிகள், தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

References:

1. தமிழக வரலாறு, மக்களும் பண்பாடும், கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ், முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி, வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை, ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

UC25H01	Heritage of Tamils	L	T	P	C
		1	0	0	1

Language and Literature: Language Families in India, Dravidian Languages, Tamil as aClassical Language, Classical Literature in Tamil, Secular Nature of Sangam Literature, Distributive Justice in Sangam Literature, Management Principles in Thirukural, Tamil Epics and Impact of Buddhism & Jainism in Tamil Land, Bakthi Literature Azhwars and Nayanmars, Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

Heritage - Rock Art Paintings to Modern Art – Sculpture: Hero stone to modern sculpture, Bronze icons, Tribes and their handicrafts, Art of temple car making, Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments, Mridhangam, Parai, Veenai, Yazh and Nadhaswaram, Role of Temples in Social and Economic Life of Tamils.

Folk and Martial Arts: Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance, Sports and Games of Tamils.

Thinai Concept of Tamils: Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature, Aram Concept of Tamils, Education and Literacy during Sangam Age, Ancient Cities and Ports of Sangam Age, Export and Import during Sangam Age, Overseas Conquest of Cholas.

Contribution of Tamils to Indian National Movement and Indian Culture:
Contribution of Tamils to Indian Freedom Struggle, The Cultural Influence of Tamils over the other parts of India, Self-Respect Movement, Role of Siddha Medicine in Indigenous Systems of Medicine, Inscriptions & Manuscripts, Print History of Tamil Books

References:

1. தமிழக வரலாறு, மக்களும் பண்பாடும், கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும், கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ், முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி, வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை, ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils, The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
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8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi, 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL), Reference Book.

EN25C01	English Essentials – I	L	T	P	C
		2	0	0	2

Course Objectives:

- Enhance learners' listening and speaking skills to understand and deliver speeches effectively
- Equip students with the skills to write clear, coherent, and grammatically correct texts for various purposes.
- Strengthen the ability to comprehend, interpret, and analyse written English across diverse contexts.

Speaking Skills: Self-Introduction (Tenses, Adjectives) Expressing opinions (Subject-Verb Agreement), Participating in Conversations (Speech Acts - agreeing & disagreeing – synonyms and antonyms**)**

Suggested Activities: Self-Introduction, Just a Minute (JAM) Video recording, Situational role plays, Spell Bee, Word Substitution, Usage of Apps.

Listening Skills: Listening to Simple Conversations (Understanding tone and intent), Short Speeches / Stories, Extracting information, Pronunciation, Listening to Various Accents.

Suggested Activities: Listening and Repeating, Gap fill exercises, Note-taking

Reading Skills: Reading Strategies – (Skimming, scanning, predicting) intensive reading - short passages and long passages on suggested themes (Sentence Patterns, Prefixes and suffixes, idioms and phrases).

Activities: Reading - newspaper and digital articles, Cloze, Reading comprehension, note making and summarising,

Writing Skills: Word Substitution, Sentence Formation, Hints Development (Guided Writing), Writing Different Types of Paragraphs - (Sentence Structure) – Letter Writing / Emails (Informal)

Activities: Error Detection, Picture and poster description, Descriptive, Narrative and Comparative paragraphs, Brainstorming and Mind Mapping - Informal letters/ Emails

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (10%), Assignments (20%), Speaking Task (10%), Reading Task (10%), Writing Task (10%), Internal Examinations (40%).

References:

1. Miller, K. Q., & Wahl, S. T. (2023). *Business and Professional Communication: KEYS for Workplace Excellence* (5th ed.). SAGE Publications.
2. Kumar, Sanjay & Pushpalatha. (2018). *English Language and Communication Skills for Engineers*. India: Oxford University Press.
3. Sharma, S., & Mishra, B. (2024). *Communication Skills for Engineers and Scientists* (2nd ed.). PHI Learning.

E-resources:

1. Cambridge English – https://www.cambridgeenglish.org/learning-english/grammar-and-vocabulary/
2. Perfect English Grammar – https://www.perfect-english-grammar.com/

3. British Council – Learn English - https://learnenglish.britishcouncil.org/grammar
4. Speechling – https://speechling.com/
5. mePro by Pearson – https://mepro.pearson.com/
6. TED Talks – https://www.ted.com/

	Description of CO	**PO**	**PSO**
CO1	Listen and comprehend spoken English, take and draft notes.	---	---
CO2	Apply vocabulary and grammar appropriately to communicate in written and spoken forms.	PO1(3)	PSO1(2) PSO3(3)
CO3	Analyze texts in different contexts using appropriate reading strategies.	PO2(2)	PSO2(1)
CO4	Communicate thoughts and ideas in real life situations.	PO9(2)	PSO3(2)
CO5	Develop communication skills relevant to engineering and technology.	PO11(1)	PSO3(3)

CS25C02	Computer Programming: Python	L	T	P	C
		2	0	2	3

Course Objectives:

- To equip engineering students with the foundational knowledge and practical skills in Python programming to analyse and solve computational problems effectively.
- To foster problem-solving, critical thinking, and modular programming skills essential for engineering domains.

Introduction to Python: Problem Solving, Problem Analysis Chart, Developing an Algorithm, Flowchart and Pseudocode, Interactive and Script Mode, Indentation, Comments, Error messages, Variables, Reserved Words, Data Types, Arithmetic operators and expressions, Built-in Functions, Importing from Packages.

Practical: Problem Analysis Chart, Flowchart and Pseudocode Practices. (Minimum three)

Control Structures: if, if-else, nested if, multi-way if-elif statements, while loop, for loop, nested loops, pass statements.

Practical: Usage of conditional logics in programs. (Minimum three)

Functions: Hiding redundancy, complexity; Parameters, arguments and return values; formal vs actual arguments, named arguments, Recursive & Lambda Functions.

Practical: Usage of functions in programs. (Minimum three)

Strings & Collections: String Comparison, Formatting, Slicing, Splitting, Stripping, Lists, tuples, and dictionaries, basic list operators, searching and sorting lists; dictionary literals, adding and removing keys, accessing and replacing values.

Practical: String manipulations and operations on lists, tuples, sets, and dictionaries. (Minimum three)

File Operations: Create, Open, Read, Write, Append and Close files. Manipulating directories, OS and Sys modules, reading/writing text and numbers, from/to a file; creating and reading a formatted file (csv, tab-separated, etc.).

Practical: Opening, closing, reading and writing in formatted file format and sort data. (Minimum three)

Packages: Built-in modules, User-Defined modules, Numpy, SciPy, Pandas, Scikit-learn**.**

Practical: Usage of modules and packages to solve problems. (Minimum three), Project (Minimum Two)

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%

Assessment Methodology: Quiz (5%), Project (15%), Assignment Programs (25%), Practical (25%), Internal Examinations (30%)

References:

1. Matthes, E. (2019). *Python crash course: A hands-on, project-based introduction to programming* (2nd ed.). No Starch Press.
2. Brown, M. C. (2018). *Python: The complete reference* (4th ed.). McGraw Hill Publishers.
3. Guttag, J. V. (2016). *Introduction to computation and programming using Python: With applications to understanding data* (2nd ed.). MIT Press.
4. McKinney, W. (2017). *Python for data analysis: Data wrangling with pandas, NumPy, and IPython*. Shroff/O'Reilly.

E-Resources:

1. Official Python Documentation – https://docs.python.org/3/
2. Python Tutorials – https://www.w3schools.com/python/
3. NumPy – https://numpy.org/doc/
4. SciPy – https://scipy.org/
5. Google's Python class – https://developers.google.com/edu/python/

	Description of CO	PO	PSO
CO1	Explain the potential usage of Python in engineering applications	---	---
CO2	To apply the concepts of Python in solving engineering problems and formulate new projects.	PO1 (2) PO5 (2)	PSO2(2) PSO3(1)
CO3	To interpret the data and effectively communicate in groups.	PO2 (3) PO8 (1) PO9 (1)	PSO3(1) PSO3(2)
CO4	Adapt new programming concepts and technologies in the profession.	PO11 (1)	PSO2(2)

ME25C04	Makerspace	L	T	P	C
		0	0	4	2

Course Objectives:

1. To impart practical skills in the assembly, disassembly, and welding of components using appropriate tools and techniques.
2. To provide hands-on training in electrical wiring practices, and the use of electronic components, sensors, and actuators.

List of Activities

(A). Dis-assembly & Assembly Practices

i. Tools and its handling techniques.
ii. Dis-assembly and assembly of home appliances – Grinder Mixer Grinder, Ceiling Fan, Table Fan & Washing Machine.
iii. Dis-assembly and assembly of Air-Conditioners & Refrigerators.
iv. Dis-assembly and assembly of a Bicycle.

(B). Welding Practices

i. Welding Procedure, Selection & Safety Measures.
ii. Power source of Arc Welding – Gas Metal Arc Welding & Gas Tungsten Arc Welding processes.
iii. Hands-on session of preparing base material & Joint groove for welding.
iv. Hands-on session of MAW, GMAW, GTAW, on Carbon Steel & Stainless Stell plates / pipes, for fabrication of a simple part.

(C). Electrical Wiring Practices

i. Electrical Installation tools, equipment & safety measures.
ii. Hands-on session of basic electrical connections for Fuses, Miniature Circuit Breakers and Distribution Box.
iii. Hands-on session of electrical connections for Lightings, Fans, Calling Bells.
iv. Hands-on session of electrical connections for Motors & Uninterruptible Power Supply.

(D). Electronics Components / Equipment Practices

i. Electronic components, equipment & safety measures.
ii. Dis-assembly and assembly of Computers.
iii. Hands-on session of Soldering Practices in a Printed Circuit Board.
iv. Hands-on session of Bridge Rectifier, Op-Amp and Transimpedance amplifier.
v. Hands-on session of integration of sensors and actuators with a Microcontroller.
vi. Demonstration of Programmable Logic Control Circuit.

(E). Contemporary Systems

i. Demonstration of Solid Modelling of components.
ii. Demonstration of Assembly Modelling of components.
iii. Fabrication of simple components / parts using 3D Printers.
iv. Demonstration of cutting of wood / metal in different complex shapes using Laser Cutting Machine.

References:

1. Stephen Christena, Learn to Weld: Beginning MIG Welding and Metal Fabrication Basics, Crestline Books, 2014.
2. H. Lipson, Fabricated - The New World of 3D Printing, Wiley, 1st edition, 2013.
3. Code of Practice for Electrical Wiring Installations (IS 732:2019)

	Description of CO	PO	PSO
CO1	Demonstrate proper use and handling of basic hand and power tools.	---	---
CO2	Carry out electrical wiring installations and repairs, applying safety measures in domestic applications.	PO1(3)	PSO2(1)
CO3	Develop solid innovative models through software.	PO5(2)	PSO2(2)
CO4	Adapt and follow safety protocols in the work environment.	PO11(2)	PSO3(2)

UC25A01	Life Skills for Engineers – I	L	T	P	C
		1	0	2	1

Course Objectives

- To equip engineering students with essential life skills encompassing personal and emotional development, effective management of time and stress, financial literacy, digital safety, and civic responsibility.
- To enhance self-awareness, interpersonal skills, and resilience to prepare students for the professional and personal challenges of engineering careers and life beyond academics**.**

Personal and Emotional Development: Self-Awareness & Personality, Emotional Intelligence & Empathy, Positive thinking, Right attitude, Stress & Anger Management, Goal-Setting & Time Management, Growth Mindset & Resilience.

Activities: Personality tests (MBTI, DISC), reflection journals, Empathy circle, role-playing difficult conversations, Guided mindfulness sessions, stress relief toolkit creation, Vision board creation, weekly time audit and planner, Group challenge scenarios, resilience journal.

Management Skills: Financial Literacy: Budgeting & Saving, Nutrition, Health, and Hygiene, Digital Literacy & Online Safety, Civic Responsibility & Ethics

Activities: Create a monthly budget, financial simulation game, Meal planning workshop, physical wellness challenge, Social media audit, privacy and safety scenarios, Community service, values debate.

Weightage: Continuous Assessment: 100%

Assessment Methodology: Assignments (20%), Flipped Class & Worksheets (10%), Practical (30%), Internal Examinations (40%)

References:

1. Khera, S. (2003). *You can win*. Macmillan.
2. Levesque, H. (n.d.). *Life skills 101: A practical guide to leaving home and living on your own*. (Publication year not specified)
3. Mitra, B. K. (2017). *Personality development & soft skills* (3rd impression). Oxford University Press.
4. ICT Academy of Kerala. (2016). *Life skills for engineers*. McGraw Hill Education (India) Private Ltd.

	Description of CO	PO	PSO
CO1	Understand personality traits and emotional intelligence, in interpersonal interactions.	---	---
CO2	To work and execute as a team through successful implementation of set goals.	PO7 (1) PO8 (2) PO9 (2)	PSO3(2)
CO3	Develop and implement best practices in day-to-day life, in terms of planning and execution.	PO11 (3)	PSO3(2)

UC25A02	Physical Education - I	L	T	P	C
		0	0	4	1

Course Objectives:

- To impart the fundamentals of physical education for development of students' physical, mental, and social well-being.
- To instill a lifelong appreciation for physical activity towards the development of positive attitude and fostering values of team work and sportsmanship.

Introduction to physical education: Exercise for Good Posture – Conditioning and Calisthenics for Before start, Jogging, Bending, Twisting, Standing, Sitting and Relaxation, Training on First Aid practices.

Participation of athletic events: Rules and regulations of important athletic events, Sprint, Jumps, Throws and Hurdles.

Skill development in any one of the following outdoor games: Basket Ball, Volley Ball, Ball Badminton, Football, Hockey, Kho-Kho, Kabaddi, Cricket, Hand ball and Tennis.

Skill development in any one of the following indoor games: Shuttle Badminton, Chess and Table Tennis.

Weightage: Continuous Assessment: 100%

Assessment Methodology: Attendance (60%), Quiz (10%), Participation in Sports and Games (20%) and Viva Voce (10%)

References:

1. Singh, A. (2008). Essentials of physical education. Kalyani Publishers.
2. Kamlesh, M. L. (2006). Psychology in physical education and sport (3rd ed.). Metropolitan Book Co.
3. Mangal, S. K. (2009). *Psychology of sports performance*. Sports Publication.

E-resources:

1. **https://www.who.int/health-topics/physical-activity**

	CO Description	PO	PSO
CO1	Understand and explain the importance of physical activity for mental and physical health.	---	---
CO2	Apply basic principles of exercise science in the routine life.	PO1(3)	PSO1(1)
CO3	Develop teamwork, discipline, and leadership through sports and group activities and collaborate effectively.	PO8(3)	PSO3(2)
CO4	Demonstrate independent learning in health, nutrition, and fitness-related topics.	PO11(2)	PSO3(2)

Semester II

MA25C02	Linear Algebra	L	T	P	C
		3	1	0	4

Course Objectives:

- To impart foundational knowledge in linear algebra essential for analysing and solving problems in engineering applications.
- To provide the knowledge on computation using software and interpret key linear algebra concepts using software.

Vector Spaces Introduction to Vector Spaces, Examples, Subspaces, Linear Combinations, Span, Generating Sets, Linear Dependence and Independence, Basis and Dimension, Dimension of Subspaces.

Activities: Open-Source software, exercises to test linear dependence and independence using rank, compute span and basis of a set of vectors, determine the dimension of subspaces, and illustrate the concept of subspace and basis in $\boldsymbol{R^2}/\boldsymbol{R^3}$ with visualization.

Linear Transformations and Diagonalization: Null space, Range, Dimension Theorem (statement only), Matrix representation of a linear transformation, Eigenvalues & Eigenvectors, Diagonalizability.

Activities: Open-Source software, exercises to compute the matrix representation of a linear transformation, find the null space and range of a matrix, and compute eigenvalues and eigenvectors of a matrix.

Inner Product Spaces: Inner product, Norms, Cauchy, Schwarz inequality, Gram, Schmidt orthogonalization, Simple problems (up to $\boldsymbol{R^3}$).

Activities: Open-Source software, exercises to compute inner products and vector norms.

Matrix Decomposition: Orthogonal transformation of a symmetric matrix to diagonal form - Positive definite matrices, QR decomposition, Singular Value Decomposition (SVD), Least squares solutions- simple problems (up to $3 \times 3\ matrices$).

Activities: Open-Source software, exercises to check if a matrix is positive definite, perform QR decomposition and SVD using built-in functions.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignment (20%), Software activity (20%), Quiz (20%), Internal Examinations (40%).

References:

1. Friedberg, S. H., Insel, A. J., & Spence, L. E. (2022). *Linear algebra*. Pearson.
2. Lay, D. C., Lay, S. R., & McDonald, J. J. (2020). *Linear algebra and its applications with MATLAB*. Pearson.
3. Bronson, R. (2011). *Schaum's outline of matrix operations*. McGraw-Hill Education.

4. Strang, G., & Thomson, R. (2005). *Linear algebra and its applications*. Brooks/Cole.
5. Lipschutz, S., & Lipson, M. (2009). *Schaum's outline of linear algebra*. McGraw-Hill.
6. Kreyszig, E. (2018). *Advanced engineering mathematics*. Wiley India.

	Description of CO	**PO**	**PSO**
CO1	Explain the fundamental concepts of Linear Algebra.	---	
CO2	Compute and interpret eigenvalues and eigenvectors.	PO1(3)	PSO1(2)
CO3	Apply inner product concepts and perform orthogonalization.	PO1 (3)	PSO1(1)
CO4	Compute least squares solutions of linear system of equations.	PO1 (2) PO2 (2)	PSO3(1)
CO5	Use MATLAB to implement and validate key linear algebra concepts	PO5 (1) PO11 (1)	PSO2(2)

ME25C02	Engineering Mechanics	L	T	P	C
		3	1	0	4

Course Objectives:

- To introduce the fundamental concepts and principles of statics related to forces acting on particles and rigid bodies.
- To develop the ability to formulate and apply equilibrium equations for particles and rigid bodies in two and three dimensions.
- To enable students to analyse force systems through vector resolution and calculation of moments and couples.

Statics of Particles: Resultant of forces in a plane, Equilibrium of a particle in a plane, Addition of concurrent forces in space, Equilibrium of a particle in space.

Activities: Assignments and Quiz on resultant forces, Solving of GATE questions.

Statics of Rigid Bodies: Concept of Free Body Diagram, Equivalent systems of forces, Transmissibility, Moment of a force about a point and an axis, Couples and force-couple systems, Equilibrium of rigid bodies in two and three dimensions, Principle of virtual work.

Activities: Virtual demonstration of rigid bodies, Solving of GATE questions.

Moments of Inertia: First moments of areas and lines, Centroids of composite areas and lines, Theorems of Pappus-Guldinus, Second moment of area, Parallel axis theorem, Rectangular and Polar Moments of inertia of composite areas, Radius of Gyration, Product of Inertia, Principal Axes and Principal Moments of Inertia, Mass moments of inertia of thin plates.

Activities: Virtual Simulation of Moment of Inertia, Principal Axes Determination, Solving of GATE questions.

Friction: Laws of friction, Coefficients of Friction, Angles of Friction, Types of Friction Problems, Wedges and Ladder friction, Belt friction.

Activities: Virtual Demonstration of Friction in belts and pulleys, Solving of GATE questions

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz - 10%, Assignments - 20%, Solving of GATE questions (20%) and Internal Examinations - 50%

References:

1. Beer, F. P., Johnston Jr., E. R., DeWolf, J. T., & Mazurek, D. F. (2015). Mechanics of Materials. McGraw-Hill Education.
2. Meriam, J. L., & Kraige, L. G. (2018). *Engineering Mechanics: Statics and Dynamics*. Wiley.

3. Pytel, A., & Kiusalaas, J. (2014). Engineering Mechanics (Indian Edition). Cengage Learning India.

E-resources:

1. Moment of Inertia Calculator – https://skyciv.com/free-moment-of-inertia-calculator/
2. OpenStax – University Physics Volume 1 – https://openstax.org/books/university-physics-volume-1/pages/10-4-moment-of-inertia-and-rotational-kinetic-energy
3. Engineering Mechanics, Dr. Dwarakish. G. S. – https://onlinecourses.swayam2.ac.in/ntr24_ed75/preview

	CO Description	PO	PSO
CO1	Explain the principles of statics in determination of forces acting on particles and rigid bodies.	---	---
CO2	Apply equilibrium conditions to predict the behaviour of particles and rigid bodies under various force configurations	PO1(3)	PSO1(3)
CO3	Analyse various systems through resolution of forces and moments.	PO2(2)	PSO1(2)
CO4	Demonstrate the ability to engage in adapting new techniques in the analysis of force and moments in a system.	PO11(1)	PSO2(2) PSO3(1)

EE25C01	Basic Electrical and Electronics Engineering	L	T	P	C
		3	0	0	3

Course Objectives:

- To impart foundational knowledge in principles and applications of electrical and electronics engineering.

DC Fundamentals: Current and Voltage sources, Resistance, Inductance and Capacitance; Ohm's law, Kirchhoff's law, Series parallel combination of R, L and C components, Voltage Divider and Current Divider Rules.

Activities: Virtual Demonstration of electrical laws & circuits, Hands-on Breadboarding, Solving GATE questions.

AC Fundamentals: Faraday's Laws of Electro-magnetic Induction, Definition of Self and Mutual Inductances, Generation of sinusoidal voltage, Instantaneous & RMS values of sinusoidal signals, Introduction to 3-phase systems, Electrical Safety, Fuses and Earthing.

Activities: Virtual Demonstration of electromagnetic induction, Measurement of instantaneous and RMS values of AC signals, Solving GATE questions.

Electric Machines: DC Machines, Transformers, Star and delta Connections, Three phase Induction motors, Synchronous Generators, Single Phase Induction Motors, Stepper Motor, Universal Motor and BLDC motor.

Activities: Virtual demonstration of step-up and step-down transformers, Virtual working models of Universal and BLDC motors, Solving GATE questions.

Semiconductor Devices: PN junction diodes, Zener Diode, Voltage regulator, BJT & FET Transistors, Timers, Operational Amplifiers.

Activities: Virtual demonstration of V-I characteristics of PN junction and Zener diodes using simulation, inverting/non-inverting amplifiers, Solving GATE questions.

Digital Electronics: Boolean algebra, Basic and Universal Gates, adders, multiplexers, demultiplexers and flip-flops.

Activity: Online logic gate simulators, Solving GATE questions.

Microcontrollers: Introduction, Architecture, Potential Applications.

Activities: Physical demonstration of a microcontroller and online simulation of microcontroller.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (5%), Assignments (25%), GATE Questions (20%), Internal Examinations (50%)

E-resources:

1. https://archive.nptel.ac.in/courses/108/106/108106172/

2. Circuit Simulator – https://www.falstad.com/circuit/

	Description of CO	PO	PSO
CO1	Understand and explain basic electrical and electronic concepts.	---	
CO2	Apply and analyse electrical circuits in real-time applications.	PO1 (3) PO2 (1)	PSO1(2)
CO3	Identify and utilise key electronic devices used in engineering applications	PO2 (2)	PSO1(2)

PH25C05	Applied Physics (ME) – II	L	T	P	C
		2	1	0	3

Course Objective(s):

- To impart fundamental knowledge of rigid body dynamics, thermal physics, phase transitions, and functional materials.
- To provide analytical abilities for evaluating physical phenomena in mechanical engineering applications.

Rigid Body Dynamics: Centre of mass – Moment of inertia (circular disc, solid cylinder, hollow cylinder, solid sphere, hollow sphere), Gear, shaft, gyroscope

Activities: Demonstration of moment of inertia of Gear, shafts and Gyroscopes.

Thermal Physics: Thermal conductivity –Transient plane source method, Transient Line Source method- Forbe's method - conduction through compound media, Laws of Thermodynamics .

Activities: Demonstration of thermal conductivity of insulators

Phase Transitions: Solid solutions - single component system, binary phase diagrams - iron-carbon equilibrium diagram, T-T-T-diagram - heat treatment of steels – hardening techniques

Activities: Demonstration of Hardening of steels

Functional Materials: Ceramics – Composites, Fiber Reinforced Plastics, Metallic Glasses, LED Characteristics

Activities: Demonstration of LED working and its characteristics.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (10%), Assignments (30%), Flipped Class (10%), Internal Examinations (50%)

References:

1) Mathur, D. S. (2008). *Elements of properties of matter*. S. Chand.
2) Brij Lal, & Subramaniyan, N. (2018). *Heat, thermodynamics and statistical physics*. S. Chand.
3) Raghavan, V. (2009). *Physical metallurgy: Principles and practice*. PHI Learning.
4) Askeland, D. (2010). *Materials science and engineering*. Brooks/Cole.

E-resources:

1. Moment of Inertia: https://youtu.be/fDJeVR0o__w
2. Conduction: http://kcl.digimat.in/nptel/courses/video/112106155/L32.html

3. Iron –Carbon phase diagram - https://archive.nptel.ac.in/courses/113/104/113104068/
4. Gyroscope_ https://www.youtube.com/watch?v=FydJu1A1oeM gyroscope-131127011945-phpapp02.pdf
5. Hardening Techniques_ https://www.youtube.com/watch?v=ckCN9jGsdUY
6. LED Characteristics - https://youtu.be/IgapvczVyXs

	Description of CO	**PO**	**PSO**
CO1	Explain the concepts of physics in mechanical engineering stream.	---	
CO2	Apply appropriate techniques in physics to solve engineering problems.	PO1(3)	PSO1(3)
CO3	Analyse physical systems and interpret data from the virtual studies in the core branches in mechanical engineering.	PO2(2)	PSO1(2)

CY25C03	Applied Chemistry (ME) – II	L	T	P	C
		2	0	0	2

Course Objective(s):

- To impart knowledge and expose to applications of chemistry in mechanical engineering stream.
- To explore the mechanisms and working principles of smart materials and coatings with real-world applications.

Functional Materials: Types, Smart coatings, Mechanisms, Sustainable energy materials.

Activities: Seminar on recent development in functional materials (e.g., smart coatings, self-cleaning surfaces), Infographic Design of functional nanomaterials.

Fuels: Classification, Chemical Composition, natural resources, Calorific Value - Alternative Fuels - Natural gas benefits.
Activities: Comparison of efficiency and emissions in fuels.

Composites: Matrix materials – Reinforcements, Hybrid composites, Engineering applications.

Activities: Design of a simple composite structure for a real engineering application (e.g., lightweight bike frame).

Lubricants: Types, Functions. Key properties, Synthetic lubricants, Mechanisms, Emerging lubricants.

Activities: Collection of lubricants used in real-world engineering systems (e.g., gears, engines, bearings), Virtual demonstration of lubricant viscosity testing.

Combustion: Reaction Kinetics, Stoichiometric combustion and air-fuel ratio calculations, Knocking and Anti-knocking agents, Hydrogen combustion, Flue Gas analysis.

Activities: Virtual simulation of flue gas analysis and gas composition, Calculation of air-fuel ratio.

Adhesives: Adhesion Mechanisms, Classification, Bond strength, Industrial adhesives.

Activities: Adhesion of thermal pads on different Integrated circuits, Industrial adhesives.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (5%), Seminar (5%), Assignments (30%), Flipped Class (10%), Internal Examinations (50%)

References:

1. Palanna, O. G. (2009). *Engineering chemistry*. McGraw-Hill Education (India) Pvt. Ltd.
2. Cheong, K. Y., Impellizzeri, G., & Fraga, M. A. (2018). *Emerging materials for energy conversion and storage*. Elsevier.
3. Jain, P. C., & Jain, M. (2013). *Engineering chemistry*. Dhanpat Rai Publishing Company (P) Ltd.

Sharma, S. C. (2000). *Composite materials*. Narosa Publishing House

	Description of CO	**PO**	**PSO**
CO1	Explain the major concepts of chemistry with regard to applications in mechanical systems.	---	
CO2	Apply the chemistry principles and evaluate the engineering materials in mechanical systems.	PO1(3)	PSO1(2)
CO3	Analyse and evaluate the performance and efficiency of mechanical systems.	PO2(3) PO3(1)	PSO2(2) PSO3(1)
CO4	Propose innovative solutions for real-world applications and challenges.	PO9(1)	

UC25H02	தமிழர்களும் தொழில்நுட்பமும்	L	T	P	C
		1	0	0	1

நெசவு மற்றும் பானைத் தொழில்நுட்பம்: சங்க காலத்தில் நெசவுத் தொழில், பானைத் தொழில்நுட்பம், கருப்பு சிவப்பு பாண்டங்கள், பாண்டங்களில் கீறல் குறியீடுகள்.

வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்: சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு, சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள், மாமல்லபுரச் சிற்பங்களும், கோவில்களும், சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள், மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள், பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ, சாரோசெனிக் கட்டிடக் கலை.

உற்பத்தித் தொழில் நுட்பம்: கப்பல் கட்டும் கலை, உலோகவியல், இரும்புத் தொழிற்சாலை, இரும்பை உருக்குதல், எஃகு, வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள், நாணயங்கள் அச்சடித்தல், மணி உருவாக்கும் தொழிற்சாலைகள், கல்மணிகள், கண்ணாடி மணிகள், சுடுமண் மணிகள், சங்கு மணிகள், எலும்புத்துண்டுகள், தொல்லியல் சான்றுகள், சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்: அணை, ஏரி, குளங்கள், மதகு, சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம், கால்நடை பராமரிப்பு, கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள், வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள், கடல்சார் அறிவு, மீன்வளம், முத்து மற்றும் முத்துக்குளித்தல், பெருங்கடல் குறித்த பண்டைய அறிவு, அறிவுசார் சமூகம்.

அறிவியல் தமிழ் மற்றும் கணித்தமிழ்: அறிவியல் தமிழின் வளர்ச்சி, கணித்தமிழ் வளர்ச்சி, தமிழ் நூல்களை மின்பதிப்பு செய்தல், தமிழ் மென்பொருட்கள் உருவாக்கம், தமிழ் இணையக் கல்விக்கழகம், தமிழ் மின் நூலகம், இணையத்தில் தமிழ் அகராதிகள், சொற்குவைத் திட்டம்.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (20%), Assignments (30%), Internal Examinations (50%)

References

1. தமிழக வரலாறு, மக்களும் பண்பாடும், கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை, ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi – 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

UC25H02	Tamils and Technology	L	T	P	C
		1	0	0	1

Weaving and Ceramic Technology: Weaving Industry during Sangam Age, Ceramic technology, Black and Red Ware Potteries (BRW), Graffiti on Potteries.

Design and Construction Technology: Designing and Structural construction House & Designs in household materials during Sangam Age, Building materials and Hero stones of Sangam age, Details of Stage Constructions in Silappathikaram, Sculptures and Temples of Mamallapuram, Great Temples of Cholas and other worship places,Temples of Nayaka Period, Type study (Madurai Meenakshi Temple), Thirumalai Nayaka rMahal, Chetti Nadu Houses, Indo, Saracenic architecture at Madras during British Period.

Manufacturing Technology: Art of Ship Building , Metallurgical studies, Iron industry, Iron smelting, steel, Copper and gold Coins as source of history - Minting of Coins, Beads making, industries Stonebeads, Glass beads, Terracotta beads, Shell beads / bone beats, Archeological evidences, Gem stone types described in Silappathikaram.

Agriculture and Irrigation Technology: Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompuof Chola Period, Animal Husbandry - Wells designed for cattle use , Agriculture and Agro Processing -Knowledge of Sea -Fisheries, Pearl, Conche diving, Ancient Knowledge of Ocean -Knowledge Specific Society.

Scientific Tamil & Tamil Computing: Development of Scientific Tamil, Tamil computing, Digitalization of Tamil Books, Development of Tamil Software, Tamil Virtual Academy, Tamil Digital Library, Online Tamil Dictionaries, Sorkuvai Project.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (20%), Assignments (30%), Internal Examinations (50%)

References

1. தமிழக வரலாறு, மக்களும் பண்பாடும், கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும்
   கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ், முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி, வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை, ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils, The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi , 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)

12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

ME25C05	Re-Engineering for Innovation	L	T	P	C
		0	0	4	2

Course Objectives:

- To cultivate foundational skills in prototyping, and automation for development of prototypes with real-world applications.
- To provide a comprehensive, hands-on exposure to product development through reverse engineering concepts.

Bootcamp 1: Introduction to Product Development, Reverse Engineering, Overview of the product lifecycle, Hands-on disassembly of simple products, Practice of basic measurements and sketching, Introduction to CAD modeling of disassembled parts, Virtual assembly of parts.

Bootcamp 2: Embedded System Programming (Open-source platforms), Practice of interfacing sensors, reading data, automation in home, healthcare and agriculture.

Reverse Engineering: Sketch and prototype alternative designs, Group brainstorming sessions, Manufacture prototype parts using 3D printing and / or workshop tools, Assemble prototype product.

Weightage: Continuous Assessment: 60%, End Semester Examinations: 40%

Assessment Methodology: Project (30%), Assignment (10%), Practical (30%), Internal Examinations (30%)

References:

1. Wang, W. (2010). Reverse engineering: Mechanisms, structures, systems & materials. CRC Press.
2. Margolis, M. (2020). Arduino cookbook: Recipes to begin, expand, and enhance your projects (3rd ed.). O'Reilly Media.

E-resources:

1. GrabCAD – https://grabcad.com/
2. GitHub – https://github.com/

	Description of CO	PO	PSO
CO1	Understand the product development lifecycle, including stages such as concept generation, design, prototyping, and testing.	---	
CO2	Apply reverse engineering techniques to analyze and document existing products.	PO1 (3) PO2 (2)	PSO1(2)
CO3	Collaborate in teams to fabricate prototypes using appropriate tools.	PO5 (2) PO8 (1) PO9 (1)	PSO3(3)
CO4	Engage in independent learning and continuously adapt to emerging technologies in product design	PO11(2)	PSO2(2) PSO3(2)

EN25C02	English Essentials – II	L	T	P	C
		1	0	2	2

Course Objectives:

- Enable learners to improve fluency and accuracy in spoken and written communication.
- Develop learners' ability to articulate ideas clearly and effectively in formal and informal spoken interactions.
- Help learners construct well-organised written documents relevant to academic and workplace contexts.

Oral Communication: Types (Verbal and Nonverbal), Interpersonal and group communication, Telephonic conversation.

Suggested Activities: Short presentations, Debates, Formal Speeches (Welcome, Vote of Thanks and introducing guests), Listen and respond to short podcasts.

Business Correspondence: Email Communication, Formal Letters (Types), Business Meeting.

Suggested Activities: Email and letter writing (Complaint, request, permission), Agenda, minutes of the meeting.

Academic Writing: Paraphrasing, Summarizing, Essay Writing, Instructions and Recommendations.

Suggested Activities: Essay writing (Cause and effect, argumentative, persuasive), User guides/ manuals, policy document.

Team Work: Leadership Skills (Team building, Team Leader, Team player), Negotiation and Problem solving skills

Suggested Activities: SWOT Analysis, Brainstorming and Group discussions.

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%

Assessment Methodology: Worksheets (10%), Group Activity (20%), Report Writing (20%), Internal Examinations (50%)

References:

1. Koneru Aruna. (2020*). English Language Skills for Engineers*. McGraw Hill Education.
2. Taylor, Shirley & Chandra .V. (2010). *Communication for Business A Practical Approach*. India: Pearson Longman.
3. Ian Badger, et al., (2014). *Listening: B2 (Collins English for Life: Skills)*, Collins.
4. Raymond Murphy (2019), *Grammar in Use*, Cambridge University Press.

E-Resources:

1. Communication for Business Success - https://open.umn.edu/opentextbooks/textbooks/8
2. TED Talks – https://www.ted.com/

	Description of CO	PO	PSO
CO1	Understand the importance of communication and drafting skills in engineering and technology.	---	
CO2	Apply listening strategies to comprehend spoken English in various contexts.	PO1(3)	PSO3(2)
CO3	Participate actively in group discussions by analysing critically from different views.	PO2(2) PO8(1)	PSO3(3)
CO4	Create written reports coherently for various purposes.	PO9(2)	PSO3(2)
CO5	Adapt communication styles to global, multicultural environments.	PO11(1)	PSO2(2)

UC25A03	Life Skills for Engineers – II	L	T	P	C
		1	0	2	1

Course Objectives:

- To impart and cultivate analytical reasoning, innovative thinking, effective collaboration, and ethical leadership to prepare students for complex challenges in professional and personal environments.

Critical Thinking: Creativity, Critical Thinking, Collaboration, Problem Solving, Decision Making, Imagination, Intuition, Experience, Sources of Creativity, Lateral Thinking, Myths of creativity, Critical thinking Vs Creative thinking, Convergent & Divergent Thinking, Critical reading & Multiple Intelligence.

Activities: Two-Brainstorm Method, “30 Circles” Challenge, “Desert Survival” Simulation, Lateral thinking riddles and puzzles, "What If?" Scenario Writing, Fast vs. Slow Thinking Game, Creativity Myth Busters

Problem Solving: Techniques, Six Thinking Hats, Mind Mapping, Forced Connections. Analytical Thinking, Numeric, symbolic, and graphic reasoning. Scientific temperament and Logical thinking.

Activities: Case study analysis, Escape Room challenge.

Leadership: Leadership Styles & Self-Assessment, Communication & Active Listening, Decision-Making & Responsibility, Teamwork & Delegation, Empathy, Integrity & Conflict Management, Vision, Motivation & Goal-Setting.

Activities: Crisis Leadership Simulation, Tower Challenge, Leadership Dilemmas Role-Play, Team Vision Board

Weightage: Continuous Assessment: 100%

Assessment Methodology: Assignments (20%), Flipped Class & Worksheets (10%), Practical (30%), Internal Examinations (40%)

References:

1. De Bono, E. (2017). *Six thinking hats*, Little, Brown Book Group.
2. Facione, P. A. (2015). *Critical thinking: What it is and why it counts*. Insight Assessment.
3. Kahneman, D. (2011). *Thinking, fast and slow*. Farrar, Straus and Giroux.
4. Whetten, D. A., & Cameron, K. S. (2016). *Developing management skills*. Pearson.

	Description of CO	PO	PSO
CO1	Explain the importance of leadership and management skills in life.	---	
CO2	Apply and demonstrate creative thinking techniques to generate innovative solutions.	PO7 (3)	PSO1(1) PSO2(1)
CO3	Exhibit effective collaboration and communication skills through teamwork, active listening, and conflict resolution strategies.	PO8 (2)	PSO3(3)
CO4	Integrate scientific temperament and logical reasoning into c problem solving in engineering and real-world contexts.	PO11 (2)	PSO2(1) PSO3(2)

UC25A04	Physical Education - II	L	T	P	C
		0	0	4	1

Course Objectives:

- To impart knowledge on gymnastic exercises and pressing needs for upskilling in a particular game.

Basic gymnastics exercises: Warming up, Suitable exercise, Lead up games, Safety education, Movement education, Balanced Walk, execution, floor exercise, tumbling/acrobatics, grip, release, swinging, parallel bar exercise, horizontal bar exercise, flic-flac-walk and pyramids.

Upskilling in any one of the athletics: Broad Jump, High Jump, Triple Jump, Relay Sprints, Javelin Throw, Discuss Throw, Shot Put, Short and Long-distance Running.

Advance skills in any one of the indoor/outdoor games, which has been opted by the student in the I semester.

Weightage: Continuous Assessment: 100%

Assessment Methodology: Attendance (60%), Quiz (10%), Participation in Sports and Games (20%) and Viva Voce (10%)

References:

1. Singh, A. (2008). Essentials of physical education. Kalyani Publishers.
2. Kamlesh, M. L. (2006). Psychology in physical education and sport (3rd ed.). Metropolitan Book Co.
3. Mangal, S. K. (2009). *Psychology of sports performance*. Sports Publication.
4. Kandappan, K. (2004). *Foundations of physical education*. Friends Publications.

E-resources:

1. **https://www.who.int/health-topics/physical-activity**

	CO Description	PO	PSO
CO1	Understand and explain the importance of physical activity for mental and physical health.	---	
CO2	Apply safety principles and methods during sports activities.	PO1(3)	PSO3(1)
CO3	Develop teamwork, discipline, and leadership through sports and group activities and collaborate effectively.	PO8 (3)	PSO3(2)
CO4	Demonstrate the advanced technical skills and strategic understanding in the game of their interest.	PO11(1)	PSO3(2)

Foreign Language^

UC25F01	Deutsch – I	L	T	P	C
		1	0	2	1

Course Objectives:

- To impart fundamentals of the Deutsch language, including reading, writing systems, pronunciation, and speaking.

Basics & Introduction: German alphabet and pronunciation, Basic greetings and farewells, Introducing yourself and others (Ich heiße…, Wer bist du?), Numbers 1–100 and days of the week, Personal pronouns (ich, du, er, sie…), Sentence structure (SVO word order).

Activities: Alphabet spelling game, short skits, Use color-coded cards for SVO sentences.

Grammar Essentials & Everyday Vocabulary: Present tense of regular verbs (spielen, arbeiten, machen…), Common irregular verbs: sein (to be), haben (to have), gehen, kommen, Articles and gender (der, die, das; ein, eine), Simple questions and negation (nicht, kein), Describing people and things: adjectives and colors, Family, school, food, and common objects vocabulary.

Activities: Conjugate regular and irregular verbs, “Question Chain” game, Create a simple family tree.

Everyday Communication in German: Asking for and giving directions, Telling the time and talking about schedules, Ordering food and drinks at a café or restaurant, Talking about hobbies, weather, and daily routines, Listening to short conversations and responding appropriately, Introduction to German culture and formal/informal language use (du vs Sie).

Activities: Ordering food and drinks, Give directions, Formal / Informal greetings, Do’s and Don’ts.

Weightage: Continuous Assessment: 100%

Assessment Methodology: Assignments (30%), Quiz (10%) and Internal Examinations 60%

References:

1. Funk, H., Kuhn, C., & Demme, S. (2015). Menschen A1: Deutsch als Fremdsprache Kursbuch. Hueber Verlag.

	CO Description	PO	PSO
CO1	Understand simple spoken Deutsch in everyday contexts.	---	
CO2	Communicate with widely used Deutsch words effectively.	PO9 (2)	PSO3(2)
CO3	Develop the skills necessary for self-directed learning and continuous improvement in Deutsch language.	PO11 (1)	PSO3(2)

UC25F02	**Japanese – I**	L	T	P	C
		1	0	2	1

Course Objectives:

- To impart fundamentals of the Japanese language, including reading, writing systems, pronunciation, and speaking.

Writing Systems & Basic Communication: Introduction to Hiragana: vowels, basic characters, reading & writing, Introduction to Katakana: basic characters and usage, Basic greetings and farewells (こんにちは, おはようございます, さようなら), Introducing yourself (名前、出身、年齢), Basic sentence structure: Subject–Object–Verb, Numbers 1–100, days of the week, classroom expressions.

Activities: Flashcard games and writing drills, Self-introduction, Numbers & date-matching, Greeting expressions, Listening to audio.

Grammar & Everyday Vocabulary: Particles: は (wa), を (wo), の (no), へ (e), に (ni), Present tense verbs: です, ます-form conjugation (たべます、のみます), Negative forms: ではありません, ません, Describing people and objects using adjectives (い and な), Question formation: なに、どこ、だれ、いつ, Vocabulary for family, food, colors, and basic actions.

Activities: Verb conjugation drills, Guessing game, Picture description, “Shopping” with food vocab and counters

Conversation & Cultural Etiquette: Talking about routines and schedules (daily verbs, time expressions), Asking and giving simple directions (〜はどこですか？), Ordering food and making polite requests (〜をください、〜をおねがいします), Expressing likes and dislikes (すき・きらい), Listening to short conversations and identifying key phrases, Introduction to formal/informal speech and Japanese etiquette.

Activities: Skits and role-plays, daily schedule, beginner-level dialogue, Group discussion on etiquette.

Activities: Practice worksheets and flashcards for hiragana, Writing drills and reading simple katakana words, Dialogue practice for greetings and self-introduction, Sentence construction exercises with basic SOV structure, Particle usage exercises and short dialogues, Role-play scheduling, shopping, and telling time, Verb conjugation drills for common verbs, Descriptive sentence exercises using adjectives, Practice Q&A dialogues forming questions and negations, Kanji writing practice and quizzes for basic characters, Vocabulary tests and conversational practice on daily topics, Oral presentations and listening comprehension quizzes.

Weightage: Continuous Assessment: 100%
Assessment Methodology: Assignments (30%), Quiz (10%) and Internal Examinations 60%
References: 1. Banno, E., Ikeda, Y., Ohno, Y., Shinagawa, C., & Tokashiki, K. (2011). Genki I: An integrated course in elementary Japanese. The Japan Times. 2. The Japan Foundation. (2017). Marugoto Japanese language and culture starter (A1) course book for communicative language activities. Goyal Publishers.

	CO Description	PO	PSO
CO1	Understand simple spoken Japanese in everyday contexts.	---	
CO2	Communicate with widely used Japanese words effectively.	PO9 (2)	PSO3(2)
CO3	Develop the skills necessary for self-directed learning and continuous improvement in Japanese language.	PO11 (1)	PSO3(2)

UC25F03	Korean – I	L	T	P	C
		1	0	2	1

Course Objectives:

- To impart fundamentals of the Korean language, including reading, writing systems, pronunciation, and speaking.

Fundamentals of Korean: Introduction to Hangul: consonants and vowels, Basic pronunciation and syllable formation, Common greetings and self-introductions, Numbers (Sino-Korean and Native Korean basics), Basic sentence structure (Subject-Object-Verb), Simple expressions (e.g., 감사합니다, 안녕하세요).

Activities: Writing and reading Hangul practice sheets, Pronunciation drills and audio repetition, Dialogue practice for greetings and self-introduction, Counting and number exercises.

Essential Grammar and Vocabulary: Particles (은/는, 이/가, 을/를) and usage, Basic verbs and present tense conjugation, Sentence patterns: affirmative, negative, interrogative, Common adjectives and descriptive sentences, Expressing possession and location, Asking simple questions (어디, 뭐, 누구).

Activities: Verb conjugation and sentence formation drills, Role-play conversations for shopping and daily routines, Descriptive writing and speaking exercises, Question and answer practice.

Everyday Korean Communication: Polite speech levels and honorifics introduction, Talking about time, dates, and schedules, Ordering food, shopping phrases, counting objects, Simple directions and transportation vocabulary, Listening practice with short dialogues, Cultural notes on etiquette and communication.

Activities: Role-play ordering at a restaurant or buying items, Listening comprehension exercises, Giving and asking for directions practice, Group conversations and presentations.

Weightage: Continuous Assessment: 100%

Assessment Methodology: Assignments (30%), Quiz (10%) and Internal Examinations 60%

References:

1. King, R., Yeon, J., & Brown, A. (2015). Elementary Korean (2nd ed.). Tuttle Publishing.
2. Cho, Y., Lee, H., Schulz, C., Sohn, H.-M., & Sohn, S.-O. (2001). Integrated Korean: Beginning 1. University of Hawai‘i Press.

	CO Description	PO	PSO
CO1	Understand simple spoken Korean in everyday contexts.	---	
CO2	Communicate with widely used Korean words effectively.	PO9 (2)	PSO3(2)
CO3	Develop the skills necessary for self-directed learning and continuous improvement in Korean language.	PO11 (1)	PSO3(2)

SEMESTER – III

MA25C09	Computational Differential Equations	L	T	P	C
		3	1	0	4

Course Objectives: The Objectives of the course are to equip students with the ability to formulate and solve various types of Ordinary and Partial Differential Equations (ODEs & PDEs) and to develop proficiency in applying numerical methods and computational tools for solving differential equations encountered in engineering problems.

First Order Ordinary Differential Equations: Basic concepts of ordinary differential equations–Formation of first order differential equations from physical problems–First order and first-degree ODE: Variables separable–Exact equations–Leibnitz's equation – Bernoulli's equation – Numerical Methods: Solving first order ODE by Euler's formula, Taylor series and Runge Kutta method of 4th order.

Activities: Application and Visualization of the first order ODE using open-source software and solving Competitive Examination questions

Higher Order Ordinary Differential Equations: Formation of second order differential equations from physical problems–Linear equations of second and higher order with constant coefficients – Euler's linear equations – Method of variation of parameters–Numerical Methods: Solving second order ODE by Runge-Kutta method of 4th order and finite difference method.

Activities: solving ordinary differential equations using open-source software and solving of Competitive Examination questions

First Order Partial Differential Equations: Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions - Solution of PDE by variable separable method – Solution of standard types of first order partial differential equations (excluding reducible to standard types) – Lagrange's linear equation – Numerical Methods for first order PDE by Method of lines with Runge-Kutta method of order fourth.

Activities: Application and Visualization of the Partial Differential Equations using open-source software and solving Competitive Examination questions

Higher Order Partial Differential Equations: Linear homogeneous partial differential equations of second and higher order with constant coefficients. Numerical Methods: Finite difference techniques for the solution of two-dimensional Laplace's and Poisson's equations on rectangular domain—Solution of one-dimensional heat equation using Bender Schmidt and Crank Nicholson difference schemes—Solution of one-dimensional wave equation by explicit scheme.

Activities: Application of the second order PDE using open-source software of 1-D wave, 1-D heat equations, Laplace and Poisson equations and Solving Competitive Examination questions

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignments (20%), Solution to application-oriented problems using software (20%), Solving Competitive Examination questions (20%), Internal Examinations (40%).

References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, (11th ed.), John Wiley & Sons, USA,2025.
2. Joe D. Hoffman, Numerical *Methods for Engineers and Scientists* (3rd ed.). CRC Press (Taylor & Francis Group), 2001.
3. Steven C. Chapra and Raymond P. Canale. *Numerical Methods for Engineers* (8th ed.). McGraw-Hill Education, 2021.
4. William E. Boyce and Richard C. DiPrima. *Elementary Differential Equations and Boundary Value Problems,* (11thed.). John Wiley & Sons, USA,2017.
5. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 45th Edition, 2026.
6. Randall J. LeVeque, Finite Difference Methods for Ordinary and Partial Differential Equations, SIAM,2007.

E-resources:

1. https://ocw.mit.edu/courses/18-03-differential-equations-spring-2010/
2. https://archive.nptel.ac.in/content/syllabus_pdf/111107063.pdf
3. https://github.com/patrickwalls/mathematicalpython

	Description of CO	PO	PSO
CO1	Explain first and higher-order ODEs using appropriate analytical and numerical techniques.	-	-
CO2	Solve higher-order PDEs using classical and finite difference methods.	PO1(3) PO5(3)	PSO1(2)
CO3	Apply various solution methods to differential equations arising in engineering contexts.	PO1 (3) PO5(3)	PSO2(1)
CO4	Interpretation of numerical solutions for partial differential equations and using open-source software.	PO2(3) PO5(3) PO11(2)	PSO2(1)

(1) = Low; (2) = Medium; (3) = High

ME25C07	Applied Engineering Mechanics	L	T	P	C
		3	0	0	3

Course Objectives:
To provide a comprehensive understanding of applied engineering mechanics principles for analyzing structures, machines, and mechanical systems. It develops the ability to solve engineering problems using analytical, energy, and momentum methods.

Analysis of Structures: Planar trusses, Assumptions, static determinacy, method of joints, method of sections. Introduction to 3D trusses. Plane Frames, analysis of member forces. Simple Machines, mechanical advantage, velocity ratio, efficiency

Activities:
- Simulation of plane trusses using FEM softwares.
- Physical modeling of 2D trusses using wooden sticks
- Case Studies of Collapse of 3D Trusses

Method of Virtual Work: Principle of virtual work, analysis of planar machines/mechanisms, Mechanical efficiency of real machines, Potential energy and equilibrium, Stability of equilibrium of mechanical systems

Activities: Problem-solving assignments using computational tools/programming environments.

Kinetics of Particles: Energy and Momentum methods: Work Energy principle, Conservation of Energy principle, Impulse Momentum principle, Impacts – Direct and Oblique.

Activities:
Assignments using programming tools to calculate the motion parameters of particles and present the results in graphical form.

Plane Motion of Rigid Bodies: Energy and Momentum methods, Kinetic energy of rigid bodies, Linear and angular momentum principles, Eccentric impacts of rigid bodies

Activities:
1. Problem-solving assignments using computational tools/programming environments
2. Case studies of rigid body motion in engineering systems

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (5%), Assignments (25%), Review of GATE/ESE questions - 20%, Internal Examinations (50%)

References:

1. Ferdinand P. Beer, E. Russell Johnston, David Mazurek, Phillip J. Cornwell and Brian Self, Vector Mechanics for Engineers: Statics and Dynamics, 13th Edition, McGraw-Hill Education, 2025.
2. R. C. Hibbeler, Engineering Mechanics: Statics & Dynamics, 16th Edition, Pearson Education, 2026.

3. James L. Meriam, L. G. Kraige and J. N. Bolton, Engineering Mechanics: Statics and Dynamics (An Indian Adaptation), 9th Edition, Wiley India, 2021.
E-resources: 1. https://nptel.ac.in/courses/112106180 2. https://nptel.ac.in/courses/112106286

CO	CO Description	PO	PSO
CO1	Explain fundamentals of statics, trusses, frames, simple machines, virtual work, and energy–momentum principles.	—	—
CO2	Apply statics, virtual work, and energy methods to determine forces, reactions, efficiency, and motion parameters.	PO1 (2), PO2 (2)	PSO1 (2), PSO2 (2)
CO3	Analyze trusses, frames, particles, and rigid bodies using force, energy, and momentum methods to evaluate system behavior.	PO1 (2), PO2 (2), PO4 (2)	PSO1 (2), PSO2 (2)
CO4	Evaluate stability, efficiency, and performance of mechanical systems and develop engineering solutions.	PO2 (2), PO3 (2), PO4 (2)	PSO1 (2), PSO2 (2)

(1) = Low; (2) = Medium; (3) = High

ME25C11	Applied Thermodynamics	L	T	P	C
		3	1	0	4

Course Objectives:
The course focuses on understanding and applying thermodynamic principles in engineering systems, with emphasis on the analysis, evaluation, and comparison of air standard cycles, steam power cycles, refrigeration systems, and heat transfer processes.

Basic Thermodynamics: Systems, closed, open and isolated. Property, state, path and process, quasi-static process, Zeroth Law.

Activities:
Observe and document thermodynamic systems in daily life (e.g., pressure cooker, air compressor, refrigerator) and classify them as open/closed systems with justification.

First and Second Law of Thermodynamics: Heat and work transfer in flow and non-flow processes, Steady flow energy equation - Engineering Applications, Second law, Kelvin-Planck statement, Clausius statement, Concept of Entropy, Clausius inequality, Entropy changes in non- flow processes. Available and Unavailable Energy.

Activities:
- Conduct an energy audit of a simple thermal device such as an electric kettle or water heater using the First Law of Thermodynamics.
- Study entropy generation in daily-life irreversible processes such as mixing hot and cold water or ice melting.
- Analyze a steam turbine/compressor/pump using the Steady Flow Energy Equation and prepare a performance report.

Air Standard Cycles: Carnot cycle, Otto, Diesel, Dual combustion and Brayton cycles. Air standard efficiency. Mean effective pressure. Comparison of cycles

Activities:
- Plot P–V and T–S diagrams for Otto, Diesel, Dual, and Brayton cycles using simulation software or graph sheets.
- Compare thermal efficiencies of different air standard cycles for varying compression ratios.

Properties Steam and Vapour Power Cycle: Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagram. p-v-T surface Properties of steam, Dryness fraction, Quality of steam-by-steam tables and Mollier chart – Rankine cycle, Rankine cycle Improvements- Reheat, Regenerative Cycle

Activities:
- Compare the efficiency improvement obtained using reheating and regeneration in Rankine cycles.
- Visit a thermal power plant (virtual/physical) and identify major Rankine cycle components.

Refrigeration: Principles of refrigeration, Vapour compression refrigeration, Performance Calculations, Working principle of Vapour absorption cycle, comparison, sustainable refrigerants.

Activities:

- Study of the working of domestic refrigerators and air conditioners and identify major VCR system components.
- Analyze eco-friendly refrigerants and prepare a report on environmental impacts (ODP/GWP).

Heat Transfer: Modes of heat transfer, Heat conduction - composite wall, Heat conduction through hollow and composite cylinders, spheres. Basics of Convective heat transfer. Fundamentals of Radiative heat transfer, heat-exchangers. LMTD for parallel and counter flow configuration.

Activities:

1. Measure temperature variation across composite walls using simple experimental setups.
2. Analyze cooling mechanisms in automobile radiators or electronic devices.
3. Perform a case study on heat exchangers and calculate LMTD for parallel and counter flow systems.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Quiz - 10%, Assignments - 20%, Review of GATE/ESE questions - 20% and Internal Examinations - 50%

References:

1. Yunus A. Çengel, Michael A. Boles & Mehmet Kanoğlu, Thermodynamics: An Engineering Approach, 10th Edition, McGraw Hill Education, 2023.
2. P.K. Nag & Sudipta De, Engineering Thermodynamics, 7th Edition, McGraw Hill Education, 2025.
3. Mahesh M. Rathore, Thermal Engineering, Latest available edition: 1st Edition, Tata McGraw Hill, 2010.
4. P. Ballaney, Thermal Engineering, 25th Edition, Khanna Publishers, 2017.
5. R.K. Rajput, Thermal Engineering, 10th Edition, Laxmi Publications (P) Ltd., 2017.

E-resources:

1. https://onlinecourses.nptel.ac.in/noc25_me148/preview
2. https://onlinecourses.nptel.ac.in/noc24_me03/preview
3. https://nptel.ac.in/courses/112103307
4. https://www.nptelprep.in/courses/112103307
5. https://nptel.ac.in/courses/112106133
6. https://nptel.ac.in/courses/112106419

CO	CO Description	PO	PSO
CO1	Explain the basic principles of thermodynamics and energy interactions in engineering systems.	-	-
CO2	Apply thermodynamic laws to analyze air standard cycles and steam power cycles.	PO1(2), PO2(2), PO3(2)	PSO1(2)
CO3	Analyse refrigeration, air-conditioning systems, and heat transfer processes including conduction, convection, and radiation.	PO2(2), PO3(2), PO4(2)	PSO2(2)
CO4	Demonstrate problem-solving skills in real-world thermodynamic and heat transfer applications, including performance evaluation and design calculations.	PO4(2), PO5(1), PO12(1)	PSO2(2), PSO3(1)

(1) = Low; (2) = Medium; (3) = High

ME25C14	Mechanical Behaviour of Materials	L	T	P	C
		3	0	2	4

Course Objectives:

To introduce the mechanical behavior of engineering materials, including deformation, strength, and tribological properties. To develop skills in material selection, testing, and analysis using standard methods. To enable evaluation and application of advanced and functional materials in engineering industries.

Introduction to Material's Behaviour: Materials classification and their properties, Stress strain Relationship, Elastic Properties of Materials, Viscoelasticity, Rubber Elasticity, Plastic Deformation in Tension, Plastic Deformation in Compression Testing, Plastic Deformation of Polymers, Plastic Deformation of Glasses, Flow, Yield, and Failure Criteria, Anisotropic Effect.

Practical: Mechanical testing and predicting the stress strain curve using Tensile test for metals, composite and polymer materials.

Activity: Virtual demonstration of Elasticity, Viscoelasticity, Plasticity of the materials

Selection of Material and Design Approach: Selection of materials based on function, Objective, Constraints, free variables and service requirements, Relationship between materials selection and processing, Effect of surface and metallurgical parameters on fatigue, Safe life, Stress-life, strain-life and fail-safe design approaches - Fracture of non metallic Materials, Failure analysis, sources of failure, procedure of failure analysis.

Practical: Measuring of Surface Roughness, Fracture surface studies using optical microscope.

Activity: Case studies in materials selection with relevance to auto, marine and aero application.

Testing of Materials Behaviour: Testing of mechanical properties of polymers/composite materials and their ASTM standards: Tensile test, compression test, Impact test, hardness test, shear and bending, Testing of tribological properties of composite materials: pin on disc, corrosion studies

Practical: Mechanical testing for Compression, Hardness, Torsion Test, Pin on Disc for wear testing, Experiments using Corrosion studies.

Activity: Sample preparation for material testing according to ASTM standards.

Study of Micro Structure Behaviour of Materials: General working principle, applications, limitations: metallurgical optical microscope, Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), X-ray diffraction (XRD), Energy Dispersive X-ray analysis (EDX), atomic force microscope (AFM), X-ray photoelectron spectroscopy (XPS), Raman spectroscope.

Practical: Micro and Macroscopic Metallurgical Observation.

Activity: Sample preparations of metallurgical micro structure study**.**

Advanced and Functional Materials: Intermetallics, Ni and Ti aluminides, Alloys, Al, Mg, Cu, Superalloys-Ironbase, Cobaltbase, Nickelbase, Metal matrix composites (MMC): Al alloys, Advanced ceramics: WC, TIC, TaC, Al2O3, SiC, Si3N4CBN, polymers: GFRP and CFRP laminated composite, polymers used in Additive manufacturing.

Practical: Development of samples using Additive manufacturing process for mechanical testing.

Activity: Visual demonstration of 3D printing

Tasks:

T1. A machine component fails due to unexpected fracture – analyze material behavior and suggest suitable material selection.

T2. A polymer component shows excessive deformation under load – evaluate viscoelastic properties and improve design.

T3. A mechanical part experiences high wear and corrosion – analyze tribological behavior and recommend material/treatment.

T4. An industrial component fails under cyclic loading **–** study fatigue behavior and propose design improvements.

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%

Assessment Methodology:

Written Test (40%), Practical (30%), Activity (30%).

Practical: Lab Experiments (50%), Tasks (50%) (Each student must complete a minimum of two tasks).

Activity: Review of GATE/ESE (10%), Mini Project/ Quiz/ Assignment Programs/ Flipped Class /Seminar Presentation (20%)

References:

1. G.E. Dieter – Mechanical Metallurgy (SI Metric Ed., McGraw-Hill, 1995)
2. T.H. Courtney – Mechanical Behaviour of Materials (2nd Ed., Waveland Press, 2005)
3. N.E. Dowling – Mechanical Behavior of Materials: Engineering Methods for Deformation, Fracture, and Fatigue (4th Ed., Pearson, 2013)
4. A.K. Bhargava & C.P. Sharma – Mechanical Behaviour and Testing of Materials (PHI Learning, 2011)
5. M.A. Meyers & K.K. Chawla – Mechanical Behavior of Materials (2nd Ed., Cambridge University Press, 2009)

E-Resources:

1. NPTEL Online Course – Mechanical Behaviour of Materials (IIT Madras) https://onlinecourses.nptel.ac.in/noc21_mm27/preview
2. MIT OpenCourseWare – 3.032 Mechanical Behavior of Materials https://ocw.mit.edu/courses/3-032-mechanical-behavior-of-materials-fall-2007/
3. DoITPoMS (Dissemination of IT for the Promotion of Materials Science) - Introduction to Mechanical Properties of Materials https://www.doitpoms.ac.uk/tlplib/mechanical_properties/index.php
4. MatWeb – Online Materials Properties Database https://www.matweb.com/index.aspx
5. Materials (MDPI Journal) – An international open-access journal of materials science and engineering (ISSN 1996-1944) https://www.mdpi.com/journal/materials

CO	CO Description	PO Mapping	PSO
CO1	Explain mechanical behavior of materials including deformation, strength, and tribological properties.	–	–
CO2	Apply material selection, testing methods, and analysis for engineering applications.	PO1 (2), PO2 (2)	PSO1 (2), PSO2 (2)
CO3	Analyze material behavior under different loading conditions including fatigue, wear, and corrosion.	PO2 (2), PO4 (2)	PSO1 (2), PSO2 (2)
CO4	Evaluate advanced and functional materials based on performance, properties, and industrial applications.	PO3 (2), PO5 (2)	PSO1 (2), PSO2 (2), PSO3 (1)

(1) = Low; (2) = Medium; (3) = High

MF25C01	Casting, Forming and Welding	L	T	P	C
		3	0	2	4

Course Objectives:
To provide fundamental knowledge of casting, forming, sheet metal processing, and welding processes. To develop the ability to understand, analyze, and select suitable manufacturing methods for engineering applications.

Casting Fundamentals: Sand casting, Moulding sand, pattern and its type, Design of pattern, Allowances and its type, solidification and cooling, core, riser, and gating design, sand casting defects, Introduction to casting simulation tools.

Practical:
1. Evaluation of moulding sand properties for casting
2. Sand mold preparation using solid, split pattern.

Special Types of Casting Process: Investment casting process, Shell molding process, Pressure Die casting process, Centrifugal casting process, Squeeze casting, stir Casting

Forming – Bulk Deformation processes: Plastic Deformation & Yield Criteria, Hot and Cold working, Rolling, Forging, Extrusion, Wire and Tube Drawing - working principle and load estimation.

Practical:
1.Analysis of thickness reduction during flat rolling.

Sheet Metal Processes: Formability of sheet metal, shearing processes, Deep Drawing, Bending, Dies and their types, Rubber pad forming, Explosive Forming, Superplastic forming.

Practical:
1. Evaluation and comparison of sheet metal formability using the Erichsen cupping test.
2. Fabrication of simple sheet metal components using standard sheet metal tools

Welding fundamentals: Classification of welding processes, Gas Welding, welding power sources: Constant current and constant voltage power sources – characteristics and applications, Arc welding, Physics of Arc welding, SMAW, TIG, MIG, SAW, Plasma Arc welding processes, Ultrasonic Welding, Resistance welding, Brazing, soldering, adhesive bonding, weld Defects, and remedies

Practical:
1. Design and fabricate a simple welded component of a specified geometry using mild steel plates and the SMAW process, ensuring proper joint design and weld quality
2. Effect of welding current on weld bead geometry in SMAW of mild steel.
3. Effect of welding current on microstructure in SMAW of mild steel.
4. Analyze hardness variation in the fusion zone and HAZ of SMAW joints at different welding currents.

Advanced welding processes: TIG Welding, Pulsed TIG Welding, CMT welding, Laser welding, Electron Beam welding, Friction welding, Friction stir welding, Diffusion Bonding

Tasks:

T1. An automobile manufacturer faces casting defects (porosity) in engine blocks – redesign gating and riser system to reduce rejection rate.

T2. A steel plant reports cracks during rolling of sheets – analyze process parameters and suggest optimal rolling conditions.

T3. A company producing fuel tanks encounters failure in deep drawing process – improve die design and material selection.

T4. A fabrication unit observes weak weld joints in structural frames – optimize welding current, technique, and joint design.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology:

Written Test (40%), Practical (30%), Activity (30%).

Practical: Lab Experiments (50%), Tasks (50%) (Each student must complete a minimum of two tasks).

Activity: Review of GATE/ESE Questions (10%), Mini Project/ Quiz/ Assignment Programs/ Flipped Class /Seminar Presentation (20%)

References:

1. Serope Kalpakjian and Steven Schmid, Manufacturing Engineering and Technology, 9th Edition, Pearson, 2025.
2. Jain, P. L., Principles of Foundry Technology, 5th Edition, McGraw Hill Education, 2022.
3. Groover, Mikell P., Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, 7th Edition, John Wiley & Sons, 2020.
4. Sharma, P. C., A Textbook of Production Technology, 9th Edition, S. Chand & Co. Ltd., 2021.
5. Sind Kou, Welding Metallurgy, 3rd Edition, Wiley Publication, 2020.
6. John, K. C., Metal Casting and Joining, 2nd Edition, PHI Learning Pvt. Ltd., 2019.
7. ASM Handbook: Metalworking – Sheet Forming, Volume 14B, ASM International, 2020.

E-resources:

1. https://nptel.ac.in/courses/112107219
2. https://nptel.ac.in/courses/112107213
3. https://nptel.ac.in/courses/112107250
4. https://nptel.ac.in/courses/112107083
5. https://msvs-dei.vlabs.ac.in/ajay/mpfclab.html
6. http://vlabs.iitkgp.ac.in/welding/loe.html
7. https://msvs-dei.vlabs.ac.in/
8. https://3dp-dei.vlabs.ac.in/

CO	CO Description	PO	PSO
CO1	Explain fundamental concepts of casting, forming, sheet metal processes, welding, and machining operations including working principles and applications.	—	—
CO2	Apply manufacturing principles to select suitable casting, forming, sheet metal, and welding processes for producing engineering components.	PO1 (2), PO2 (2)	PSO1 (2), PSO2 (2)
CO3	Analyze various manufacturing processes to identify defects, material behavior, process parameters, and performance under different conditions.	PO2 (2), PO4 (2)	PSO1 (2), PSO2 (2)
CO4	Evaluate and develop suitable manufacturing solutions by comparing different processes based on quality, efficiency, and industrial requirements.	PO3 (2), PO5 (2)	PSO1 (2), PSO2 (2), PSO3 (1)

(1) = Low; (2) = Medium; (3) = High

EC25C17	Embedded Systems	L	T	P	C
		3	0	0	3

Course Objective:

This course introduces students to embedded system architecture, microcontrollers, and real-time operating systems. Students learn programming in C and Python, peripheral interfacing, and communication protocols to design and implement embedded applications for real-world automation systems.

Embedded Hardware Architecture: CISC Architecture: Introduction to MCS51 Family, 8051 Microcontroller – Architecture, Timers, Interrupts, Serial Data Communication.

RISC Architecture: Overview of PIC16F487x family, PIC16F877A – Architecture, Timers, Interrupts, Serial ports.

Activity: Simulate and compare basic programs (timers/interrupts) on 8051 and PIC microcontrollers.

Arm And Embedded Software Development Tools: Introduction to ARM – LPC4088 Architecture. Software Development Tools: IDE Tools, ISP Tools, ARM Development Tools.

Activity: Develop and debug a simple embedded application using an ARM-based IDE and development tools.

Wired Communication Interfaces: Wired Communication Protocols: Serial – RS232, RS485, I2C, SPI, USB; Parallel – IEEE 488.

Activity: Implement serial communication (UART/I2C/SPI) between a microcontroller and an external device.

Wireless Communication Interfaces: Wireless Communication Protocols: Bluetooth Classic, BLE, IEEE 802.15.4, Zigbee, IEEE 802.11, LoRaWAN.

Activity: Demonstrate wireless data transmission using a module (e.g., Bluetooth/Zigbee/Wi-Fi).

Real-Time Operating System: Operating System Basics: The Kernel and its subsystems, Kernel Space and User Space. Types and Functions of RTOS: Task, Process and Threads, Interrupt Handling, Multiprocessing and Multitasking, Task Scheduling. Comparative study of various RTOSs.

Activity: Simulate task scheduling and interrupt handling using an RTOS environment.

Embedded Programming and Peripheral Interfacing: Embedded C and Python Programming for Embedded Applications. Peripheral Interfacing: Input and Output Devices, ADC, DAC, PWM Generation, Sensor Interface.

Activity: Develop an embedded application interfacing sensors/actuators using open source tool.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (5%), Assignments (25%), Review of GATE/ESE Questions, Internal Examinations (50%)

References

1. Raj Kamal, Embedded Systems: Architecture, Programming and Design, 3rd Edition, McGraw Hill Education, 2017.
2. James K. Peckol, Embedded Systems: A Contemporary Design Tool, 2nd Edition, Wiley, 2019.
3. Tammy Noergaard, Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers, 2nd Edition, Elsevier, 2012.
4. Han-Way Huang, Embedded System Design Using C8051, 1st Edition, Cengage Learning, 2009.
5. Rajib Mall, Real-Time Systems: Theory and Practice, 2nd Edition, Pearson Education, 2017.
6. Shibu K. V., Introduction to Embedded Systems, 3rd Edition, McGraw Hill Education, 2017.

E-Resources:

1. https://nptel.ac.in/courses/108105057
2. https://nptel.ac.in/courses/106105193
3. https://nptel.ac.in/courses/106105172
4. https://nptel.ac.in/courses/106105193
5. https://nptel.ac.in/courses/106105159

CO	CO Description	PO	PSO
CO1	Explain the architecture, components, programming, and communication protocols of embedded systems.	—	—
CO2	Apply embedded C/Python programming and peripheral interfacing techniques to implement embedded applications.	PO1 (2), PO5 (2)	PSO1 (2), PSO2 (2)
CO3	Analyze embedded systems for performance, task scheduling, and peripheral communication using real-time operating systems.	PO1 (2), PO3 (2), PO5 (2)	PSO1 (2), PSO2 (2)
CO4	Evaluate efficiency, reliability, and suitability of embedded systems, communication protocols, and RTOS-based solutions.	PO1 (2), PO2 (2), PO5 (2)	PSO1 (2), PSO2 (2), PSO3 (2)

(1) = Low; (2) = Medium; (3) = High

EN25C03	English Communication Skills Laboratory– I	L	T	P	C
		0	0	2	1

Course Objectives: The objectives of the course are to foster students' confidence and fluency in professional and social communication and to bridge the gap between academic English and industry expectations.

List of Activities

A. Elements of Effective Speaking and Listening

(i) Sharing life experience/ turning point in their life – SATORI

(ii) Situational Conversation – eg. Talking to a Senior about Internship Tips

(iii) Welcoming a Guest Speaker at a Seminar

(iv) Pictography to represent data using images or symbols

(v) B2-C1 Listening exercises include lectures, interviews, and discussions.

B. Mastering Presentations

(i) Presentation Skills – Non-verbal communication

(ii) Mini-Presentations: Topics like "My Dream Project," "Engineering in 2050," 3-minute technical pitches with logical flow

(iii) Technical Presentations with PPT

C. Group Discussion Strategies:

(i) Introduction to Group Discussions - Key skills for effective participation

(ii) Phases in a GD and Conversational Phrases in GD.

(iii) Group Discussions – Abstract and Factual topics

D. Resume & LinkedIn Optimization

(i) Building LinkedIn Profile – Drafting headlines and summaries

(ii) Social Media Optimisation

(iii) Preparing Video Resume

E. Podcast-Based Language Learning:

(i) Listening to podcast (motivational, career oriented, success stories)

(ii) Podcast Preparation – Purpose – Topic – Structure – Recording Tips - Publication of the Podcast

F. Mock Interviews and Communication Strategies:

(i) Listening – Job interview

(ii) Speaking – Mock interviews

Weightage: Continuous Assessment: 60%, End Semester Examinations: 40%.

Internal Assessment: 1. Listening (20 marks)
2. Video Resume (20 marks)
3. Creating a Podcast (30 marks)
4. Mock interview (30 marks)

End Semester Assessment: 1. Presentation with PPT (50 marks)
2. Group Discussion (50 marks)

References:

1. Floyd Kory, "Interpersonal Communication", McGraw Hill Publication, 2023.
2. Bharadwaj Apoorva, "Leadership Communication Skills for Intercultural Management: Strategies for Effective Intercultural Management (Contemporary Themes in Business and Management)", Routledge India; 1st edition, 2024.
3. Helen Spencer-Oatey and DomnaLazidou**, "**Making Working Relationships Work: The TRIPS Toolkit for Handling Relationship Challenges and Promoting Rapport", Castledown Publishers,2023.
4. Presentations - Cambridge
5. Speaking Extra
6. Listening Extra – Miles Craven by Cambridge University Press
7. CVs, Resumes, and LinkedIn: A Guide to Professional English – Springer International Publishing

E-resources:

1. Train your mind to perform under pressure- Simon Sinek https://curiosity.com/videos/simon-sinek-on-training-your-mind-to-perform-under-pressure-capture-your-flag/
2. Brilliant way one CEO rallied his team in the middle of layoffs https://www.inc.com/video/simon-sinek-explains-why-you-should-put-people-before-numbers.html
3. Will Smith's Top Ten rules for success https://www.youtube.com/watch?v=bBsT9omTeh0

	Description of CO	PO	PSO1
CO1	Communicate effectively in everyday professional situations with confidence		
CO2	Deliver well-organised and effective presentations.	PO9(3)	PSO1(1) PSO3(2)
CO3	Participate in group discussions and express ideas clearly and confidently.	PO8(2) PO9(3)	PSO3(2)
CO4	Create professional video resumes and participate in interviews effectively.	PO9(2)	PSO3(3)
CO5	Create, record and publish motivational podcasts.	PO9(2) PO11(1)	PSO2(2) PSO3(3)

(1) = Low; (2) = Medium; (3) = High

SEMESTER – IV

CS25C16	Applied Data Science	L	T	P	C
		3	0	0	3

Course Objectives

This course introduces the core concepts of data science, including data preprocessing, exploratory analysis, and machine learning techniques. It aims to develop the ability to analyze and interpret data using modern tools for real-world problem solving while emphasizing ethical and responsible use of data.

Introduction and Mathematics for Data Science: Linear equations and solutions, Matrices and their Properties; Eigenvalues and eigenvectors; Matrix Factorizations, Inner products, Distance measures; Projections; Notion of hyperplanes; halfplanes. Descriptive statistics, Inferential statistics, Hypothesis testing, Regression analysis Statistical modelling.

Activity: Perform statistical analysis and regression on a dataset using programming language to understand data distribution and relationships.

Introduction and Mathematics for Data Science: Data Science Definition, Data Science lifecycle, Types of data (structured, unstructured, semi-structured), Data sources and data collection methods- Role of Data Scientist- Applications in healthcare, banking, e-commerce.

Data Preprocessing & Wrangling: Data cleaning (missing values, noise handling), Data transformation and normalization, Feature engineering, Data integration, Handling Outliers-Data pipelines-Tools: Python (Pandas, NumPy)

Activity: Clean and preprocess a real dataset by handling missing values, outliers, and applying normalization using Pandas.

Exploratory Data Analysis (EDA) & Visualisation: Descriptive statistics, Data visualisation techniques, Bar charts, histograms, box plots, Scatter plots, heatmaps, Correlation and covariance- Identifying patterns and trends, Tools: Matplotlib, Seaborn

Activity: Analyze and visualize a dataset using plots (histogram, scatter, heatmap) to identify patterns and correlations.

Machine Learning Techniques: Supervised Learning: Linear Regression, Logistic Regression, Decision Trees, k-NN, Unsupervised Learning: K-Means Clustering, Hierarchical Clustering, Model evaluation: Accuracy, Precision, Recall, F1-score, Confusion Matrix, Overfitting & Underfitting.

Activity: Build and evaluate a machine learning model (e.g., regression or classification) using Scikit-learn.

Applied Data Science & Case Studies: Real-world applications, Recommendation systems, Fraud detection, Traffic Route Optimisation, Customer segmentation, Introduction to Big Data concepts, Ethics in Data Science, Data privacy and security basics.

Activity: Develop a mini project (e.g., house price prediction or customer segmentation) and present insights with ethical considerations.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (5%), Assignments (25%), Review of GATE/ESE Questions (20%), Internal Examinations (50%)

References

1. Provost, F., & Fawcett, T. (2013). Data Science for Business: What You Need to Know About Data Mining and Data-Analytic Thinking. O'Reilly Media.
2. Wes McKinney, *Python for Data Analysis:* Data Wrangling with Pandas, NumPy, and Jupyter*, 3rd Edition, O'Reilly Media*, 2022.
3. *Aurélien Géron,* Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 3rd Edition, O'Reilly Media, 2022.
4. Joel Grus, Data Science from Scratch: First Principles with Python, 2nd Edition, O'Reilly Media, 2019.

E-resources:

1. https://onlinecourses.nptel.ac.in/noc25_cs120/preview
2. https://nptel.ac.in/courses/106106212
3. https://ocw.mit.edu/courses/6-0002-introduction-to-computational-thinking-and-data-science-fall-2016/
4. https://ocw.mit.edu/courses/18-650-statistics-for-applications-fall-2016/
5. https://www.coursera.org/learn/what-is-datascience
6. https://www.coursera.org/specializations/data-science-python
7. https://pandas.pydata.org/docs/
8. https://numpy.org/doc/
9. https://scikit-learn.org/stable/user_guide.html

CO	CO Description	PO	PSO
CO1	Explain the concepts of data science lifecycle, mathematics, preprocessing, EDA, and ML techniques.	–	–
CO2	Describe data preprocessing, feature engineering, and visualization techniques.	PO1 (2), PO5 (2)	PSO2 (2)
CO3	Apply data preprocessing, visualization, and machine learning algorithms using tools.	PO2 (2), PO5 (2)	PSO2 (2)
CO4	Analyze datasets using statistical and analytical methods to derive insights.	PO2 (2), PO4 (2)	PSO2 (2), PSO3 (2)

(1) = Low; (2) = Medium; (3) = High

ME25C09	Kinematics and Dynamics of Machines	L	T	P	C
		3	0	2	4

Course Objectives:
The course introduces the fundamental concepts of mechanical linkages and mechanisms used in machines, including higher pairs such as cams and gear transmissions. It develops an understanding of force analysis in mechanisms, the effects of unbalanced forces, and the basic principles governing vibrations in mechanical systems.

Kinematic Analysis in Simple Mechanisms and Cams: Mechanisms, Terminology and definitions, kinematics inversions of 4 bar and slide crank chain, kinematics analysis in simple mechanisms, velocity and acceleration polygons.

Practical: Analysis of Four Bar Chain and Slider Crank Mechanisms,

Cams: Cam-terminology, different types of cams and followers, Cam design for different follower motion curves, graphical construction of cam profiles for different types of followers.

Practical: Cam displacement curves.

Gears and Geartrains: Gear terminology, law of toothed gearing, involute gearing, Gear tooth action, Interference and undercutting, geartrains, parallel axis gear trains, Epicyclic geartrains.

Practical: Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains.

Static and Dynamic Force Analysis: Applied and Constrained Forces, Free body diagrams, Static equilibrium conditions, Static Force analysis in simple mechanisms, Dynamic Force Analysis in simple machine members, Inertia Forces and Inertia Torque, D'Alembert's principle.

Balancing of Rotating Masses and Gyroscope: Static and Dynamic balancing, Balancing of revolving masses, Balancing machines, Gyroscopes, Gyroscopic Couple, Gyroscopic stabilization, Gyroscopic effects in Automobiles, ships and airplanes.

Practical: Motorized gyroscope, Study of gyroscopic effect and couple.

Mechanical Vibrations: Vibrations-single degree of freedom system, equations of motion-undamped and damped free vibration of single degree of freedom system, logarithmic decrement, Forced vibration of single degree of freedom system, magnification factor, rotating unbalance-support harmonic excitation, critical speed of shafts

Practical:

- Undamped free vibrations of a single degree freedom spring-mass system.
- Torsional Vibration (Undamped) of single rotor shaft system
- Determination of critical speed of shafts.

Tasks:

T1. Design a four-bar mechanism for an application such as a windshield wiper or robotic arm to achieve a desired motion path.

T2. Design a cam and follower system for an IC engine valve mechanism to achieve specified motion (displacement, velocity, acceleration).

T3. Design a gear train system (simple or epicyclic) for an automobile gearbox or industrial machine to obtain required speed reduction and torque transmission.

T4. Analyze and design a rotating system (shaft with masses) for proper balancing and determine the critical speed to avoid excessive vibration in machines (e.g., turbine shaft or motor rotor).

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%.

Assessment Methodology:

Written Test (40%), Practical (30%), Activity (30%).

Practical: Lab Experiments (50%), Tasks (50%) (Each student must complete a minimum of two tasks).

Activity: Review of GATE/ESE Questions (10%), Mini Project/ Quiz/ Assignment Programs/ Flipped Class /Seminar Presentation (20%)

References:

1. S. S. Rattan, Theory of Machines, 5th Edition, McGraw Hill, 2019.
2. J. J. Uicker Jr., G. R. Pennock & J. E. Shigley, Theory of Machines and Mechanisms, 6th Edition, Cambridge University Press, 2023.
3. P. L. Ballaney, Theory of Machines and Mechanisms, 26th Edition, Khanna Publishers, 2024.
4. R. L. Norton, Kinematics and Dynamics of Machinery, 3rd Edition (SI Units), McGraw Hill Education, 2020.

E-resources:

1. https://nptel.ac.in/courses/112105268
2. https://nptel.ac.in/courses/112104114
3. https://nptel.ac.in/courses/112107212
4. https://nptel.ac.in/courses/112104121

CO	CO Description	PO	PSO
CO1	Understand basic mechanisms and solve kinematic analysis of various mechanisms	–	–
CO2	Evaluate static and dynamic forces in mechanical systems.	PO1 (2), PO2 (2)	PSO1 (2)
CO3	Analyze rotating masses for unbalance and examine the vibrational behavior of mechanical systems	PO2 (2), PO3 (2)	PSO1 (2)
CO4	Conduct experiments in groups and interpret the data	PO4 (2), PO8 (1)	PSO1 (2), PSO2 (2)

(1) = Low; (2) = Medium; (3) = High

CE25C12	Fluid Mechanics and Machinery	L	T	P	C
		3	0	2	4

Course Objective:

To introduce the students about properties of the fluids, behaviour of the fluids under statics, kinematics and dynamic conditions. To expose to the applications of the conservation laws to flow measurements, flow through pipes and forces on pipe bends. To impart basic knowledge to the students about the working principles and performance characteristics of hydraulic machineries.

Fluids Properties and Fluid Statics: Types and properties of fluids, Viscosity, Surface tension and Compressibility, Basics of Compressible flow Fluid statics, Concept of fluid pressure, Manometers, Forces on plane and curved surfaces, Buoyancy and floatation, Stability of floating bodies, metacentric height and its determination.

Activity: Mini case study on buoyancy applications in ships/submarines, Problem-solving using simulation tools for pressure distribution.

Practical: Determination of metacentric height

Fluid Kinematics and Dynamics: Kinematics: Classification of fluid flows, Eulerian and Lagrangian approach, concept of control volume and system, Velocity and acceleration, Stream function and velocity potentials, Flow nets; Dynamics: Application of control volume to continuity, energy and momentum, Euler's equation of motion along a stream line, Bernoulli's equation, Applications to velocity and discharge measurements, Linear momentum equation.

Activity: Group activity on Bernoulli-based engineering applications (aircraft wing, carburetor, atomizer, etc., software demonstration for flow patterns.

Practical: Determination of coefficient of discharge of a venturimeter.

Flow Through Pipes and Boundary Layer: Reynold's Experiment, Laminar flow through circular conduits, Hagen Poiseuille equation, Darcy-Weisbach equation, Moody diagram, Major and minor losses of flow in pipes, Hydraulic gradient and total energy gradient, Pipes in series and parallel, Equivalent pipes, Boundary layer concepts, types of boundary layer thickness.

Activity: Pipe network design exercise using campus/building water supply layout, Industrial case study on pipeline losses and leakage reduction.

Practical: Determination of friction factor for flow through pipes.

Dimensional Analysis: Fundamental dimensions, Dimensional homogeneity, Rayleigh's method and Buckingham Pi theorem, Dimensionless parameters, Similitude and model studies, Distorted and undistorted models

Activity: Model-making activity demonstrating similitude concepts, Group exercise on identifying dimensionless numbers in engineering systems.

Turbines: Impact of jets, Velocity triangles, Theory of rotodynamic machines, Classification of turbines, Pelton wheel, Francis turbine and Kaplan turbine, working principles, Work done by water on the runner, Efficiencies, Draft tube, Specific speed, Performance curves for turbines.

Activity: Virtual demonstration of Turbines.

Practical: Characteristics of Pelton wheel turbine

Pumps: Classification of pumps, Centrifugal pumps, working principle, Heads and efficiencies, Work done by the impeller, NPSH, Minimum speed to start the pump, Pumps connected in series and parallel, Performance curves, Reciprocating pump working principle, Indicator diagram and its variations, Air vessels - Work saved by air vessels.

Activity: Virtual demonstration of Pumps.

Practical:
1. Characteristics of centrifugal pumps
2. Characteristics of reciprocating pump

Tasks:

T1. Design a water supply pipeline system for a residential building, considering flow rate, head loss, and pipe sizing.

T2. Design a flow measurement system using a venturimeter or orifice meter for an industrial application to determine discharge accurately.

T3. Select and design a hydraulic turbine system (Pelton/Francis/Kaplan) for a small hydroelectric power plant based on site conditions.

T4. Design a pumping system (centrifugal or reciprocating) for irrigation or water transfer, considering head, discharge, and efficiency.

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%

Assessment Methodology:

Written Test (40%), Practical (30%), Activity (30%).

Practical: Lab Experiments (50%), Tasks (50%) (Each student must complete a minimum of two tasks).

Activity: Review of GATE/ESE Questions (10%), Mini Project/ Quiz/ Assignment Programs/ Flipped Class /Seminar Presentation (20%)

References:

1. P. N. Modi and S. M. Seth, Hydraulics and Fluid Mechanics including Hydraulic Machines, 23rd Edition, Standard Book House, New Delhi, 2022.
2. A. K. Jain, Fluid Mechanics including Hydraulic Machines, 12th Edition, Khanna Publishers, New Delhi, 2022.
3. S. K. Som, Gautam Biswas and S. Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, 3rd Edition, McGraw Hill Education, Chennai, 2024.
4. B. S. Pani, Fluid Mechanics: A Concise Introduction, 2nd Edition, PHI Learning Private Limited, 2021.
5. A. K. Jain, Fluid Mechanics including Hydraulic Machines, 12th Edition, Khanna Publishers, New Delhi, 2022.
6. V. L. Streeter, E. B. Wylie and K. W. Bedford, Fluid Mechanics, 9th Edition, McGraw Hill Education, New Delhi, 2017.

E-resources:

1. https://onlinecourses.nptel.ac.in/noc25_ce107/preview
2. https://elearn.nptel.ac.in/shop/nptel/introduction-to-fluid-mechanics/
3. https://opencw.aprende.org/courses/mechanical-engineering/2-06-fluid-dynamics-spring-2013/
4. https://www.digimat.in/nptel/courses/video/112105171/112105171.html
5. https://fm-hfs-iitb.vlabs.ac.in/
   https://archive.nptel.ac.in/content/syllabus_pdf/105101082.pdf

CO	CO Description	PO	PSO
CO1	Explain fundamentals of fluid properties, statics, kinematics, dynamics, pipe flow, dimensional analysis, and hydraulic machines.	—	—
CO2	Apply fluid mechanics principles to compute forces, flow parameters, losses, and machine performance.	PO1 (2), PO2 (2)	PSO1 (2), PSO2 (2)
CO3	Analyze fluid systems involving statics, dynamics, pipe flow, and hydraulic machines to determine behavior.	PO2 (2), PO4 (2)	PSO1 (2), PSO2 (2)
CO4	Evaluate performance, efficiency, and operating conditions of fluid systems and machines.	PO3 (2), PO5 (2)	PSO1 (2), PSO2 (2), PSO3 (1)

(1) = Low; (2) = Medium; (3) = High

MF25C02	Machine Tools and Machining	L	T	P	C
		2	0	2	3

Course Objectives:

To Impart knowledge on the science and application of metal cutting through the application of mechanics of machining, material properties, and other relevant engineering knowledge.

Theory of Metal Cutting: Need for metal cutting, Mechanics of orthogonal and oblique cutting, forces in machining, Shear stress and shear strain in metal cutting, Types of chips, Nomenclature of single point cutting tool, Cutting tool materials, Tribological aspects in metal cutting, cutting fluids, Measurement of cutting temperature, tool wear and mechanisms, tool life, surface integrity - surface roughness, machining induced microstructural changes, Machinability.

Practical:

1. Study the effect of workpiece material property on machinability using cutting force, and tool wear measurements
2. Analysis of chip morphology in machining
3. Measurement of machining temperature using IR thermal camera

Turning Machines: Centre lathe, constructional features, specification, Specification of cutting tool inserts and tool holders as per ISO standard, operations, taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Automatic lathes: semi-automatic, single spindle: Swiss type, automatic screw type, multi spindle.

Practical:

1. Perform basic lathe operations: Plain turning, taper turning, thread cutting.
2. Machining economics: determination of the effect of process parameters on machining time

Drilling and Milling: Drilling - geometry of helical drills, Drilling related operations - reaming, boring, tapping, Milling, Classification, Horizontal vs Vertical and Conventional vs Climb milling - types of milling cutters - Surface finish in milling, machining time calculations, Construction features of milling machines, Work holding devices in milling

Practical:

1. Drilling and reaming of a hole using a vertical milling machine
2. Slot and contour milling using a vertical milling machine

Gear Cutting and Broaching: Gear cutting, gear hobbing and gear shaping, gear finishing methods; broaching machines: broach construction, push, pull, surface broaching.

Practical:

1. Cutting of spur gear using a milling machine
2. Gear generation by using a gear hobber and gear shaper
3. Broaching of components using a broaching machine

Grinding: Grinding, Mechanics of grinding and specific energy in grinding, grinding wheel, specifications and selection, types of grinding process, cylindrical grinding, surface grinding, centreless grinding, internal grinding; Surface integrity in grinding

Practical: Grinding components using cylindrical, surface, and centerless grinding machine

Abrasive Finishing Processes: Traditional micro-/nano-finishing methods, Honing, Lapping, Superfinishing, Typical applications, Hybrid mass finishing of AM parts.

Practical: Superfinishing using honing / lapping

Computer Numerical Control Machine Tools: Computer Numerical Control (NC) machine tools – Need, types, constructional details, special features, ball screws, ATC, sensors, machining centre, part programming fundamentals, G-codes and M-codes, manual part programming and computer assisted part programming.

Practical:

1. Manual part programming using CNC Machining Center
2. Manual part programming using CNC Turning Center

Tasks:

T1. Foundry faces casting defects (blowholes, shrinkage); optimize pattern, gating, and sand properties.

T2. Weld failures in steel frames; select suitable welding process and parameters for strength.

T3. Deep drawing defects (tearing, wrinkling); improve tooling and process conditions.

T4. 3D printed parts lack accuracy and finish; choose proper method and post-processing.

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%

Assessment Methodology:

Written Test (40%), Practical (30%), Activity (30%).

Practical: Lab Experiments (50%), Tasks (50%) (Each student must complete a minimum of two tasks).

Activity: Review of GATE/ESE Questions (10%), Mini Project/ Quiz/ Assignment Programs/ Flipped Class /Seminar Presentation (20%)

References:

1. Kalpakjian. S, “Manufacturing Engineering and Technology”, Pearson Education India Edition, 2009.
2. Roy. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006.
3. Geofrey Boothroyd, “Fundamentals of Metal Machining and Machine Tools”, McGraw Hill, 1984.
4. HMT – “Production Technology”, Tata McGraw Hill, 1998.

CO	CO Description	PO	PSO
CO1	Explain principles of metal cutting, machining processes, machine tools, finishing, and CNC fundamentals.	–	–
CO2	Apply machining concepts to calculate cutting parameters, machining time, and perform machining operations.	PO1 (2), PO2 (2), PO5 (2)	PSO2 (2)
CO3	Analyze machining processes to examine tool wear, chip formation, machinability, and process performance.	PO2 (2), PO4 (2)	PSO1 (2), PSO2 (2)
CO4	Evaluate machining techniques and process parameters to assess performance, quality, and efficiency.	PO2 (2), PO3 (2), PO4 (2)	PSO1 (3), PSO2 (2)

(1) = Low; (2) = Medium; (3) = High

ME25C15	Metrology and Measurements	L	T	P	C
		2	0	2	3

Course Objectives

This course introduces principles of measurement, metrology, and tolerance analysis in manufacturing. It enables application of measurement techniques and modern metrology tools for precision and quality control.

Basics of Metrology: Measurement, Need, Process, Role in quality control; Factors affecting measurement, SWIPE; Errors in Measurements, Types, Control, Measurement uncertainty – Types, Estimation, Problems on Estimation of Uncertainty, Statistical analysis of measurement data, Measurement system analysis, Calibration of measuring instruments, Principle of air gauging- ISO standards.

Practical:

1. Calibration of linear measuring instruments – Vernier caliper, micrometer, Vernier height
2. gauge using gauge blocks and reporting the calibration uncertainty
3. Perform gauge repeatability and reproducibility analysis

Measurement of Linear, Angular Dimensions, Assembly and Transmission Elements: Linear Measuring Instruments: Vernier caliper, Micrometer, Vernier height gauge, Depth Micrometer, Bore gauge, Telescoping gauge; Gauge blocks – Use and precautions, Comparators, Working and advantages, Angular measuring instruments, Bevel protractor, Clinometer, Angle gauges, Precision level, Sine bar, Autocollimator, Angle dekkor, Alignment telescope. Measurement of Screw threads, Single element measurements, Pitch Diameter, Lead, Pitch. Measurement of Gears, purpose, Analytical measurement, Runout, Pitch variation, Tooth profile, Tooth thickness, Lead, Functional checking – Rolling gear test.

Practical:

1. Measurement of external and internal linear dimensions in the given component using vernier caliper, micrometer, vernier height gauge, depth micrometer, bore gauge and telescopic gauge.
2. Measurement of angles using bevel protractor and sine bar.
3. Non-contact (Optical) measurement using measuring microscope, profile projector and video measurement system

Tolerance Analysis: Tolerancing– Interchangeability, Selective assembly, Tolerance representation, Terminology, Limits and Fits, Problems (using tables IS919); Design of Limit gauges, Problems. Tolerance analysis in manufacturing, Process capability, tolerance stackup, tolerance charting.

Practical:

1. Use of mechanical and pneumatic comparators to check the dimensions in a component and variation from the given standard.
2. Process capability analysis of a given machining process
3. Tolerance stackup analysis in a given assembly

Metrology of Surfaces: Fundamentals of GD & T, Conventional vs Geometric tolerance, Datums, Inspection of geometric deviations like straightness, flatness, roundness deviations; Simple problems, Measurement of Surface finish, Functionality of surfaces, Parameters, Comparative, Stylus based and Optical Measurement techniques, Filters, Introduction to 3D surface metrology- Parameters.

Practical:

1. Measurement of geometric parameters – Roundness, runout, parallelism, perpendicularity, symmetry – in the given components using V-block / Bench center / Height gauge / roundness tester.
2. Measurement of surface roughness in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus-based instruments.

Advances in Metrology: Lasers in metrology, Advantages of lasers, Laser scan micrometers; Laser interferometers, Applications, Straightness, Alignment; Ball bar tests, Computer Aided Metrology, Basic concept of CMM, Types of CMM, Constructional features, Probes, Accessories, Software, Applications, Multi-sensor CMMs.

Machine Vision, Basic concepts of Machine Vision System, Elements, Applications, On-line and in-process monitoring in production, Computed tomography, White light Scanners.

Practical:

1. Measurement of features in a prismatic component using Coordinate Measuring Machine (CMM) and offline Programming of CNC Coordinate Measuring Machines for repeated measurements of identical components
2. Machine tool Metrology – Geometrical / Alignment tests on lathes / milling machines and measurement of straightness using autocollimator / electronic level.

Tasks:

T1. Dimensional variation in parts; plan measurement and calibration.

T2. Inconsistent inspection results; perform Gauge R&R analysis.

T3. Assembly fit issues; analyze and assign proper tolerances.

T4. Surface and geometric errors; select suitable measurement methods.

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%

Assessment Methodology:

Written Test (40%), Practical (30%), Activity (30%).

Practical: Lab Experiments (50%), Tasks (50%) (Each student must complete a minimum of two tasks).

Activity: Review of GATE/ESE Questions (10%), Mini Project/ Quiz/ Assignment Programs/ Flipped Class /Seminar Presentation (20%)

References:

1. Ammar Grous, J “Applied Metrology for Manufacturing Engineering”, Wiley-ISTE, 2011.

2. Galyer, J.F.W. Charles Reginald Shotbolt, “Metrology for Engineers”, Cengage Learning EMEA; 5th revised edition, 1990.
3. Raghavendra N.V. and Krishnamurthy, L., Engineering Metrology and Measurements, Oxford University Press, 2013.
4. Venkateshan, S. P. “Mechanical Measurements”, Second edition, John Wiley & Sons, 2015.
5. NPL Measurement good practice guides relevant to the syllabus – No. 40, No. 41, No. 42, No. 43, No. 80, No. 118, No. 130, No. 131.

E-Resources:

1. https://nptel.ac.in/courses/112104250
2. https://nptel.ac.in/courses/112106179
3. https://nptel.ac.in/courses/112106138
4. https://vlabs.iitkgp.ac.in/metrol/loe.html

CO	CO Description	PO	PSO
CO1	Explain principles of metrology, measurement systems, tolerances, surface metrology, and advanced measurement techniques.	PO1 (2)	–
CO2	Apply measurement instruments and techniques for dimensional analysis and tolerance evaluation.	PO1 (2), PO2 (2), PO4 (2)	PSO2 (2)
CO3	Analyze measurement data, uncertainty, and process capability for interpreting system performance.	PO2 (2), PO4 (2)	PSO1 (2), PSO2 (2)
CO4	Evaluate GD&T, surface metrology, and advanced measurement systems for quality validation.	PO2 (2), PO3 (2), PO4 (2)	PSO1 (2), PSO2 (2)

(1) = Low; (2) = Medium; (3) = High

ME25C10	Standards in Mechanical Engineering	L	T	P	C
		1	0	0	1

Course Objectives:

The course introduces standardization, conformity assessment, and the roles of BIS and ISO, while familiarizing students with key standards in engineering drawings, testing, management systems, and machinery safety for practical application.

Introduction: Aims of standardization, Types of standards, Importance of standards to industry.

Activity: Study and present the importance and types of standards used in mechanical engineering industries.

Conformity Assessment: Objects of conformity assessment, First-party assessment, Second-party assessment, Third-party assessment, Certifications and markings.

Activity: Analyze different types of conformity assessment and identify certification markings on products.

Bureau of Indian Standards (BIS): Objectives, roles, and functions of BIS, Application of any one BIS standard.

Activity: Study BIS functions and identify BIS standards applied to common engineering components.

International Organization for Standardization (ISO): Key principles for ISO standards development, ISO SDirectives, Stages in ISO standard development, Application of any one ISO standard.

Activity: Analyze ISO standard development process and study key ISO standards.

Standards for Engineering Drawing: SP 46:2003 – Sizes and layout of drawing sheets, Scales, Lines, Sections, Screw threads and threaded parts, Springs, Gears, Dimensioning, Surface texture, Linear and angular tolerances, Geometrical tolerances.

Activity: Interpret engineering drawings using SP 46 standards and identify symbols, tolerances, and dimensions.

ASTM Standards (American Society for Testing and Materials): Objectives and scope of ASTM standards, Application of any one ASTM standard.

ASME Standards (American Society of Mechanical Engineers): Objectives and scope of ASME standards.

Weightage: Continuous Assessment: 100%.

Assessment Methodology: Quiz - 10%, Assignments - 20%, and Internal Examinations - 70%

References:

1. Bureau of Indian Standards, Engineering Drawing Practice for Schools & Colleges, SP 46:2003, Bureau of Indian Standards, New Delhi, India, 2003, ISBN: 81-7061-019-2.
2. W. Hesser, A. Inklaar, and J. Weigand, Standardization Essentials: Principles and Practice, Wiley-VCH, Weinheim, Germany, 2010.
3. C. D. Sullivan, Standards and Standardization: Basic Principles and Applications, Marcel Dekker Archive Information, New York, USA, 1983, ISBN: 0-8247-1919-0.
4. ASTM International Standards Catalog, ASTM International, West Conshohocken, Pennsylvania, USA.
5. James D. McCabe, Introduction to the Practice of Mechanical Engineering, including ASME standards and codes, Pearson Education.

E-resources:

1. https://standardsbis.bsbedge.com/
2. https://www.iso.org/sites/edumaterials/trbsaunders.pdf
3. https://www.ds.dk/media/px5jhney/a-world-built-on-standards.pdf?srsltid=AfmBOoqD36gwxLHthIlwtvrIqVtSnLaQFL7N8vSJcNfrxSF_qUstL8ia
4. https://www.bis.gov.in/?lang=en
5. https://www.iso.org/home.html

CO	CO Description	PO	PSO
CO1	Explain fundamental concepts of standardization, conformity assessment, BIS, ISO, engineering drawing standards, testing standards, management systems, and machinery safety standards.	—	—
CO2	Explain the roles, functions, and applications of national and international standards in engineering practice.	PO1 (2)	PSO2 (2)
CO3	Apply principles of standardization and conformity assessment to identify and use appropriate standards, codes, and certifications in engineering applications.	PO1 (2), PO2 (2)	PSO1 (2), PSO2 (2)

(1) = Low; (2) = Medium; (3) = High

EN25C04	English Communication Skills Laboratory– II	L	T	P	C
		0	0	2	1

Course Objectives: The objectives of the course are to build students' advanced communication skills for workplace readiness and develop intercultural competence for effective collaboration in global and virtual teams. Prepare students for competitive exams with focused skill-building and test-oriented practice.

List of Activities

Stage Ready – Impactful Public Speaking

(i) Simulate a formal event such as an academic conference, convocation, or awards ceremony, where students roles including Master of Ceremonies (MC), Role as a dignitary, and a Commentator
(ii) Visual Prompt Storytelling: Use random images to create spontaneous stories, focusing on plot, setting, and character,
(iii) **Digital Presentation - Record** a short video explaining a project or technical concept, using slides, voiceover, and visual aids (to be uploaded using google classroom or drive link)

Professional and Application-Oriented Writing

(i) Résumé Preparation: Design ATS-friendly résumés tailored to various job descriptions, using action verbs and quantifiable impact. ·
(ii) Design engaging content for poster presentation relevant to their domain.

Receptive Skills in Workplace Communication·

(i) Reading articles related to their domain and discuss in groups
(ii) Visit company websites, make inferences and present in the class
(iii) Listen to recorded mock interviews and take detailed notes. Summarise key points and action items in a professional format and make a presentation.

Intercultural Communication

(i) Assertive vs Aggressive communication
(ii) Role play activities – workplace communication in intercultural/crosscultural contexts

From Campus to Career: Industry Skills and Global Exam Preparation

(i) Participate in HR interviews using AI tools or peer interviewers, responding to behavioural questions using methods like STAR (Situation, Task, Action, Result)
(ii) Practice Verbal Ability in competitive exams like UPSC, SSC, CDS, TNPSC, etc.

Weightage: Continuous Assessment: 60%, End Semester Lab Examinations: 40%.

Internal Assessment Methodology: 1. Oral story telling using visual prompts (30 marks)
2. Poster presentation (40 marks)
3. ATS resume writing (30 marks)

End Semester Assessment:

1. Interview (50 marks)
2. Verbal Ability test (50 marks)

(students must bring the resume but evaluation must be done based on the performance in the interview)

References:

1. Lucas, Stephen, and Paul Stob. The Art of Public Speaking. Thirteenth edition, McGraw- Hill Education, 2020.
2. Abrahams, Matt. Think Faster, Talk Smarter: How to Speak Successfully When You're Put on the Spot. Simon & Schuster, 2023.
3. Beshara, Tony. Powerful Phrases for Successful Interviews, Rev. ed., McGraw-Hill, 2023.
4. Papalia, Anna. Interviewology: The New Science of Interviewing. Harper Business, 2024.
5. Verbal Ability and Reading Comprehension by Ajay Singh McGraw Hill Education 2020

E-resources:

1. Purdue OWL – Online Writing Lab (Academic and professional writing help) https://owl.purdue.edu/
2. Canva Resume Builder (Creative, ATS-friendly resume design) https://www.canva.com/resumes/
3. BBC Learning English – Pronunciation https://www.bbc.co.uk/learningenglish/english/features/pronunciation
4. India Bix website

	Description of CO	PO	PSO1
CO1	Understand basic industry-related reading materials.	-	-
CO2	Design and present a domain specific poster	PO9(3)	PSO1(2) PSO3(3)
CO3	Deliver effective digital presentations	PO9(3)	PSO2(1)
CO4	Communicate appropriately in intercultural/cross cultural contexts	PO9(3)& PO11(1)	PSO3(3)
CO5	Perform in interviews and competitive exams successfully	PO9(3)	PSO3(1)

(1) = Low; (2) = Medium; (3) = High