LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
(AUTONOMOUS)
Mylavaram-521 230, Krishna Dist., Andhra Pradesh

B. Tech (Regular-Full time)

(Effective for the students admitted into I year from the AcademicYear **2026-27** onwards)

&

B.Tech.(Lateral Entry Scheme)

(Effective for the students admitted into II year through Lateral Entry Scheme from the Academic Year **2027 - 28** onwards)

DEPARTMENT VISION

To impart knowledge in Mechanical Engineering with global perspectives for the graduates to serve the society and industry.

DEPARTMENT MISSION

1. To enable the graduates technically sound with the state- of- the –art curriculum and innovative teaching methods.
2. To provide training programs that bridge the gap between academia and industry.
3. To create a conducive environment and facilities to improve overall personality development of the graduates.
4. To make the graduates aware of role and responsibilities of an engineer in society.

B.TECH. – MECHANICAL ENGINEERING COURSE STRUCTURE – R26
(Applicable from the academic year 2026-27 onwards)

I Semester

S. No.	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	A2610011	English for Technical Communication	3	0	0	3	40	60	100
2	A2610002	Linear Algebra & Calculus	3	0	0	3	40	60	100
3	A2610014	Physics for Mechanical Systems	3	0	0	3	40	60	100
4	A2610015	Computational Thinking & Problem Solving through Python	3	0	0	3	40	60	100
5	A2610013	Environmental Science	2	0	0	0	100	00	100
Laboratory Courses									
6	A2610012	English for Technical Communication and MOODLE Lab	0	0	3	1.5	50	50	100
7	A2610017	Physics for Mechanical Systems Lab	0	0	3	1.5	50	50	100
8	A2610018	Computational Thinking & Problem Solving through Python Lab	0	0	3	1.5	50	50	100
9	A2610016	Engineering Graphics	0	1	3	2.5	50	50	100
10	A2610019	AI Tools & Applications	0	1	3	2.5	50	50	100
Total			**14**	**2**	**15**	**21.5**	**510**	**490**	**1000**

II Semester

S. No.	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1		Differential Equations & Vector Calculus	3	0	0	3	40	60	100
2		Chemistry for Mechanical systems	3	0	0	3	40	60	100
3		Elements of Electrical & Electronics Engineering	3	0	0	3	40	60	100
4		Engineering Mechanics	3	0	0	3	40	60	100
Laboratory Courses									
5		Chemistry for Mechanical systems Lab	0	0	3	1.5	50	50	100
6		Elements of Electrical & Electronics Engineering Lab	0	0	3	1.5	50	50	100
7		Engineering Mechanics Lab	0	0	3	1.5	50	50	100
8		Design Thinking & Innovation	0	1	3	2.5	50	50	100
9		Workshop Practice	0	0	3	1.5	50	50	100
10		Sports and Yoga or NSS/NCC	0	0	2	0	100	00	100
Total			**12**	**1**	**17**	**20.5**	**510**	**490**	**1000**

III Semester

S. No.	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1		Numerical Methods & Transform Techniques	3	0	0	3	40	60	100
2		Materials Science and Engineering	3	0	0	3	40	60	100
3		Mechanics of Solids	3	0	0	3	40	60	100
4		Thermodynamics	3	0	0	3	40	60	100
5		Engineering Economics and Financial Analysis	3	0	0	3	40	60	100
PROGRAM ELECTIVE – I									
6		Instrumentation &Control Systems	2	0	0	2	40	60	100
		Mechanical Measurements	2	0	0	2	40	60	100
7		Indian Knowledge system (Indian Knowledge and creative Thinking / Indian perspective on scientific sustainable development)	2	0	0	0	100	00	100
Laboratory Courses									
8		Materials Science and Engineering & Mechanics of Solids Lab	0	0	3	1.5	50	50	100
9		Computer Aided Machine Drawing	0	0	3	1.5	50	50	100
Total			**19**	**0**	**6**	**20**	**440**	**460**	**900**

IV Semester

S. No.	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1		Complex Variables, Probability & Statistics	3	0	0	3	40	60	100
2		Fluid Mechanics and Hydraulic Machines	3	0	0	3	40	60	100
3		Kinematics of Machinery	3	0	0	3	40	60	100
4		Manufacturing Processes	3	0	0	3	40	60	100
5		Thermal Engineering	3	0	0	3	40	60	100
6		Professional Ethics & Practice	2	0	0	0	100	00	100
Laboratory Courses									
7		Fluid Mechanics and Hydraulic Machines Lab	0	0	3	1.5	50	50	100
8		Manufacturing Processes Lab	0	0	3	1.5	50	50	100
9		Thermal Engineering Lab	0	0	3	1.5	50	50	100
10		Geometric Dimensioning and Tolerancing	0	0	2	1	50	50	100
PROGRAM ELECTIVE – II									
11		AI&ML for Mechanical Engineers	0	0	3	1.5	50	50	100
		C & Data Structures	0	0	3	1.5	50	50	100
Total			**17**	**0**	**14**	**22**	**550**	**550**	**1100**
*Mandatory Industry Internship / CSP / Mini Project of 06 weeks duration during summer vacation									

V Semester

S. No.	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1		Dynamics of Machinery	3	0	0	3	40	60	100
2		Industrial Engineering & Management	3	0	0	3	40	60	100
3		Machine Tools and Metrology	3	0	0	3	40	60	100
PROGRAM ELECTIVE – III									
4		Hydraulics & Pneumatics	3	0	0	3	40	60	100
		Energy Auditing & Management	3	0	0	3	40	60	100
		Mechatronics & Microprocessor Applications	3	0	0	3	40	60	100
		Operations Research	3	0	0	3	40	60	100
		SWAYAM / NPTEL 12 Week MOOCs Course	3	0	0	3			
PROGRAM ELECTIVE – IV									
5		Data analytics for Mechanical Engineers	3	0	0	3	40	60	100
		Sustainable Energy Systems	3	0	0	3	40	60	100
		Industrial Robotics	3	0	0	3	40	60	100
		Industrial IOT for Smart Machines	3	0	0	3	40	60	100
		SWAYAM / NPTEL 12 Week MOOCs Course	3	0	0	3			
OPEN ELECTIVE – I									
6		Industrial Safety	1	0	0	1	40	60	100
		Sustainability and Green Engineering	1	0	0	1	40	60	100
		Industry 4.0	1	0	0	1	40	60	100
		SWAYAM / NPTEL 4 Week MOOCs Course	1	0	0	1			
7		Research Methodology	2	0	0	0	100	00	100
Laboratory Courses									
8		Theory of Machines Lab	0	0	3	1.5	50	50	100
9		Machine Tools and Metrology Lab	0	0	3	1.5	50	50	100
10		Evaluation of industry Internship/ Community Service Project / Mini Project*	0	0	0	2	00	100	100
Total			**18**	**0**	**6**	**21**	**440**	**560**	**1000**

VI Semester

S. No.	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1		Design of Machine Elements	3	0	0	3	40	60	100
2		CAD/CAM & Automation	3	0	0	3	40	60	100
3		Heat Transfer	3	0	0	3	40	60	100
PROGRAM ELECTIVE – V									
4		Electric & Hybrid Vehicle Technology	3	0	0	3	40	60	100
		Automobile Engineering	3	0	0	3	40	60	100
		Additive Manufacturing	3	0	0	3	40	60	100
		Machine Learning Applications for Mechanical Engineers	3	0	0	3	40	60	100
		SWAYAM / NPTEL 12 Week MOOCs Course	3	0	0	3			
PROGRAM ELECTIVE – VI									
5		System Engineering & Model Based Design	3	0	0	3	40	60	100
		Turbo Machinery	3	0	0	3	40	60	100
		Drones & Autonomous systems	3	0	0	3	40	60	100
		Reliability & Quality Management	3	0	0	3	40	60	100
		SWAYAM / NPTEL 12 Week MOOCs Course	3	0	0	3			
OPEN ELECTIVE – II									
6		Principles of Product Design	2	0	0	2	40	60	100
		Thermal Management of Electronics	2	0	0	2	40	60	100
		Advanced Manufacturing system	2	0	0	2	40	60	100
		SWAYAM / NPTEL 8-week MOOCs Course	2	0	0	2			
OPEN ELECTIVE – III									
7		Robotics And Automation	1	0	0	1	40	60	100
		Non-Conventional Sources of Energy	1	0	0	1	40	60	100
		Total Quality Management	1	0	0	1	40	60	100
		SWAYAM / NPTEL 4-week MOOCs Course	1	0	0	1			
8		Universal Human Values II	2	0	0	0	100	00	100
Laboratory Courses									
9		CAD / CAM& Automation Lab	0	0	3	1.5	50	50	100
10		Heat Transfer Lab	0	0	3	1.5	50	50	100
Total			**20**	**0**	**6**	**21**	**480**	**520**	**1000**
Industry Internship / Mini Project of 06 weeks duration during summer vacation									

VII Semester

S. No.	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1		Finite Element Methods	3	0	0	3	40	60	100
2		Refrigeration & Air Conditioning	3	0	0	3	40	60	100
PROGRAM ELECTIVE – VII									
3		Mechanical Vibrations	3	0	0	3	40	60	100
		Power Plant Engineering	3	0	0	3	40	60	100
		Smart Materials and Manufacturing	3	0	0	3	40	60	100
		Production Planning and Control	3	0	0	3	40	60	100
		SWAYAM / NPTEL 12 Week MOOCs Course	3	0	0	3			
PROGRAM ELECTIVE – VIII									
4		Fracture Mechanics	3	0	0	3	40	60	100
		Jet Propulsion & Rocket Engineering	3	0	0	3	40	60	100
		Industry 4.0	3	0	0	3	40	60	100
		Quantum Science & Technology	3	0	0	3	40	60	100
		SWAYAM / NPTEL 12 Week MOOCs Course	3	0	0	3			
PROGRAM ELECTIVE – IX									
5		Mechanics of Composite Materials	3	0	0	3	40	60	100
		Computational Fluid Dynamics	3	0	0	3	40	60	100
		Non-Destructive Evaluation	3	0	0	3	40	60	100
		Micro Electro Mechanical Systems							
		SWAYAM / NPTEL 12 Week MOOCs Course	3	0	0	3			
OPEN ELECTIVE – IV									
6		Optimization Techniques for Engineers	2	0	0	2	40	60	100
		Hydrogen and Fuel Cell Technologies	2	0	0	2	40	60	100
		Engineering Materials	2	0	0	2	40	60	100
		SWAYAM / NPTEL 8 Week MOOCs Course	2	0	0	2			
OPEN ELECTIVE – V									
7		Predictive Maintenance and Prognostics	1	0	0	1	40	60	100
		Additive manufacturing	1	0	0	1	40	60	100
		SWAYAM / NPTEL 4 Week	1	0	0	1			

		MOOCs Course							
Laboratory Courses									
PROGRAM ELECTIVE – X									
8		Mechatronics Lab	0	0	2	1	50	50	100
		Computational Fluid Dynamics Lab							
9		Evaluation of Industry Internship / Mini Project	0	0	0	2	00	100	100
Total			**18**	**0**	**2**	**21**	**330**	**570**	**900**

VIII Semester

S. No.	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
OPEN ELECTIVE – VI									
1		Surface Coating Techniques	3	0	0	3	40	60	100
		Energy Storage Systems	3	0	0	3	40	60	100
		Operations Research	3	0	0	3	40	60	100
		SWAYAM/NPTEL 12-week MOOCs Course	3	0	0	3			
OPEN ELECTIVE – VII									
2		Product Life Cycle Management	2	0	0	2	40	60	100
		Energy Conservation & Management	2	0	0	2	40	60	100
		Digital Manufacturing	2	0	0	2	40	60	100
		SWAYAM/NPTEL 8-week MOOCs Course	2	0	0	2			
Laboratory Courses									
3		Project work / Industry Internship	0	0	24	12	120	80	200
Total			**5**	**0**	**24**	**17**	**200**	**200**	**400**

B.Tech. (I Sem.)	A2610011-ENGLISH FOR TECHNICAL COMMUNICATION	L	T	P	C
		3	0	0	3

Course Objectives:

- Listen the authentic texts to comprehend and respond appropriately as both audience and conversant;
- Communicate in academic and social (formal) contexts with reasonable fluency and accuracy (neutral accent, social and grammatical appropriateness);
- Comprehend the texts of various types for academic, technical and career purposes;
- Write for academic and professional purposes;
- Communicate across cultures that requires a blend of cognitive, interpersonal, and linguistic skills

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Comprehend specific information, context, and central ideas from social, academic, or workplace conversations and audio-visual material. (K2)

CO2: Apply appropriate social norms to bridge the gaps and collaborate effectively across diverse cultural backgrounds (K3)

CO3: Evaluate the content, limitations and ethical aspects of AI tools in communication and language learning, and apply them to create concise, accurate essays/summaries/letters/paraphrases. (K5)

CO4: Examine discourse features and writing strategies to participate effectively in informal exchanges, short presentations on technical and general topics and to compile reports/E-mails. (K4)

CO5: Construct well-organized paragraphs, essays, critical reviews, and other professional documents suited to academic and workplace contexts. (K6)

Course Articulation Matrix:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	2	–	–	1	2	–	–	1	3	1			
CO2	1	1	1	–	1	3	2	2	3	3	2			
CO3	2	3	2	2	3	1	1	3	2	3	3			
CO4	1	2	1	1	1	2	1	1	3	3	3			
CO5	1	2	1	1	1	2	1	1	3	3	3			
1 = Slight (Low) 2= Moderate (Medium) 3 = Substantial (High)														

Unit 1 : Effective Communication: Exploring Channels and Methods **10 hrs**

Vocabulary: Roots, Prefixes, and Suffixes Homonyms

Grammar: Articles, Prepositions, Tenses.

Reading: Definition and Importance, Skills and Sub-Skills of Reading Writing :Cohesion and Coherence, Paragraph Writing.

Listening : Listening for main ideas and supporting details, Note-taking

Speaking: Introducing self and others, Describing people and objects, JAM.

Unit 2: Eco-Consciousness: Negotiating for a Sustainable Future **9 hrs**

Vocabulary: Contractions, Phrasal Verbs, Idioms & Phrases

Grammar: Subject-Verb Agreement, Conditional Sentences

Reading: Reading for Inference, Point of View, Tone and Perspective.
Writing : Note making, Summarizing, Paraphrasing.
Listening : Listening to various texts and comprehension
Speaking: Role-plays, Extempore.

Unit 3: **Disruptive Technologies: Ethical Implications and Future Prospects** **9 hrs**
Vocabulary: One-Word Substitutes, Commonly Confused Words
Grammar: Degrees of Comparison, Active and Passive Voice, Question Tags.
Reading: Reading the extracts/articles/ essays of the News Papers, Journals and literary texts.
Writing : Paraphrasing, Letter Writing
Listening : Listening to stories, news, documentaries and discussions.
Speaking: Debate, Group Discussions

Unit 4: **Entrepreneurship and Start-Up Culture: Emerging Trends** **10 hrs**
Vocabulary: Business/ Profession/ Career/ Job-related Vocabulary.
Grammar: Sentence Synthesis, Simple, Compound and Complex Sentences.
Reading: Reading various texts for global understanding
Writing : Email Writing, Data Interpretation, Report Writing
Listening : Listening to debates and discussions.
Speaking: Power Point Presentations by Individuals and Teams.

Unit 5: **Ethical Leadership: Integrating Social Responsibility and Core Values** **10 hrs**
Vocabulary: Advanced Vocabulary for GRE/TOEFL/ IELTS/CAT etc.
Grammar: Sentence Synthesis, Para Jumbles.
Reading: Reading texts for global comprehension.
Writing : Book/Film Reviews, Social Media Etiquette
Listening : Listening to the talks/speeches by the eminent personalities
Speaking: Team Discussions and Presentations

Learning Resources:

Textbook:

1. Chekuri, T., & Perumalla, R. K. (2026). Next Gen English for engineers: A course book for technical English communication. Cengage.
2. Coelho, P. (2020). The alchemist. HarperCollins. (Non-Detailed Text)

Reference Books:

1. Technical Communication (2nd Ed.) by M. Raman & S. Sharma. Oxford University Press, 2012.
2. Effective Technical Communication by M.A. Rizvi, Tata McGraw-Hill, 2005.
3. English for Engineers and Technologists, Orient Black swan 2010 (Combined edition, Vol.1 &2).
4. The Oxford Guide to Writing and Speaking by John Seely, Oxford University Press, 2004.

Web Resources:

1. eGyanKosh. (n.d.). National digital repository. https://egyankosh.ac.in/
2. Read Theory. (n.d). Adaptive reading comprehension practice. https://readtheory.org/

L	T	P	C
3	0	0	3

B.Tech. (I Sem.) **A2610002- LINEAR ALGEBRA & CALCULUS**

Common to all Branches

Course Objectives:

- The main objective of this course is to provide the learner with variety of linear algebra techniques to solve linear systems, orthogonal representation of the quadratic surfaces and apply its knowledge in optimization problems.
- It aims further to calculate areas, surfaces and volumes in various coordinate systems.

Course Outcomes: Upon completion of the course, the student will be able to:

CO1 : Analyse the solutions of homogeneous and non-homogeneous systems of linear equations. (K4)

CO2 : Evaluate Eigen values and Eigen vectors to reduce quadratic form to canonical form. (K5)

CO3 : Estimate the bounds of a given function by mean vale theorems. (K3)

CO4 : Apply the knowledge of derivatives in optimizing functions of several variables. (K3)

CO5 : Evaluate double and triple integrals in Cartesian and polar coordinates. (K5)

K1- Remembering, K2- Understanding, K3-Applying, K4- Analyzing, K5- Evaluating, K6- Creating

Course Articulation Matrix:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	M	-	-	-	-	-	-	-	-
CO2	H	H	M	-	-	-	-	-	-	-	-
CO3	H	H	M	-	-	-	-	-	-	-	-
CO4	H	H	M	-	-	-	-	-	-	-	-
CO5	H	H	M	-	-	-	-	-	-	-	-

H – High, M - Medium, L - Low

UNIT I: Matrices, Eigenvalues, Eigenvectors

Elementary row operations, Rank of a matrix by echelon form, normal form, System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations, Gauss elimination method, Inverse by Gauss-Jordan method, Gauss Seidel Iteration Methods**.** Eigenvalues, Eigenvectors and their properties (without proof).

UNIT II: Diagonalization of a matrix

Cayley-Hamilton Theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton Theorem, Diagonalization of a matrix, Quadratic forms and Nature of the Quadratic Forms, Reduction of Quadratic form to canonical forms by Orthogonal Transformation.

UNIT III: Calculus

Mean Value Theorems: Rolle's Theorem, Lagrange's mean value theorem with their geometrical interpretation, Cauchy's mean value theorem, Taylor's and Maclaurin's theorems with remainders (without proof), Problems and applications on the above theorems. Taylor's and Maclaurin's series.

UNIT IV: Partial differentiation and Applications (Multi variable calculus)

Functions of several variables: Continuity and Differentiability, Partial derivatives, total derivatives, chain rule, Euler's homogeneous function theorem, Taylor's and Maclaurin's series expansion of functions of two variables. Jacobians, Functional dependence, Maxima and Minima of functions of two variables without constraints and with constraints by the method of Lagrange multipliers.

UNIT V: Multiple Integrals

Double integrals, change of order of integration, triple integrals, change of variables from Cartesian to polar, cylindrical and spherical coordinates. Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

TEXTBOOKS:

1. B. S. Grewal, "Higher Engineering Mathematics", 45th Edition, Khanna Publishers, 2024.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 11th Edition, John Wiley & Sons, 2025.

REFERENCE BOOKS:

1. B. V. Ramana, "Higher Engineering Mathematics", McGraw Hill Education, 2017.
2. Glyn James, "Advanced Modern Engineering Mathematics", 5th Edition, Pearson Education, 2018.
3. H. K. Dass, "Advanced Engineering Mathematics", 22nd Edition, S. Chand Publishing, 2022.
4. R. K. Jain and S. R. K. Iyengar, "Advanced Engineering Mathematics", 5th Edition, Narosa Publications, New Delhi, 2016.

WEB RESOURCES

1. https://en.wikipedia.org/wiki/System_of_linear_equations
2. https://en.wikipedia.org/wiki/Eigenvalues_and_eigenvectors
3. https://www.math.hmc.edu/calculus/tutorials/eigenstuff/
4. https://en.wikipedia.org/wiki/Quadratic_form
5. https://en.wikipedia.org/wiki/Calculus
6. https://en.wikipedia.org/wiki/Partial_derivative
7. https://www.whitman.edu/mathematics/calculus_online/section14.03.html
8. https://en.wikipedia.org/wiki/Multiple_integral
9. http://tutorial.math.lamar.edu/Classes/CalcIII/MultipleIntegralsIntro.aspx

L	T	P	C
3	0	0	3

B.Tech. (I Sem.) A2610014- PHYSICS FOR MECHANICAL SYSTEMS

(For Mechanical and Aerospace Engineering Branches)

Course Objectives

- To provide students with a strong foundation in wave optics concepts such as interference, diffraction and polarization along with their applications in optical measurements.
- To introduce the fundamentals of crystallography and X-ray diffraction methods for understanding crystal structures and material characterization.
- To equip students, the basic principles of quantum mechanics and quantum computing, including quantum states, tunneling, superposition and secure communication.
- To familiarize students with oscillations, vibration control systems, lasers and precision engineering applications in modern industries.
- To impart knowledge on the principles of ultrasonics and non-destructive testing methods for defect detection and quality inspection.

Course Outcomes (COs): At the end of the course, the student will be able to:

CO1:	Examine the principles of interference, diffraction and polarization and utilize optical analysis techniques in engineering applications.	K3 (Apply)
CO2:	Analyze crystal structures, diffraction patterns and material characterization using X-ray diffraction methods.	K4 (Analyze)
CO3:	Interpret the concepts of quantum mechanics and quantum computing and apply for secure communication systems.	K3 (Apply)
CO4:	Analyze oscillatory systems, vibration control mechanisms and laser-based metrology techniques.	K4 (Analyze)
CO5:	Evaluate ultrasonic testing and non-destructive testing methods for defect identification and quality assessment.	K5 (Evaluate)

Course Articulation Matrix:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	L	M	H	–	–	–	L	–	M
CO2	H	H	L	H	H	–	–	–	L	–	M
CO3	H	M	L	L	M	–	–	–	L	–	H
CO4	H	H	L	H	H	L	–	L	L	–	M
CO5	H	H	L	H	H	M	–	L	L	–	M

UNIT – I: APPLIED WAVE OPTICS **10** Hrs

Interference: Superposition Principle – Coherence – Types of Interference – Thin-film interference (reflection geometry) – Newton's rings – Determination of wavelength and refractive index.

Diffraction: Fresnel and Fraunhofer diffraction – Fraunhofer's diffraction due to single slit, double slit & N-slits (qualitative) – Diffraction Grating and grating spectrum – Dispersive and Resolving power of a grating.

Polarization: Types of polarization – Nicol's prism – Half-wave and Quarter-wave plates.

UNIT – II: CRYSTALLOGRAPHY AND MATERIAL CHARACTERIZATION **9** Hrs

Crystallography: Space lattice – Basis – Unit cell – Lattice parameters – Crystal systems and Bravais lattices, Co-ordination number and packing fraction of SC, BCC and FCC structures.

Material Characterization: Miller indices – Inter-planar spacing between successive (hkl) planes – Bragg's law – X-ray Diffractometer – Crystal structure determination by Laue's method.

UNIT - III: INTRODUCTION TO QUANTUM MECHANICS & QUANTUM COMPUTING **10** Hrs

Quantum Mechanics: de Broglie concept of matter waves – Heisenberg's uncertainty principle – Wave function – Postulates of quantum mechanics – Schrödinger's time dependent and time-independent wave equations –Particle in a one-dimensional potential well – Quantum tunnelling (basic idea).

Quantum Computing: Introduction to quantum computing – Classical bits vs qubits – Superposition and entanglement – Basic quantum operations – Hadamard gate – Pauli-X gate – Idea of quantum measurement.

UNIT – IV: OSCILLATIONS and LASER-BASED METROLOGY **10 Hrs**

Oscillations: Oscillations of springs – Series and parallel combination of springs (quantitative) – Stiffness factor and its significance – Damping and resonance: over-, under- and critical damping (qualitative) – Forced oscillations and resonance – Sharpness of resonance – Quality factor (Q).

Lasers and Precision Engineering: Principles of Absorption, Spontaneous and Stimulated Emission, Population Inversion. Three-level and Four-level laser systems, Construction and working of Ruby and He-Ne Laser, Applications (qualitative): Role of high-power lasers in CNC Laser Cutting and Welding.

UNIT – V: ULTRASONICS AND NON-DESTRUCTIVE TESTING **9** Hrs

Ultrasonics: Introduction – Characteristics of ultrasonic waves – Production of ultrasonic waves by magnetostriction and piezoelectric methods – Detection - Acoustic grating – Applications.

Non-Destructive Testing (NDT): Introduction - pulse echo system through transmission and reflection modes– Applications.

Textbooks:

1. Avadhanulu, M.N., Kshirsagar, P.G., & Murthy, T.V.S.A., A textbook of engineering physics, S. Chand Publishing (2022)
2. P.K. Palaniswamy, Engineering physics, SciTech Publications (2019)

Reference Books:

1. Fundamentals of Physics by David Halliday, Robert Resnick, and Jearl Walker, John Wiley & Sons publications, 12th Edition (2021).
2. Solid State Physics by S. O. Pillai, New Age International Publishers, 9th edition (2023).
3. Concepts of Modern Physics by Arthur Beiser, Shobit Mahajan & S. Rai Choudhury MC Graw Hill, 8th Edition (2026).
4. Nielsen & Chuang, Quantum Computation & Quantum Information, Cambridge University Press, 10th Edition, (2010).
5. D. J. Griffiths, Introduction to Electrodynamics, Cambridge University Press, 5th Edition (2023).

Web Resources:

1. NPTEL. National Programme on Technology Enhanced Learning. https://nptel.ac.in
2. MIT Open Course Ware, Physics courses. https://ocw.mit.edu
3. Georgia State University, Hyper Physics. http://hyperphysics.phy-astr.gsu.edu
4. PhET Interactive Simulations, University of Colorado Boulder. https://phet.colorado.edu
5. American Concrete Institute, (2021). ACI 228.2R: Nondestructive test methods for evaluation of concrete in structures. https://www.concrete.org

B.Tech. (I Sem.)	A2610015- COMPUTATIONAL THINKING & PROBLEM SOLVING THROUGH PYTHON	L	T	P	C
		3	0	0	3

Pre-requisite: Basics of Computers.

Course Objectives: The main objectives of the course are to

- Introduce the fundamental concepts of computational thinking, including decomposition, pattern recognition, abstraction, and algorithmic thinking for systematic problem solving.
- Develop basic algorithmic problem-solving skills using pseudocode and flowcharts and translate problem-solving logic into Python programs.
- Develop proficiency in Python programming constructs, including variables, data types, operators, conditional statements, loops, and nested control structures.
- Develop the ability to organize and process information using Python data structures such as strings, lists, tuples, and dictionaries, along with functions and basic modular programming.
- Introduce practical Python programming techniques including recursion, file handling, exception handling, basic data analysis and visualization, and their integration into a small problem-solving project.

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

CO	Course Outcome Description	Knowledge Level (K)#
CO1	Describe the principles of computational thinking and basic algorithms, pseudocode, and flowcharts used for problem solving.	K2
CO2	Apply variables, operators, conditional statements, loops, and nested control structures to develop Python programs for solving basic problems.	K3
CO3	Apply appropriate Python data structures such as strings, lists, tuples, and dictionaries to store, organize, and manipulate problem-specific data.	K3
CO4	Apply functions, recursion, modules, and basic debugging techniques to develop modular and reusable Python programs.	K3
CO5	Implement file handling, exception handling, and basic data analysis/visualization techniques to develop an integrated Python-based problem-solving application.	K3

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO 1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PO8	PO 9	PO 10	PO 11	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	-	-	-	-	-	1	2	-	2
CO2	3	3	2	2	3	-	-	-	-	-	2	2	-	2
CO3	3	3	2	2	3	-	-	-	-	-	2	2	-	2
CO4	3	3	2	2	3	-	-	-	-	-	2	2	-	2
CO5	3	3	2	2	3	1	1	-	-	1	2	2	2	2

UNIT	CONTENTS	Contact Hours
UNIT – 1	**Computational Thinking, Algorithm Design & Flowcharting** **Computational thinking pillars** - decomposition, pattern recognition, abstraction, algorithmic thinking, and the problem-solving process. **Algorithm design** - characteristics of a good algorithm, stepwise refinement, pseudocode. **Flowcharts** - standard symbols, construction rules, and manual tracing for verification. **Translating algorithms and flowcharts into Python code** - variables, data types, operators, and input/output. **Introduction to good coding practice** - docstrings, inline comments, and print-based debugging.	8
UNIT – 2	**Control Structures** **Conditional statements** - as abstraction over multiple cases. **Loops** (for, while) - as pattern recognition of repetition. Nested loops and loop control (break, continue, pass) - as decomposition of complex repetitive logic.	8
UNIT – 3	**Data Structures — Strings, Lists, Tuples & Dictionaries** **Strings -** pattern matching and abstraction of text as a sequence. **Lists -** abstraction of ordered, mutable collections**.** **Tuples and dictionaries** - abstraction of fixed and key-based data	10
UNIT – 4	**Functions & Modular Programming** **Functions -** decomposition of a program into independent, reusable sub-problems. **Recursion -** algorithmic thinking applied to self-similar sub-problems. **Basic algorithmic efficiency -** informal comparison of iterative vs. recursive approaches and their time trade-offs. Modules and built-in libraries, including responsible AI-assisted coding practices.	10
UNIT – 5	**File Handling, Exception Handling, Data Analysis & Capstone Project** **File handling -** decomposition of a data workflow into read/process/write stages. **Exception handling -** abstraction of error cases into predictable, manageable patterns. Introduction to data analysis and visualization (NumPy/Pandas/Matplotlib basics) - pattern recognition in real datasets. Capstone integration - combining all prior units into one end-to-end project.	10
	Total	**46**

Text Books:

1. Downey, A. B. (2015). Think Python: How to think like a computer scientist (2nd ed.). O'Reilly Media.
2. Guttag, J. V. (2021). Introduction to computation and programming using Python: With application to computational modeling and understanding data (3rd ed.). MIT Press.

Reference Books:

1. Sweigart, A. (2025). Automate the boring stuff with Python: Practical programming for total beginners (3rd ed.). No Starch Press.
2. McKinney, W. (2022). Python for data analysis: Data wrangling with pandas, NumPy, and Jupyter (3rd ed.). O'Reilly Media.
3. Wing, J. M. (2006). Computational thinking. Communications of the ACM, 49(3), 33–35. https://doi.org/10.1145/1118178.1118215

Web References:

1. Python Software Foundation. (n.d.). The Python tutorial. https://docs.python.org/3/tutorial/
2. W3Schools. (n.d.). Python tutorial. https://www.w3schools.com/python/
3. NPTEL. (n.d.). Programming, data structures and algorithms using Python. https://nptel.ac.in

B.Tech. (I Sem.) **A2610013- ENVIRONMENTAL STUDIES**

L	T	P	C
2	0	0	0

Course Objectives:

- To understand the fundamental structures and interactions of natural ecosystems biogeochemical cycles, and Earth's natural resources
- To evaluate the causes, impacts, and mitigation strategies of various forms of environmental pollution (air, water, soil, noise)
- To analyze current global environmental issues, climate change mechanisms, and principles of sustainable development and green engineering.
- To apply social, legal, and ethical frameworks to environmental management, environmental impact assessments (EIA), and corporate social responsibility.
- To propose sustainable engineering concepts and analytical solutions for contemporary environmental problems through case-based design approaches.

Course Outcomes: On completion of the course, the student should be able to

CO1: Assess natural resource distribution, ecological balance mechanisms, and biodiversity index parameters.

CO2: Analyze pollution control options and waste handling strategies for air, water, and solid waste systems based on regulatory guidelines.

CO3: Evaluate carbon footprints, evaluate climate change mitigation policies, and integrate life-cycle thinking into industrial plans.

CO4: Understand environmental legislation, outline introductory Environmental Impact Assessments (EIAs), and practice professional environmental ethics.

CO5: Implement green building concepts, renewable energy applications, and circular economy practices conceptually in professional environments.

Course articulation matrix

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	–	–	–	1	**3**	–	–	–	–	–			
CO2	2	**3**	–	–	–	**3**	**3**	1	–	–	–	–			
CO3	2	**3**	–	–	–	**3**	**3**	1	–	–	–	–			
CO4	1	2	–	–	–	**3**	**3**	**3**	–	–	–	–			
CO5	2	2	–	–	–	**3**	**3**	2	–	–	–	–			

UNIT I: Ecosystems, Natural Resources, and Biodiversity

Concept, structure, and functions of an ecosystem - Producers, consumers, decomposers; **Energy flow in ecosystems:** Food chains, food webs, ecological pyramids; **Biogeochemical cycles:** Carbon, Nitrogen, Phosphorus, and Water cycles; **Natural resources:** Renewable and non-renewable resources - Forest, Water, Mineral, Energy and Food resources and associated exploitation challenges; **Biodiversity:** Levels - genetic, species, ecosystem, values, hot-spots, threats, and conservation methods (In-situ and Ex-situ); **Case Studies & Activities.**

UNIT II: Environmental Pollution and Control Technologies

Air Pollution: Sources, primary/secondary pollutants, ambient air quality standards, control equipment principles - Electrostatic Precipitators, Baghouses, Scrubbers; **Water Pollution:** Characteristics of wastewater, parameters - BOD, COD, TDS, municipal wastewater treatment

principles - Primary, Secondary, Tertiary treatment; **Soil Pollution:** Industrial waste, agricultural runoff, solid waste management Municipal Solid Waste - generation, segregation, incineration, composting, landfilling; **Noise and Thermal Pollution:** Sources, measurement metrics (dB, dBA), physiological impacts, and mitigation techniques; **Case Studies & Activities.**

UNIT III: Global Environmental Issues and Climate Change

The Earth's climate system, enhanced greenhouse effect, and global warming potential (GWP); **Ozone layer depletion:** CFCs, catalytic destruction cycles, and the Montreal Protocol; **Acid rain formation** - atmospheric chemistry impacts, and regional degradation; **International Conventions and Policies**: UNFCCC, Paris Agreement, Kyoto Protocol, and Carbon Trading mechanisms; **Concepts of Life Cycle Assessment (LCA)**: Carbon Footprint analysis, and Net-Zero carbon engineering; **Case Studies & Activities.**

UNIT IV: Environmental Ethics, Laws, and Sustainable Development

Sustainable Development Goals (SDGs) set by the United Nations: Targets and engineering intersections; **Environmental Legislation**: Overview of Water (Prevention and Control of Pollution) Act, Air Act, Environment (Protection) Act, and Wildlife Protection Ac; **Environmental Impact Assessment (EIA)**: Process, scoping, public consultation, clearance lifecycle, and Environmental Management Plan (EMP); **Environmental Ethics:** Corporate Social Responsibility (CSR); **Case Studies & Activities.**

UNIT V: Green Technology and Sustainable Engineering

Renewable Energy Technologies: Solar photovoltaic, wind energy, biomass conversion, and hydrogen fuel cells; **Green Building Concepts:** Leadership in Energy and Environmental Design (LEED), IGBC ratings, energy-efficient architecture, and waste-water recycling loops; **Circular Economy:** Upcycling, industrial symbiosis, waste-to-energy recovery systems, and sustainable supply chains; **Case Studies & Activities and Field Activity(Plantation, Species identification, Study of ecosystems etc)**

Textbook:

1. **Rajagopalan, R.** (2023). *Environmental Studies: From Crisis to Cure*, 4th Edition. Oxford University Press, New Delhi. ISBN: 9789354978944.
2. **Masters, G. M., & Ela, W. P.** (2013). *Introduction to Environmental Engineering and Science* (3rd ed.). Pearson.
3. **Bharucha, E.** (2021). *Textbook of Environmental Studies for Undergraduate Courses*. Universities Press.
4. **Kaushik, Anubha and Kaushik,** C. P. (2021). *Perspectives in Environmental Studies*, 7th Edition. New Age International Pvt. Ltd., New Delhi.

Reference Books:

1. **De, A. K.** (2010). *Environmental Chemistry* (7th ed.). New Age International Publishers.
2. **Nebel, B.J., & Wright, R.T.** (2008). *Environmental Science: Toward a Sustainable Future.* Pearson.
3. KVSG Murali Krishna, The Book of Environmental Studies, 2/e, VGS Publishers, 2011.
4. **UN Environment Programme (UNEP):** Official publications and Sustainable Development Goals resource repositories [unep.org].
5. **Coursera / edX Online Modules:** Introduction to Sustainability or Circular Economy and Sustainable Technologies (DelftX / LundX).
6. NPTEL, Environmental Science, Prof. Sudha Goel and Prof. Shamik Chowdhury, IIT Kharagpur,NPTEL–SWAYAM. https://onlinecourses.nptel.ac.in/noc26_hs120/preview?utm_source=chatgpt.com

B.Tech. (I Sem.)	A2610012- ENGLISH FOR TECHNICAL COMMUNICATION AND MOODLE LAB	L	T	P	C
		0	0	3	1.5

Part – A

Course Objectives:

- Develop active listening skills and the traits of an effective listener using lab activities and Ai-based listening tools.
- Develop speaking and presentation skills through structured practice and AI-speech coaching tools.
- Apply reading techniques and Analyze the texts to strengthen comprehension and employability.
- Apply writing techniques for technical and professional letters, emails, resumes and report writing to enhance employability.

Course Outcomes:

At the end of the course, the students will be able to

CO1: Apply a variety of strategies to interpret and comprehend spoken texts/ discourse using contextual clues.

CO2: Apply appropriate speaking strategies to interpret content/material related to engineering and technology domain.

CO3: Participate in discussions and presentations on general and technical topics.

CO4: Possess an ability to write clearly on topics related to technology and workplace communication.

CO5: Choose functional language, cohesive devices and skills of organization to express clearly in speaking.

CO6: Demonstrate proficiency in using Moodle LMS and digital learning tools to access learning resources, manage academic activities, submit assignments, participate in quizzes and discussions, and organize learning effectively.

CO7: Apply digital communication, academic, research, and presentation skills while demonstrating academic integrity, responsible use of AI and digital technologies, and professional online behaviour.

Course Articulation Matrix:

COs\POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	–	2	–	–	1	2	–	2	2	3	–
CO2	1	3	–	2	2	2	–	–	–	2	2
CO3	–	2	–	–	2	2	–	3	3	3	2
CO4	–	2	–	–	2	2	–	2	2	3	2
CO5	–	2	–	–	1	2	–	3	3	3	2
CO6	–	2	–	–	3	2	–	2	2	2	3
CO7	–	2	1	2	3	2	2	3	3	3	3

1 = Slight (Low) 2= Moderate (Medium) 3 = Substantial (High)

List of Experiments

1. Phonetics & Accent Neutralisation

- Sound Lab Drills — Students record minimal pairs (/p/–/b/, /t/–/d/) and compare wave forms using free apps like Voice Recorder.
- Pronunciation Clinics — Peer-correction circles where each student reads a short passage focusing on stress and intonation.
- IPA Treasure Hunt — Give IPA transcriptions; students identify the words and pronounce them.
- Shadowing Practice — Students mimic short clips (newsreader, documentary narrator) to reduce mother-tongue influence.

2. Introducing Self and Others

- Speed Networking — Students rotate every 2 minutes and introduce themselves to a new partner.
- Identity Cards — Each student prepares a "professional identity card" and introduces another student using it.
- Role-based Introductions — introduce yourself as a student, intern, job applicant, club member, etc.

3. Brief Talk in Formal/Informal Contexts, JAM/Extempore

- JAM Box — A box with random topics; students pick one and speak for 60 seconds.
- Context Switch — Students speak on the same topic twice: once formally (seminar), once informally (friends).
- Prompt Cards — Situational prompts: "Convince your friend to join a club", "Address a class meeting".

4. Listening Comprehension

- Audio Quizzes — Play short clips (announcements, interviews) and ask MCQs.
- Gap-fill Listening — Provide partially blank transcripts; students fill missing words.
- Error Spotting — Students listen to a narration and identify factual inconsistencies.

5. Process Description & Paragraph Writing (Technical Lab Context)

- Lab-to-Paragraph — After a lab experiment, students write a process description using sequence markers.
- Flowchart to Paragraph — Provide a technical flowchart; students convert it into a coherent paragraph.
- Reverse Engineering — Give a paragraph; students convert it back into steps and check accuracy.

6. Group Discussions & Deliberations – Coming to Consensus

- Consensus Challenge — Groups must agree on one solution to a problem (e.g., "Best way to reduce campus waste").
- Fishbowl GD — Inner circle discusses; outer circle observes and gives feedback.
- Ranking Task — Groups rank items (e.g., skills for employability) and justify their consensus.

7. Micro Presentations (2–5 minutes)

- One-Slide Presentation — Students prepare a single slide and speak for 3 minutes.
- Teach a Concept — Students explain a simple technical idea (e.g., "How Wi-Fi works").
- Object Talk — Students bring an object and present its use, history, or mechanism.

8. Presenting Logical Arguments – Debates

- Two-Minute Debates — Quick debates with timed arguments and rebuttals.
- Evidence Hunt — Students gather data or examples to support their stance before debating.
- Role-based Debates — Students debate from assigned roles (environmentalist, policymaker, student).

9. Talking About Social Issues & Data Interpretation

- Data Talk — Provide charts/graphs (literacy rates, pollution levels); students interpret and present insights.
- Issue Circles — Groups discuss a social issue and propose one actionable solution.
- Poster-to-Speech — Students convert an infographic into a 2-minute talk.

10. Interviews – Formal & Semi-formal

- Mock Interview Panels — Students face a panel of peers acting as interviewers.
- Resume-based Q&A — Students ask each other questions based on their resumes.
- Situational Interviews — Semi-formal scenarios: club membership, internship, volunteer role.

Lab Manual

- Propel: A Course Book for Technical English Communication. Cengage Publishers, 2026.

Reference Books:

1. Raman Meenakshi, Sangeeta-Sharma.TechnicalCommunication.OxfordPress.2018.
2. Taylor Grant: English Conversation Practice, Tata McGraw Hill Education India,2016.
3. Hewing's, Martin. Cambridge Academic English (B2).CUP, 2012.
4. J.Sethi & P.V.Dhamija. A Course in Phonetics and Spoken English, (2ndEd), Kindle, 2013
5. Richards, Jack C., Jonathan Hull, and Susan Proctor. Interchange Level 3 Student's Book with Self-study DVD-ROM. Vol. 3. Cambridge University Press, 2012.

Web Resources:

1. www.esl-lab.com
2. www.englishmedialab.com
3. www.englishinteractive.net
4. https://www.britishcouncil.in/english/online
5. http://www.letstalkpodcast.com
6. https://www.youtube.com/c/mmmEnglish_Emma/featured
7. https://www.youtube.com/c/ArnelsEverydayEnglish/featured
8. https://www.youtube.com/c/engvidAdam/featured
9. https://www.youtube.com/c/EnglishClass101/featured
10. https://www.youtube.com/c/SpeakEnglishWithTiffani/playlists
11. https://www.youtube.com/channel/UCV1h_cBE0Drdx19qkTM0WNw
12. https://www.youtube.com/user/letstalkaccent/videos
13. https://www.youtube.com/c/EngLanguageClub/featured
14. https://www.youtube.com/channel/UC_OskgZBoS4dAnVUgJVexc
15. https://www.youtube.com/channel/UCNfm92h83W2i2ijc5Xwp_IA

Part B

Moodle Learning Management System: Digital learning and Academic Skills Course Objectives

- To become familiar with model LMS and on-line learning
- To develop basic Digital and Academic Skills needed for Engineering students
- To learn effective on-line communication and collaboration
- To develop skills in Assignments, Quizzes, Presentation and Refreshing
- To practice Academic Integrity and Responsible use of Digital Technology

Moodle Learning Management System: Digital learning to enhance Academic Skills. Students familiarize with model LMS and on-line learning, communication and collaboration. They develop skills in Assignments, Quizzes, Presentation and online interviews. They exercise academic Integrity and responsible use of Digital Technology. They adopt the usage of Grammarly, ChatGPT, Culture Wizard, Quizlet AI and Google Speech –to-text to enhance their respective skills.

List of Experiments

1. **Introduction to Moodle LMS**
   - Introduction to Moodle
   - Student login and profile management
   - Moodle dashboard and course navigation
   - Accessing announcements and course materials
   - Notifications and calendars
2. **Learning Through Moodle**
   - Accessing PDFs, videos, web resources, and lecture materials
   - Downloading and organizing study materials
   - Moodle lessons and learning activities
   - Tracking course completion
   - Managing deadlines and study schedules
3. **Assignments, Quizzes and Assessments**
   - Understanding assignment instructions
   - Creating and uploading assignments
   - File formats and file naming
   - Online quizzes and question types
   - Viewing marks and teacher feedback
   - Re-submission and revision
4. **Academic honesty**
   - Plagiarism and how to avoid it
   - Copyright and fair use
   - Responsible use of AI tools
   - Digital privacy and cyber security
   - Evaluating reliable online information
   - Professional behavior in online environments
   - Practical Activities

@ @ @

L	T	P	C
0	0	3	1.5

B.Tech. (I Sem.)

A2610017- PHYSICS FOR MECHANICAL SYSTEMS LAB

(For Mechanical and Aerospace Engineering Branches)

Course Objectives

- To develop an experimental understanding of fundamental principles of optics, mechanics, oscillations, ultrasonics, and quantum physics through laboratory investigations.
- To determine important optical parameters, mechanical properties, wave characteristics, and physical constants using appropriate experimental techniques and measurement methods.
- To develop practical skills in experimental measurement, data analysis, error estimation, interpretation of observations, and verification of fundamental physical principles.

Course Outcomes

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

CO1 : Apply the principles of interference, diffraction, and polarization to determine optical parameters such as wavelength, grating element, radius of curvature, and Brewster angle through experimental methods. **K3 (Apply)**

CO2 : Analyze the mechanical properties of materials by experimentally determining Young's modulus and rigidity modulus using bending and torsional methods. **K4 (Analyze)**

CO3 : Apply the principles of mechanical oscillations, standing waves, and ultrasonic wave propagation to determine acceleration due to gravity, radius of gyration, frequency, and ultrasonic velocity. **K3 (Apply)**

CO4 : Analyze the resolving capability of optical instruments by experimentally determining the resolving power of a telescope and relating it to diffraction and the ability to distinguish closely spaced objects. **K4 (Analyze)**

CO5 : Apply the principles of quantum physics and photoelectric effect to estimate Planck's constant experimentally and interpret the relationship between photoelectric observations and quantum theory. **K3 (Apply)**

Course Articulation Matrix

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	–	H	M	–	–	–	L	M	–
CO2	H	H	–	H	M	–	–	–	L	M	–
CO3	H	H	–	H	M	–	–	–	L	M	–
CO4	H	H	–	H	H	–	–	–	L	M	–
CO5	H	H	–	H	M	–	–	–	L	M	–

Correlation Levels

- **H** – High correlation; **M** – Moderate correlation; **L** – Low correlation

LIST OF EXPERIMENTS FOR PHYSICS FOR MECHANICAL SYSTEMS (PMS) LAB

(Any TEN of the following listed experiments)

(Out of which any TWO experiments may be conducted in virtual mode)

1. Laser: Determination of wavelength and grating element.
2. Sonometer: Verification of laws of stretched string.
3. Determination of ultrasonic velocity in a given liquid.
4. Estimation of Planck's constant using photoelectric effect.
5. Determination of Rigidity modulus of material of a wire-dynamic method (Torsional pendulum).
6. Determination of radius of curvature of given plano-convex lens by forming Newton's rings.
7. Determination of Acceleration due to gravity and Radius of gyration using Compound pendulum.
8. Determination of frequency of electrically maintained tuning fork by Melde's experiment.
9. Determination of the resolving power of telescope.
10. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration.
11. Verification of Brewster's Law.
12. Determination of temperature coefficients of a thermistor.
13. Determination of dielectric constant of given capacitor by charging and discharging method.
14. Study the variation of magnetic field along the axis of a current carrying circular coil by Stewart & Gee's method.
15. Determination of thickness of thin object by wedge method.
16. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
17. Young's modulus of given material of wooden scale by non –uniform bending method.
18. Determination of Hall voltage and Hall coefficients of a given semiconductor using Hall Effect.

References:

1. S. Balasubramanian, M.N. Srinivasan "A Text Book of Practical Physics"- S Chand Publishers, 2017.

V-Lab: vlab.co.in

B.Tech. (I Sem.)	A2610018- COMPUTATIONAL THINKING & PROBLEM SOLVING THROUGH PYTHON LAB	L	T	P	C
		0	0	3	1.5

Pre-requisite: Concurrent with Python Programming

Course Objectives: The main objectives of the course are to

- Develop basic Python programming skills using variables, data types, operators, input/output statements, conditional statements, loops, and appropriate coding practices.
- Develop the ability to represent and manipulate different forms of data using Python strings, lists, tuples, dictionaries, and comprehensions.
- Apply functions, recursion, lambda expressions, modules, and functional programming constructs to develop modular and reusable Python programs.
- Introduce object-oriented programming concepts such as classes, objects, encapsulation, inheritance, polymorphism, operator overloading, and composition for implementing Python-based solutions.
- Develop practical skills in file processing, exception handling, and basic data analysis and visualization using Python libraries and integrate these techniques to solve computational problems.

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

CO	Course Outcome Description	Knowledge Level (K)#
CO1	Apply Python variables, data types, operators, input/output, conditional statements, loops, and coding practices to solve basic computational problems.	K3
CO2	Apply strings, lists, tuples, dictionaries, and comprehensions to represent, manipulate, and process different types of data.	K3
CO3	Apply functions, lambda expressions, recursion, modules, and functional programming constructs to develop modular Python programs.	K3
CO4	Apply classes, objects, encapsulation, inheritance, polymorphism, operator overloading, and composition to implement object-oriented Python solutions.	K3
CO5	Implement file processing, exception handling, and basic data analysis and visualization using Python libraries for solving computational problems.	K3

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	1	3	–	–	1	–	–	1	3	–	2
CO2	3	3	2	2	3	–	–	1	–	–	1	3	–	2
CO3	3	3	3	2	3	–	–	1	1	–	2	3	1	3
CO4	3	3	3	2	3	1	–	2	2	1	2	3	–	2
CO5	3	3	3	3	3	1	1	2	2	2	2	3	2	3

Lab Requirements (tools / software to carry out the experiments):

- Python 3.x interpreter (C Python, from python.org).
- IDE / editor: Thonny or IDLE (beginner-friendly), VS Code (Python extension) or PyCharm Community.
- pip package manager with the NumPy, pandas and Matplotlib libraries for the data-analysis exercises.
- Notebook environment: Jupyter Notebook or Google Colab (no install) for experimentation and plotting.
- Operating system: Windows, Linux or macOS, 64-bit, with 4 GB RAM or more.
- No-install alternative: Google Colab, Replit or Programiz Python for practice in a browser.

List of Experiments

Exercise 1: Getting Started with Python

1. Write and run a Python program that prints “Hello, World!” along with the Python version in use. Note the difference between running a saved script from the terminal and typing the same statements in the interactive shell.
2. Write a Python program that reads a name and an age from the user and prints a personalized greeting.
3. Write a Python program that reads two numbers and prints their sum, difference, product, quotient and remainder, each on a labelled line.
4. Write a Python program to compute simple interest given principal, rate, and time.
5. Write a Python program to compute the area and perimeter of a rectangle from user input.
6. Write a Python program to swap two numbers without using a third variable.

Exercise 2: Conditionals

1. Write a Python program to compute the Body Mass Index (BMI) from height and weight, rounded to two decimal places, and classify it as Underweight, Normal, Overweight or Obese using if-elif-else.
2. Write a menu-driven Python program to convert a temperature between Celsius, Fahrenheit and Kelvin based on the user's choice.
3. Write a Python program to find the largest of three numbers.
4. Write a Python program to Check whether a given year is a leap year.

Exercise 3: Write a Python program to

1. Determine whether a number is positive, negative, or zero.
2. Check if a given number is prime
3. Convert temperature between Celsius and Fahrenheit based on user choice
4. Compute and display the area of a valid triangle using Heron's formula, with inline comments explaining each step.

Exercise 4: Loops, Number Problems and Patterns

1. Use a for loop to print the first n Fibonacci terms, and a while loop to test whether a number is prime (using break, printing the number of division tests).
2. Use a while loop to compute the GCD and LCM of two integers using Euclid's algorithm.
3. Find the first n prime numbers using nested loops with break.
4. Sum of first N natural numbers

Exercise 5: String Processing

1. Write a function that checks whether a string is a palindrome using slicing and string methods, ignoring spaces, punctuation and case; justify whether a string or a list of characters is the better structure.
2. Write a script that counts the vowels, consonants, digits and special characters in a user-provided paragraph.
3. Write a script that sanitizes a full name with irregular capitalization and excess spaces using .strip() and .title(), and extracts the initials.

Exercise 6: Lists and List Comprehensions

1. Remove duplicates from a list of sensor readings, first without set() and then with set(); compare the two approaches for time complexity and readability.
2. Use a list comprehension to filter out noise readings outside a realistic range (e.g., -40°C to 85°C).
3. Compute and display the average, maximum and minimum of the filtered list.

Exercise 7: Write a Python Program to

1. Find the second-largest element in a list of exam scores.
2. Merge two sorted lists of student roll numbers into a single sorted list.
3. Generate squares of all even numbers from 1 to 50 using list comprehension.

Exercise 8: Dictionaries and Tuples

1. Create a dictionary of student records keyed by roll number with (Name, Marks) tuples as values; justify why a dictionary is preferable to a list of tuples for lookup.
2. Build a word-frequency dictionary from a text paragraph (case-insensitive). (Count the frequency of each word in a paragraph using a dictionary)
3. Search the student dictionary by roll number, assign grades and identify the highest scorer.

Exercise 9: Recursion vs Iteration

1. Write a recursive function fibonacci_recursive(n) that returns the n-th Fibonacci term.
2. Write an iterative function fibonacci_iterative(n) using a loop.
3. Compute the GCD of two numbers recursively using the Euclidean algorithm.
4. Compute factorial using recursion

Exercise 10: File Handling and Modular Workflow

1. Create a file student_records.txt and write five lines of data formatted as RollNo, Name, Marks.
2. Read the file, identify students scoring above 75 and write them to distinction_list.csv using context managers.
3. Count the words, lines, and characters in a given text file.
4. Read a text file of daily temperature readings and write the maximum, minimum, and average to an output file

Exercise 11: Exception Handling

1. Write a program to compute the real roots of a quadratic equation, handling all cases (real distinct, real equal, no real roots).

2. Wrap the parsing and calculation in a try-except block handling Value Error and Zero Division Error, with a finally block logging attempts to calculation_log.txt.
3. Package the logic into a reusable function solve_quadratic(a, b, c) suitable for import by other modules.

Reference Books:

1. Sweigart, A. (2025). Automate the boring stuff with Python: Practical programming for total beginners (3rd ed.). No Starch Press.
2. McKinney, W. (2022). Python for data analysis: Data wrangling with pandas, NumPy, and Jupyter (3rd ed.). O'Reilly Media.
3. Wing, J. M. (2006). Computational thinking. Communications of the ACM, 49(3), 33–35. https://doi.org/10.1145/1118178.1118215

Web References:

- Python Software Foundation – The Python Tutorial: https://docs.python.org/3/tutorial/
- NPTEL – Python for Data Science: https://nptel.ac.in

L	T	P	C
0	1	3	2.5

B.Tech. (I Sem.) **A2610016- ENGINEERING GRAPHICS**

(ASE, CE, & ME Branches)

Note: Students shall carry out all the practical exercises of Sections A and B.

Course Objectives: The course aims to:

1. Develop spatial visualization and graphical communication skills for representing engineering objects, components, structures and systems.
2. Introduce the principles, conventions and standards of engineering graphics, including geometrical constructions, scales, dimensioning, projections and sectional representation.
3. Develop the ability to visualize and represent three-dimensional engineering entities through orthographic, isometric, sectional and surface-development techniques.
4. Develop proficiency in computer-aided engineering graphics, including 2D drafting, 3D modelling, visualization and generation of engineering drawings.
5. Enable students to communicate engineering design information effectively through freehand sketches, conventional drawings and digital CAD models across different engineering disciplines.

Course Outcomes

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

CO's	CO Statements	BTL
CO1:	Apply standard engineering graphics principles and conventions to prepare accurate sketches and engineering drawings.	Applying-L3
CO2:	Visualize and represent three-dimensional objects and systems using appropriate projection, orthographic, isometric, sectional and surface-development techniques.	Applying-L3
CO3:	Interpret and transform engineering representations, including conversion between 2D drawings, 3D views and physical objects.	Applying-L3
CO4:	Use CAD tools to generate, modify and communicate 2D drawings and 3D models with appropriate dimensions, annotations, symbols and features.	Analyzing-L4
CO5:	Communicate engineering design information effectively through graphical representations, CAD models and engineering drawings for multidisciplinary engineering applications.	Analyzing-L4

SECTION A – Manual Engineering Drawing

Exp. Practical Exercise

1 **Fundamentals of Engineering Drawing:** Lines, lettering, dimensioning, geometrical constructions, symbols and standard drawing conventions

2 **Engineering Curves:** Construction and applications of ellipse, parabola, hyperbola, cycloid, involute and other commonly used engineering curves

3 **Scales:** Construction and application of plain and diagonal scales for representing engineering dimensions

4 **Projection of Points and Straight Lines:** Projection of points in different quadrants and straight lines in different orientations

5 **Projection of Planes:** Projection of simple planes parallel, perpendicular and inclined to reference planes

6 **Projection of Solids and Engineering Objects:** Projection of basic solids and simple engineering objects in different orientations

7 **Orthographic and Isometric Views:** Conversion between orthographic and isometric representations of simple engineering objects and systems

8 **Sections of Solids and Engineering Objects:** Sectional views and true shapes of simple solids and objects

9 **Development of Surfaces:** Development of surfaces of prismatic, cylindrical, pyramidal, conical and other developable forms

10 **Freehand Engineering Sketching:** Freehand sketching, proportioning and dimensioning of simple engineering components, objects, assemblies and systems

SECTION B – Computer-Aided Engineering Graphics (CAD)

Exp. Practical Exercise

11 **Introduction to 2D CAD:** Drawing setup, basic drawing and editing commands, layers, dimensions, text, symbols and hatching

12 **CAD Geometrical Constructions and Curves:** Construction of polygons, circles, arcs, ellipse and other engineering curves using CAD

13 **2D CAD – Orthographic Views:** Preparation of front, top, side and other appropriate views of simple engineering objects

14 **Basic 3D CAD Modelling:** Creation of simple three-dimensional engineering objects using basic modelling features

15 **3D CAD Modelling of Engineering Components:** Modelling of representative engineering components, structures and functional objects using basic modelling features

16 **3D CAD Modelling with Features:** Creation and modification of 3D models using features such as hole, fillet, chamfer, mirror, pattern and other appropriate tools

17 **CAD Sectional Views:** Creation of sectional views of 3D engineering objects and generation of corresponding 2D drawings

18 **CAD Surface Development:** Development of cylindrical, conical, prismatic and other developable surfaces using CAD

19 **3D Model to Engineering Drawing:** Generation of orthographic, isometric and sectional views with dimensions, annotations and symbols from a 3D CAD model

20 **CAD Modelling of Physical Engineering Objects:** Measurement and interpretation of a physical engineering object, recreation of its geometry in CAD, and preparation of its engineering drawing.

Text Books

- Bhatt, N. D., & Panchal, V. M. (2023). Elementary engineering drawing (53rd ed.). Charotar Publishing House.
- Narayana, K. L., Kannaiah, P., & Reddy, K. V. (2020). Engineering graphics (2nd ed.). Scitech Publications.

Reference Books

- Venugopal, K., & Prabhu Raja, V. (2019). Engineering drawing and graphics (5th ed.). New Age International.
- Gopalakrishna, K. R. (2018). Engineering drawing (Vols. 1–2). Subhas Stores.
- Engineering Drawing with an Introduction to AutoCAD, Dhananjay Jolhe, Tata McGraw Hill, 2017.

L	T	P	C
0	1	3	2.5

B.Tech. (I Sem.) **A2610019- AI TOOLS & APPLICATIONS**

Course Outline:

- This course introduces first-year engineering students to the practical use of Artificial Intelligence tools across problem-solving, data analysis, content creation, and coding.
- Students gain hands-on experience with generative AI, prompt engineering, AI-assisted data visualization, and productivity/coding copilots through weekly lab practice.
- The course emphasizes responsible and ethical AI use alongside technical competence and serves as a foundation for AI-assisted work in higher-semester courses across all branches.
- By the end, students will be able to independently select, apply, and evaluate AI tools for academic and engineering tasks.

Course Objectives: The main objectives of the course are to

1. To familiarize students with the landscape of AI tools and their underlying working principles.
2. To develop competence in prompt engineering for effective interaction with generative AI systems.
3. To enable students to apply AI tools for data analysis, visualization, and interpretation.
4. To train students in using AI-assisted tools for coding, writing, and productivity tasks.
5. To instill awareness of ethical, legal, and societal considerations in AI tool usage.

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

CO	Course Outcome Description	Knowledge Level (K)#
CO1	Recall the categories, capabilities, and limitations of major AI tools (text, image, code, data).	K1
CO2	Explain the principles of prompt engineering and how generative AI models process instructions.	K2
CO3	Apply AI tools to solve first-year engineering problems in analysis, writing, and coding tasks.	K3
CO4	Analyze AI-generated outputs for accuracy, bias, and reliability before use.	K4
CO5	Evaluate the ethical, academic-integrity, and societal implications of AI tool use, justifying appropriate usage choices.	K5

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	M	–	–	–	H	L	L	–	–	–	L	M	M	M
CO2	M	M	–	–	H	L	–	L	–	M	L	M	M	M
CO3	H	H	M	M	H	L	L	–	L	M	M	H	M	H
CO4	M	H	M	H	H	M	M	H	L	M	M	M	H	M
CO5	L	M	M	M	M	H	H	H	M	H	M	M	M	H

<table>
<tr><th>UNIT</th><th>CONTENTS</th><th>Contact Hours</th></tr>
<tr><td>UNIT – 1</td><td>
Introduction to AI and the AI Tools Landscape
What is AI, Machine Learning, and Generative AI — basic definitions and how they relate to one another.
Core categories of AI tools: conversational/text, code assistants, data-analysis tools, image-generation tools, and writing/productivity tools.
Large language models process and generate responses: conceptual, non-mathematical overview.
Criteria for selecting the right AI tool for a given task — accuracy needs, cost, data sensitivity, and output format.
Setting up accounts and workspaces: understanding free-tier versus paid-tier capabilities and limitations.
Widely Used AI Tools by Application:
<table>
<tr><th>Category</th><th>Example Tools</th><th>Typical Application</th></tr>
<tr><td>Conversational / General-Purpose AI</td><td>ChatGPT, Claude, Gemini, Perplexity</td><td>Writing, research, coding help, file/data analysis, cited web search</td></tr>
<tr><td>AI Coding Assistants</td><td>GitHub Copilot, Cursor, Claude Code</td><td>In-IDE code completion, AI-native editing, multi-file agentic coding</td></tr>
<tr><td>Data Analysis Tools</td><td>ChatGPT (Advanced Data Analysis), Microsoft Copilot in Excel, Julius AI</td><td>Upload a dataset, generate statistics/charts, spreadsheet formulas via natural language</td></tr>
<tr><td>Image Generation</td><td>Midjourney, DALL·E 3, Stable Diffusion / Flux</td><td>Illustrations, concept art, design mockups</td></tr>
<tr><td>Writing & Productivity</td><td>Grammarly, Gamma, Fathom, Notion AI</td><td>Grammar/style checking, slide generation, meeting summaries, task automation</td></tr>
<tr><td>Audio, Video & Presentation (optional)</td><td>ElevenLabs, Runway/Sora, Synthesia</td><td>Text-to-speech, AI video generation, script-to-video presentations</td></tr>
</table>
Unit Outcome(s):
1. Identify the categories of AI tools available and select an appropriate tool for a given academic or engineering task.
Teacher Practical Examples (for classroom demonstration):
1. Live comparison of the same general engineering query (e.g., "explain the engineering design process") answered by two different AI chatbots, highlighting differences in response style and accuracy.
2. Walkthrough of an AI tool's interface — settings, conversation history, file upload, and model selection — using a common platform.
</td><td>9</td></tr>
</table>

	Student Exercise Problems (for practice): 1. Create accounts on two AI platforms and compare their responses to a simple engineering question (e.g., "explain the difference between analysis and design"). 2. Prepare a one-page comparison chart of five AI tools by category and primary use case. 3. Write a short reflection identifying one task in your daily academic life where an AI tool could help.	
UNIT – 2	**Prompt Engineering and Generative AI Tools** **Anatomy of a good prompt** — context, clear instruction, desired format, and constraints. **Types of prompt Techniques:** Zero-shot, few-shot, and chain-of-thought prompting techniques and when to use each. **Role-based and context-setting prompts** (e.g., asking the AI to respond as a reviewer, tutor, or domain expert). **Iterative prompt refinement** — diagnosing a poor AI response and rewriting the prompt to fix it. **Using generative AI** ----for brainstorming, summarizing, and drafting technical content. **Unit Outcome(s):** **1.** Construct clear, well-structured prompts using zero-shot, few-shot, and chain-of-thought techniques to obtain reliable AI output. **Teacher Practical Examples (for classroom demonstration):** **1.** Refine a vague prompt (e.g., "explain project scheduling") into a precise one step-by-step, showing output improvement at each stage. **2.** Demonstrate few-shot prompting by providing examples to guide the AI toward a specific output format (e.g., a formatted comparison table). **Student Exercise Problems (for practice):** **1.** Write three versions of a prompt (basic, detailed, role-based) for the same task and compare outputs. **2.** Use an AI tool to summarize a one-page technical article and verify the summary against the original. **3.** Draft a chain-of-thought prompt to solve a multi-step numerical/logical problem (e.g., a unit-conversion or estimation problem) and check the reasoning.	9
UNIT – 3	**AI Tools for Data Analysis and Visualization** AI-assisted spreadsheet and dataset analysis using natural-language commands. Natural-language querying of datasets to extract summary statistics and insights. AI tools for generating charts, graphs, and visual summaries from tabular data.	9

	Interpreting AI-generated statistical summaries correctly and recognizing their limitations. Identifying and correcting errors or misinterpretations in AI-generated data analysis. **Unit Outcome(s):** **1.** Use AI tools to clean, summarize, and visualize a dataset via natural-language commands, and identify errors in AI-generated analysis. **Teacher Practical Examples (for classroom demonstration):** **1.** Upload a small dataset (e.g., class attendance or survey data) to an AI tool and generate a summary-statistics report and chart using natural-language commands. **2.** Show an example where an AI tool misinterprets data (e.g., treats a numeric code as text), and demonstrate how to verify and correct it. **Student Exercise Problems (for practice):** **1.** Use an AI tool to clean and summarize a small sample dataset (e.g., class attendance or marks data). **2.** Generate three different chart types from the same dataset using AI prompts and justify which is most appropriate. **3.** Cross-check one AI-generated statistical claim manually and report any discrepancy found.	
UNIT – 4	**AI Tools for Coding, Writing, and Productivity** AI coding assistants — code generation, explanation, and debugging support for simple programs. AI writing assistants for reports, emails, and technical documentation. AI tools for scheduling, note-taking, and meeting/lecture summarization. AI-assisted presentation and slide-outline generation from a topic prompt. Integrating AI tools into an efficient day-to-day academic and engineering. **Unit Outcome(s):** **1.** Apply AI coding assistants and writing tools to complete and refine a simple technical task. **2.** Integrate multiple AI tools into a coherent workflow. **Teacher Practical Examples (for classroom demonstration):** **1.** Use an AI coding assistant to generate a simple program (e.g., a temperature converter), then intentionally introduce a bug and have the AI debug it. **2.** Generate a presentation outline and speaker notes from a topic prompt using an AI writing/productivity tool. **Student Exercise Problems (for practice):** **1.** Use an AI coding tool to write and debug a simple program for a given problem statement. **2.** Draft a formal email or short report using an AI writing assistant, then manually edit it for accuracy and tone. **3.** Generate a slide outline for a 5-minute seminar topic using an AI tool and refine it.	9

UNIT – 5	**Ethics, Reliability, and Emerging Trends** Bias and hallucination in AI outputs, and techniques for detecting and fact-checking them. Academic integrity and appropriate citation of AI assistance in coursework and submissions. Data privacy and security considerations, including obligations under India's Digital Personal Data Protection Act, 2023 (DPDP Act), when uploading personal or institutional data. Copyright and intellectual property considerations in AI-generated text and image content. Emerging trends — multimodal AI and AI agents — and their implications for future engineering practice. **Unit Outcome(s):** **1.** Evaluate AI-generated output for hallucination, bias, and copyright concerns, and apply ethical and data-privacy principles to AI tool use. **Teacher Practical Examples (for classroom demonstration):** **1.** Show a documented case of AI hallucination (a fabricated fact or citation) and demonstrate how to fact-check it. **2.** Walk through an example of properly citing AI assistance in an academic submission per institutional guidelines. **3.** Walk through a worked example of checking whether AI-generated text or image output raises a copyright/IP concern (e.g., close paraphrasing of a source). **Student Exercise Problems (for practice):** **1.** Identify and document a hallucination or bias instance produced by an AI tool on a factual query. **2.** Draft an "AI usage declaration" for a hypothetical assignment, citing tools and extent of use appropriately. **3.** Review the data-handling/privacy policy of one AI tool used in this course and identify one DPDP Act, 2023 compliance consideration relevant to student data.	9
	Total	**45**

Text Books

1. Marr, B. (2024). Generative AI in practice: 100+ amazing ways generative artificial intelligence is changing business and society. Wiley.
2. Mollick, E. (2024). Co-intelligence: Living and working with AI. Portfolio/Penguin.

Reference Books

1. Selwyn, N. (2022). Education and technology: Key issues and debates (3rd ed.). Bloomsbury.
2. Susskind, R., & Susskind, D. (2022). The future of the professions: How technology will transform the work of human experts (Updated ed.). Oxford University Press.
3. Russell, S., & Norvig, P. (2021). Artificial intelligence: A modern approach (4th ed.). Pearson.

Web Resources

1. Google. (n.d.). Google AI essentials. Grow with Google. https://grow.google/ai-essentials/
2. OpenAI. (n.d.). OpenAI documentation and guides. https://platform.openai.com/docs
3. Anthropic. (n.d.). Prompt engineering overview. Claude Docs. https://docs.claude.com/en/docs/build-with-claude/prompt-engineering/overview
4. UNESCO. (2023). Guidance for generative AI in education and research. https://unesdoc.unesco.org/
5. AICTE. (2025). AICTE inputs on Artificial Intelligence — Year of AI initiative. https://www.aicte.gov.in/downloads/initiatives/AICTE%20inputs%20on%20Artificial%20Intelligence%20-compre hensive.pdf
6. Ministry of Electronics and Information Technology, Government of India. (2023). Digital Personal Data Protection Act, 2023. https://www.meity.gov.in/content/digital-personal-data-protection-act-2023

Review Questions

1. Explain the difference between AI, Machine Learning, and Generative AI with a suitable example.
2. Describe the anatomy of a good prompt and illustrate zero-shot versus few-shot prompting with an example.
3. Discuss two ways AI tools support data analysis and visualization, with an example of each.
4. What is meant by hallucination in AI-generated output? Explain how it can be detected and verified.
5. Discuss the ethical, academic-integrity, and data-privacy considerations relevant to using AI tools for coursework, referencing the DPDP Act, 2023.

Practical Applications

1. Using AI tools to accelerate literature review and topic understanding for mini-projects and seminars.
2. Applying AI-assisted data analysis to quickly clean, summarize, and visualize experimental or survey data.
3. Using AI coding assistants to write, explain, and debug simple programs across engineering assignments.
4. Leveraging AI writing assistants to draft clear reports, emails, and presentations for academic and professional communication.
5. Applying responsible AI-usage practices — verification, citation, and privacy awareness — in everyday academic work.

B.Tech. (II Sem.)	26XXX- DIFFERENTIAL EQUATIONS & VECTOR CALCULUS	L	T	P	C
		3	0	0	3

Course Objectives: It is aimed

- To provide the learner with several methods for solving differential equations and partial differential equations.
- To prepare the student to calculate gradient, surface and volume integrals by applying standard theorems.

Course Outcomes: Upon completion of the course, the student will be able to:

CO1 : **Create** a Mathematical model for simple physical problems. (K6)

CO2 : **Apply** second order differential equations to analyse L - C - R circuits. (K3)

CO3 : **Formulate** and **solve** the partial differential equations that model physical processes. (K6)

CO4 : **Apply** knowledge of Gradient, divergence, Curl and interpret the physical meaning of different operators. (K3)

CO5 : **Compute** the work done against a field, circulation and flux using vector calculus methods. (K3)

K1- Remembering, K2- Understanding, K3-Applying, K4- Analyzing, K5- Evaluating, K6- Creating

Course Articulation Matrix

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	M	-	-	-	-	-	-	-	-
CO2	H	H	M	-	-	-	-	-	-	-	-
CO3	H	H	M	-	-	-	-	-	-	-	-
CO4	H	H	M	-	-	-	-	-	-	-	-
CO5	H	H	M	-	-	-	-	-	-	-	L

H – High, M - Medium, L - Low

UNIT I: Differential equations of first order and first degree

Exact equations and equations reducible to exact form (integrating factor), Linear differential equations – Bernoulli's equations. Applications: Orthogonal Trajectories in Cartesian Coordinates, Newton's Law of cooling – Law of natural growth and decay- Electrical circuits.

UNIT II: Linear differential equations of higher order (Constant Coefficients)

Definitions of linear and non – linear equations, homogenous and non-homogenous equations, complementary function, particular integral, general solution, Method of variation of parameters - Wronskian. Simultaneous linear equations, Applications to L-C-R Circuit problems.

UNIT III: Partial Differential Equations

Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations using Lagrange's method. Homogeneous Linear Partial differential equations with constant coefficients.

UNIT IV: Vector differentiation

Scalar and vector point functions, vector operator Del, Gradient and applications, Directional derivative, Divergence - Solenoidal and Curl - Irrotational Field - Scalar Potential, Vector identities.

UNIT V: Vector integration

Line integral-circulation-work done by the force, surface integral-flux, Green's theorem in a plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and their applications.

TEXTBOOKS:

1. B. S. Grewal, "Higher Engineering Mathematics", 45th Edition, Khanna Publishers, 2024.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 11th Edition, John Wiley & Sons, 2025.

REFERENCE BOOKS:

1. B. V. Ramana, "Higher Engineering Mathematics", McGraw Hill Education, 2017.
2. Glyn James, "Advanced Modern Engineering Mathematics", 5th Edition, Pearson Education, 2018.
3. H. K. Dass, "Advanced Engineering Mathematics", 22nd Edition, S. Chand Publishing, 2022.

WEB RESOURCES

1. https://mathworld.wolfram.com/First-OrderOrdinaryDifferentialEquation.html
2. https://en.wikipedia.org/wiki/Differential_equation
3. https://en.wikipedia.org/wiki/Partial_differential_equation
4. https://en.wikipedia.org/wiki/Vector_calculus
5. https://en.wikipedia.org/wiki/Vector_calculus

L	T	P	C
3	0	0	3

B.Tech. (II Sem.) 26XXX- CHEMISTRY FOR MECHANICAL SYSTEMS

(For Mechanical and Allied Branches of Engineering)

Pre-requisite: Basic knowledge of chemistry (Higher Secondary level).

Course Outline

This course builds the chemistry foundation mechanical engineering students need for corrosion protection, fuels, lubrication, and materials aspects of mechanical systems. It covers corrosion chemistry, energy chemistry (fuels and combustion), the chemistry of lubricants, engineering materials and composites, and nanochemistry. The course directly underpins later courses in manufacturing technology, IC engines, tribology, and materials science. Quantitative estimation techniques and hands-on demonstrations connect chemical theory to everyday workshop and quality-control practice.

Course Objectives

- To understand corrosion mechanisms and surface engineering in mechanical systems.
- To analyze fuels, combustion, and energy-conversion processes.
- To study lubrication chemistry and material behavior under friction.
- To explore engineering materials including metals, polymers, and composites.
- Explore the chemistry, synthesis methods, and properties of nanomaterials.

Course Outcomes (COs)

After successful completion of the course, the student will be able to:

CO	Course Outcome Statement	Knowledge Level (K)#
CO1	Interpret the principles of corrosion, apply appropriate corrosion prevention and surface protection methods for engineering applications.	K2 (Understand) K3 (Apply)
CO2	Explain the characteristics and processing of conventional/green fuels, apply combustion principles to energy-related engineering applications.	K2 (Understand) K3 (Apply)
CO3	Apply the properties of lubricants and refractories to select suitable materials for mechanical and high-temperature applications.	K3 (Apply)
CO4	Understand the composition, properties and applications of engineering materials; apply suitable treatment and recycling methods for manufacturing waste.	K2 (Understand) K3 (Apply)
CO5	Summarize nanomaterial synthesis methods; analyse the properties and applications of advanced materials in mechanical engineering.	K2 (Understand) K4 (Analyse)

#Based on suggested Revised BTL

CO-PO/PSO Articulation Matrix:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	M	M	L	M	L	L	-	M	M	L
CO2	H	H	H	M	H	L	L	M	L	L	M
CO3	M	M	M	L	M	L	L	-	M	M	L
CO4	H	H	H	M	H	L	L	M	M	L	M
CO5	H	M	H	H	H	M	L	L	-	L	H

Scale: H - Strong | M - Moderate | L - Slight | - No Correlation.

UNIT I: Corrosion Chemistry and Protective Methods [9hrs]

Chemical and electrochemical theories of corrosion, galvanic series, Types of corrosion (galvanic, pitting, intergranular, stress corrosion).

Corrosion prevention: Cathodic protection and anodic protection

Protective coatings: Galvanizing (hot-dip galvanizing, electro-galvanizing, sherardizing).

Electroplating: Copper and nickel plating

Anodizing: Aluminium anodizing, hard anodizing

Surface hardening: Carburizing, nitriding

Conversion coatings: Phosphating and chromating.

UNIT II: Energy Chemistry (Fuels and Combustion) [10hrs]

Classification, calorific value, HCV and LCV, Dulong's formula, problems,

Solid fuels (coal): Classification (anthracite, bituminous, lignite, peat), analysis (proximate, ultimate)

Liquid fuels (petroleum oil): Composition, refining processes, fractional distillation, cracking - thermal and catalytic- fixed and fluid bed); synthetic fuels (Fischer-Tropsch synthesis).

Knocking in petrol engines: Octane number, anti-knock additives TEL, MTBE, ethanol); knocking in diesel engines: cetane number, ignition quality, anti-knock additives.

Green fuels: Green hydrogen, hythane.

Fuel cell: Introduction, H_2-O_2, PEMFC, applications.

UNIT III: Chemistry of Lubricants and refractories [9hrs]

Lubricants: Functions of lubricants - mechanism [fluid-film (hydrodynamic) lubrication, boundary-film (thin-film) lubrication, extreme-pressure lubrication], classification (solid, semi-solid, liquid), Properties of lubricants - viscosity, viscosity index, flashpoint, fire point, cloud point, pour point, aniline point, saponification.

Refractories: Characteristics, classification, properties (refractoriness, refractories under load, thermal spalling, porosity) - factors affecting the refractory materials -applications.

UNIT IV: Engineering Materials and Solid Waste management [10hrs]

Ferrous alloys: Composition and applications of carbon steels, alloy steels, stainless steels, cast irons; heat treatment-annealing, normalizing, hardening, tempering, age hardening.

Polymer chemistry: Types of polymerizations (excluding mechanisms), mechanical properties of polymers, thermoplastics, thermosets; engineering properties and applications of ABS, Bakelite; polymer processing (injection moulding, extrusion moulding, compression moulding, blown film moulding).

Elastomers: Natural rubber, vulcanization, synthetic rubbers (BUNA-S and BUNA-N).

Ceramics: Alumina, silicon carbide, silicon nitride, zirconia and applications.

Composite materials: Classification and applications.

Solid waste management: Classification, treatment, recycling relevant to manufacturing and machine-shop operations.

UNIT V: Advanced Materials & Nano chemistry [10hrs]

Carbon nanomaterials: Fullerenes, carbon nanotubes (CNTs), graphene; synthesis by chemical vapor deposition (CVD) method, sol-gel process (metal oxides nanoparticles), applications.

Nanomaterials for Mechanical Engineering: Graphene and Graphene-Based Composites, Nanocomposites for Wear and Friction Reduction High-Entropy Alloys (HEAs), Smart Materials and Shape-Memory Alloys (Definition, properties, applications).

Self-Healing Materials: Types, working, applications.

Textbooks (APA Format)

1. Jain, P. C., & Jain, M. (2020). Engineering chemistry (17th ed.). Dhanpat Rai Publishing Company.
2. Agarwal, S. (2026). Engineering chemistry (5th ed.). Cambridge University Press.

Reference Books (APA Format)

1. Davis, M. L. (2020). Water and wastewater engineering: Design principles and practice (2nd ed.). McGraw-Hill Education.
2. Shikha, A., & Sharma, R. K. (2019). Engineering chemistry. Krishna Prakashan Media.
3. Dara, S. S., & Umare, S. S. (2018). Engineering chemistry (15th ed.). S. Chand Publishing.

Web Resources (APA Format)

- Society of Tribologists and Lubrication Engineers. (n.d.). Tribology and lubrication resources. https://www.stle.org
- ASM International. (n.d.). Materials information and education. https://www.asminternational.org
- Society of Automotive Engineers. (n.d.). Automotive engineering standards. https://www.sae.org
- American Society of Mechanical Engineers. (n.d.). Mechanical engineering resources. https://www.asme.org
- National Association of Corrosion Engineers. (n.d.). Corrosion prevention and control. https://www.nace.org

B.Tech. (II Sem.)	A2620016- ELEMENTS OF ELECTRICAL & ELECTRONICS ENGINEERING (ASE, CE & ME Branches)	L	T	P	C
		3	0	0	3

Pre-requisite: NIL

Course Objectives: This course covers DC and AC circuits, electrical machines, transformers, semiconductor devices, basic electronic circuits, digital electronics, and electrical measuring instruments. It develops fundamental knowledge of electrical and electronic systems, with emphasis on circuit analysis, machine operation, electronic devices, digital logic, and practical measurement techniques.

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

CO1: Apply Ohm's law, Kirchhoff's laws, and network theorems to analyze and simplify DC electrical circuits. **(Understand)**

CO2: Analyze single-phase AC circuits using phasor concepts, impedance, and power calculations, and the basic concepts of three-phase systems. **(Understand)**

CO3: Understand the construction, operating principles, basic equations, speed-control methods, and applications of DC and AC machines. **(Understand)**

CO4: Understand the operating principles of semiconductor devices, rectifiers, Zener regulators, BJTs, and operational amplifiers. **(Understand)**

CO5: Analyze basic digital logic circuits and the operating principles and applications of common electrical measuring instruments. **(Understand)**

UNIT-I

DC Circuits and Network Theorems: Electrical circuit elements and terminology; Ohm's law; Kirchhoff's Current Law (KCL) and Voltage Law (KVL); series-parallel DC circuits; mesh and nodal analysis; Thevenin's theorem, Norton's theorem, Superposition theorem.

UNIT-II

AC Circuits: Generation of alternating EMF; peak, average, RMS values, form factor and peak factor; Voltage and current relationship with phasor diagrams in R, L, and C series circuits only, conceptof reactance and impedance, concept of power factor, active power, reactive power and apparent power. Introduction to three-phase systems; star and delta connections (line and phase relations only).

UNIT-III

Electrical Machines: Transformers: working principle, EMF equation, losses, and efficiency; DC machines: Principle of operation of DC Generator, EMF Equation; Principle of operation of DC Motor, Torque Equation, types of DC motors, speed control using flux control and armature voltage control methods; three-phase induction motor: principle of operation and applications.

UNIT-IV

Semiconductor Devices and Electronic Circuits: Semiconductor basics: intrinsic and extrinsic semiconductors; PN junction diode and its V-I characteristics; Operation of half-wave and full- wave bridge rectifiers without filters; Zener diode and voltage regulation; Operation of PNP and NPN junction transistors- CE Configuration - input and output characteristics. Operational amplifiers: inverting and non inverting amplifiers

UNIT-V

Digital Electronics and Electrical Measuring Instruments:

Overview of Number Systems, Logic gates including Universal Gates, BCD codes, Boolean Algebra, Basic Theorems and properties of Boolean Algebra, Truth Tables and Functionality of Logic Gates: NOT, OR, AND, NOR, NAND, XOR and XNOR.

Electrical measuring instruments: Operation of moving-coil and moving-iron instruments; digital multi meters, digital energy meters;

Learning Resources:

Textbooks

1. Ed Hughes, (2016), Electrical & Electronic Technology, 12th Edition, Pearson Education
2. Vincent Del Toro,(2015), Electrical Engineering Fundamentals, 2nd Edition, Pearson Education.

Reference Books

1. Mehta, V. K., & Mehta, R. (2008). Principles of electrical engineering and electronics. S. Chand Publishing.
2. Charles K. Alexander and Mathew N.O. Sadiku, (2017), Fundamentals of Electrical Circuits, (6th edition.), McGraw-Hill Education, India.

Web Resources

1. https://nptel.ac.in/courses/108105112
2. https://nptel.ac.in/courses/108101091
3. https://nptel.ac.in/courses/108105113
4. https://nptel.ac.in/courses/108105153

B.Tech. (II Sem.) **26XXX- ENGINEERING MECHANICS**

L	T	P	C
3	0	0	3

Applicable Branch(es)	Civil Engineering (CE) and Mechanical Engineering (ME)
Semester	1 / 2 (as per branch curriculum placement)
Duration	16 weeks
Pre-requisite Course(s)	Nil
Feeds Into (Higher-Semester Courses)	Strength of Materials, Machine Design, Design of Structures

1. Course Outline

1. Engineering Mechanics introduces the fundamental principles of statics and dynamics that govern the behaviour of forces, bodies, and motion in engineering systems.
2. The course covers force systems, equilibrium, friction, centroids, and moment of inertia, followed by the kinematics and kinetics of particles and rigid bodies.
3. It builds the analytical foundation required for structural and machine design, combining classical hand analysis with AI-assisted verification tools.
4. The concepts learnt here feed directly into higher-semester courses such as Strength of Materials, Machine Design, and Design of Structures.

2. Course Objectives

1. To introduce the fundamental principles of statics and dynamics applicable to engineering systems.
2. To develop the ability to analyze force systems and equilibrium conditions in structures and mechanisms.
3. To enable students to determine centroids, moments of inertia, and friction effects in engineering components.
4. To build competence in analyzing the motion of particles and rigid bodies using kinematics and kinetics.
5. To familiarize students with AI-assisted tools for solving, verifying, and visualizing mechanics problems.

3. Course Outcomes (COs)

CO	Course Outcome — Students will be able to:	Bloom's Level
CO1	Understand the basic concepts of force systems, free body diagrams, and conditions of equilibrium of rigid bodies.	Understanding-L2
CO2	Apply the principles of friction and determine centroids and moments of inertia of engineering sections.	Applying- L3
CO3	Analyze the kinematics of particles undergoing rectilinear and curvilinear motion, including projectile motion.	Analyzing-L4
CO4	Apply Newton's laws, work-energy, and impulse-momentum principles to solve kinetics problems of particles.	Applying- L3
CO5	Analyze the motion and forces on rigid bodies undergoing plane motion, including through AI-assisted simulation tools.	Analyzing-L4

4. Unit-wise Content

The course is organized into five units spanning 48 hours of lecture (L) across 16 weeks, in line with the 3-0-0 (L-T-P) structure and 3 credits assigned in Section A.

Unit I: Force Systems and Equilibrium of Rigid Bodies

Unit Title	Force Systems and Equilibrium of Rigid Bodies
Topics / Contents	• Introduction to Engineering Mechanics — basic concepts and idealizations (particle, rigid body, continuum). • Force systems: coplanar and non-coplanar, concurrent and non-concurrent forces. • Resolution and composition of forces; Principle of transmissibility. Moment of a force; Varignon's theorem; Couples. • Free body diagrams (FBD) of engineering components. Conditions of equilibrium; two-force and three-force members. • Equilibrium of coplanar force systems — graphical and analytical methods.
AI Integration with Contents	Use of AI-based symbolic solvers (e.g., Python/MATLAB with AI plug-ins, generative problem-solving assistants) to construct and verify free body diagrams and check equilibrium equations for statically indeterminate-looking systems before analytical solution.
Unit Learning Outcome(s)	Students will be able to construct free body diagrams and apply equilibrium equations to determine unknown forces and moments in simple engineering structures.
Practical Examples (In-class)	1. Analysis of forces in a cantilever bracket supporting a wall-mounted load. 2. Equilibrium analysis of a simply supported beam carrying point loads.
Exercise / Practice Problems	1. Determine the resultant of a coplanar concurrent force system acting on a bracket. 2. Find the support reactions of a simply supported beam using equilibrium equations. 3. Draw the FBD and determine member forces of a pin-jointed bracket carrying an inclined load.

Unit II: Friction, Centroids and Moment of Inertia

Unit Title	Friction, Centroids and Moment of Inertia
Topics / Contents	• Laws of friction; coefficient of friction; angle of friction and angle of repose. Friction in wedges, ladders, and belt drives. • Centroid of plane figures and composite areas — first principles and standard formulae. • Centroid of composite bodies (lines, areas, volumes). • Moment of inertia of plane areas; parallel axis and perpendicular axis theorems. • Radius of gyration; moment of inertia of composite sections.
AI Integration with Contents	Use of AI-assisted CAD/CAE tools (e.g., AI-augmented modelling software) to compute the centroid and moment of inertia of complex composite cross-sections and cross-verify results against manual analytical calculations.
Unit Learning Outcome(s)	Students will be able to determine the centroid and moment of inertia of composite engineering sections, and analyze friction effects in engineering systems.
Practical Examples	1. Friction analysis of a ladder resting against a smooth wall on a rough floor. 2. Centroid and moment of inertia determination of an I-section/channel

(In-class)	section used in structural members.
Exercise / Practice Problems	1. Determine the minimum force required to move a block up an inclined rough plane. 2. Locate the centroid of a composite lamina made of a rectangle, triangle, and semicircle. 3. Calculate the moment of inertia of a T-section about its centroidal axis.

Unit III: Kinematics of Particles

Unit Title	Kinematics of Particles
Topics / Contents	• Rectilinear motion: displacement, velocity, and acceleration. Motion under uniform and variable acceleration. • Curvilinear motion: rectangular and normal-tangential components. Projectile motion. • Relative motion of particles. • Motion (s–t, v–t, a–t) diagrams and their interpretation.
AI Integration with Contents	Use of AI-powered simulation and animation tools to visualize particle trajectories under variable acceleration and projectile motion, and to validate analytically derived motion equations.
Unit Learning Outcome(s)	Students will be able to analyze the rectilinear and curvilinear motion of particles and solve projectile-motion problems.
Practical Examples (In-class)	1. Motion analysis of a vehicle accelerating uniformly from rest. 2. Projectile motion of a ball thrown at an angle to the horizontal.
Exercise / Practice Problems	1. Determine the velocity and position of a particle moving with variable acceleration a = f(t). 2. Find the range and maximum height of a projectile launched at a given angle and velocity. 3. Plot the v–t and a–t diagrams for a given s–t motion curve and interpret the motion.

Unit IV: Kinetics of Particles

Unit Title	Kinetics of Particles
Topics / Contents	• Newton's second law of motion; equations of motion for particles. D'Alembert's principle. • Work-energy principle for particles; conservation of energy. Impulse-momentum principle; conservation of momentum. Direct central impact; coefficient of restitution.
AI Integration with Contents	Use of AI-based numerical solvers to simulate impact and collision problems and compare simulated outcomes with results obtained through the work-energy and impulse-momentum methods.
Unit Learning Outcome(s)	Students will be able to apply Newton's laws, the work-energy principle, and the impulse-momentum principle to solve kinetics problems involving particles.
Practical Examples (In-	1. Motion of a block sliding down an inclined plane under an applied force, with friction considered.

class)	2. Collision analysis of two spheres undergoing direct central impact.
Exercise / Practice Problems	1. Determine the acceleration and velocity of a block pulled up an incline using Newton's second law. 2. Solve a work-energy problem for a body moving under a variable force. 3. Determine the velocities after direct central impact of two bodies given the coefficient of restitution.

Unit V: Kinematics and Kinetics of Rigid Bodies (Plane Motion)

Unit Title	Kinematics and Kinetics of Rigid Bodies (Plane Motion)
Topics / Contents	• Types of rigid body motion: translation, rotation about a fixed axis, general plane motion. • Instantaneous centre of rotation; velocity analysis using the instantaneous centre method. • Relative velocity and relative acceleration methods for plane motion. D'Alembert's principle applied to rigid bodies; equations of motion for plane motion. • Introduction to the principle of virtual work and its application to the equilibrium of mechanisms.
AI Integration with Contents	Use of AI-driven mechanism-simulation software to model rigid-body plane motion (linkages, wheels) and verify velocity/acceleration diagrams constructed manually.
Unit Learning Outcome(s)	Students will be able to analyze the plane motion of rigid bodies and apply the principle of virtual work to the equilibrium of simple mechanisms.
Practical Examples (In-class)	1. Velocity analysis of a four-bar mechanism using the instantaneous centre method. 2. Rolling-without-slipping motion analysis of a wheel/cylinder on an inclined plane.
Exercise / Practice Problems	1. Locate the instantaneous centre of rotation of a rigid link and determine the velocity of a given point. 2. Determine the acceleration of the centre of a cylinder rolling without slipping down an incline. 3. Apply the principle of virtual work to determine the equilibrium configuration of a simple mechanism.

5. Textbooks, Reference Books and Web Resources

Textbooks

1. Hibbeler, R. C. (2016). Engineering mechanics: Statics and dynamics (14th ed.). Pearson.
2. Shames, I. H., & Rao, G. K. M. (2006). Engineering mechanics: Statics and dynamics (4th ed.). Pearson Education.
3. Bhavikatti, S. S. (2016). Engineering mechanics (4th ed.). New Age International Publishers.

Reference Books

1. Beer, F. P., Johnston, E. R., Mazurek, D. F., & Cornwell, P. J. (2019). Vector mechanics for engineers: Statics and dynamics (11th ed.). McGraw-Hill Education.
2. Rajasekaran, S., & Sankarasubramanian, G. (2015). Engineering mechanics: Statics and dynamics (3rd ed.). Vikas Publishing House.

3. Timoshenko, S., & Young, D. H. (1956). Engineering mechanics. McGraw-Hill.

Web Resources

1. National Programme on Technology Enhanced Learning. (n.d.). Engineering mechanics [Video lecture series]. NPTEL. https://nptel.ac.in
2. Massachusetts Institute of Technology. (n.d.). Engineering mechanics I. MIT Open Course Ware. https://ocw.mit.edu
3. Khan Academy. (n.d.). Forces and Newton's laws of motion. https://www.khanacademy.org

CO–PO / PSO Mapping (NBA / ABET Format)

Mapping strength scale: 3 = Substantial (High), 2 = Moderate, 1 = Slight (Low), – = No correlation.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	1	-	-	-	1	1	-	2	2	1
CO2	3	2	3	2	1	-	1	-	1	1	-	2	3	1
CO3	3	3	2	1	1	-	-	-	1	1	-	2	2	1
CO4	3	2	3	2	2	-	1	-	1	1	-	2	3	2
CO5	2	3	3	2	3	-	1	-	2	2	1	3	3	3

ABET Student Outcome (SO) cross-reference: CO1–CO3 map primarily to SO1 (ability to identify, formulate, and solve engineering problems); CO4 maps to SO1 and SO2 (design/development of solutions); CO5 maps to SO1 and SO6 (ability to develop and conduct experiments/analyze data, supported by AI-based simulation).

Project Ideas

1. Design and analysis of a truss bridge model, with force distribution verified using free body diagrams and equilibrium equations.
2. Development of an AI-assisted mechanism simulator for velocity and acceleration analysis of planar linkages.
3. Experimental determination of the coefficient of friction and coefficient of restitution for different material pairs, with software-based validation.
4. Design of a projectile-launching device and comparison of theoretical versus AI/video-tracked experimental trajectories.
5. Development of a centroid and moment-of-inertia calculator for composite structural sections, cross-verified using AI-assisted CAD tools.

Practical Applications

1. Structural design and analysis of trusses, beams, and frames in civil engineering construction (CE).
2. Design and dynamic balancing of machine components such as flywheels, cams, and linkages (ME).
3. Stability analysis of retaining walls, dams, and slopes under friction and equilibrium principles (CE).
4. Motion analysis and design of robotic arms, manipulators, and mechanical linkage systems (ME).
5. Impact and vibration analysis in structural and mechanical systems, e.g., pile driving, vehicle collision, and machine foundations (CE/ME)

L	T	P	C
0	0	3	1.5

B.Tech. (II Sem.)

26XXX- CHEMISTRY FOR MECHANICAL SYSTEMS LAB

(For Mechanical and Allied Branches of Engineering)

Pre-requisite: Concurrent with Chemistry for Mechanical systems (Theory).

Course Objectives:

- To determine the thermal and physical properties of fuels and lubricating oils (calorific value, flash/fire point, viscosity, viscosity index, acid value, saponification value) relevant to engineering applications.
- To familiarize students with electroanalytical techniques (conductometry, potentiometry) for acid-base and redox titrations.
- To develop skills in evaluating corrosion behaviour of metals and determining electroplated coating thickness.
- To introduce photocatalytic degradation as a chemistry-based technique for environmental remediation of dye pollutants.

Course Outcomes (COs)

After successful completion of the course, the student will be able to:

CO	Course Outcome Statement	Knowledge Level (K)#
CO1	Determine the calorific value, viscosity, and flash/fire point of fuels and lubricating oils using bomb calorimeter, Ostwald/Redwood viscometer, and Pensky-Martens apparatus.	**K3** (Apply)
CO2	Perform quantitative analysis of resin, fuel and construction material quality — proximate analysis of coal, iron content in cement, and acid/saponification value of lubricants.	**K3** (Apply)
CO3	Apply electroanalytical techniques (conductometry, potentiometry, pH-metry) to determine concentration, acid strength, and battery electrolyte characteristics.	**K3** (Apply)
CO4	Conduct experiments safely following laboratory protocols, and record, interpret and report data working individually and in teams	**K3** (Apply)
CO5	Conduct experiments safely following laboratory protocols, and record, interpret and report data working individually and in teams.	**K3** (Apply)

Mapping of course outcomes with program outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	L	H	H	-	M	-	M	L	M
CO2	H	M	L	H	H	M	M	-	M	L	M
CO3	H	M	L	H	H	-	L	-	M	L	M
CO4	H	M	L	H	H	M	M	-	M	L	M
CO5	H	H	H	H	H	H	M	M	M	L	M

Scale: H - Strong | M - Moderate | L - Slight | - No Correlation.

LIST OF EXPERIMENTS

(Any **TEN** of the following listed experiments)

(Out of which any **TWO** experiments may be conducted in virtual mode)

1. Determination of the calorific value of a solid/liquid fuel using a bomb calorimeter.
2. Preparation and observation of colloidal gold / silver nanoparticles (size-dependent colour-change).
3. Determination of the viscosity of a polymer / nanomaterial-dispersion solution using an Ostwald viscometer.
4. Determination of the flash point and fire point of a lubricating oil using a Pensky-Martens / Abel apparatus.
5. Determination of a strong acid against a strong base by using conductometer.
6. Determination of the corrosion rate of a mild-steel specimen by the weight-loss method.
7. Study of galvanic corrosion using a zinc-iron electrochemical couple.
8. Determination of percentage of iron in cement sample by colorimeter
9. Preparation and study of a urea-formaldehyde / phenol-formaldehyde resin sample.
10. Determination of the thickness of an electroplated coating (copper / nickel) using Faraday's law.
11. Proximate analysis of a coal sample-determination of moisture, volatile matter, ash and fixed carbon. (Demo Experiment).
12. Determination of the viscosity and viscosity index of a lubricating oil using a Redwood viscometer.
13. Determination of the acid value of a lubricating oil.
14. Determination of the saponification value of a lubricating oil. (Virtual Lab).
15. Photocatalytic degradation of dye.
16. Redox titration by using potentiometer.
17. Determination of strength of an acid in Pb-Acid battery.
18. Determination of pH of water and soil samples using a pH meter.

References:

- Vogel, A. I. (2012). Vogel's textbook of quantitative chemical analysis (6th ed.). Pearson Education.
- Ahluwalia, V. K., & Dhingra, S. (2017). Comprehensive practical organic chemistry. Universities Press.
- Virtual Labs, Ministry of Education, Government of India. https://vlab.co.in

B.Tech. (II Sem.)	A2620020- ELEMENTS OF ELECTRICAL & ELECTRONICS ENGINEERING LAB (ASE, CE & ME Branches)	L	T	P	C
		0	0	3	1.5

Pre-requisite: NIL

Course Objectives: This laboratory course develops practical skills in DC and AC circuit measurements, verification of Kirchhoff's laws and network theorems, mesh and nodal analysis, DC-shunt-motor speed control, diode and Zener-diode characteristics, rectifier circuits, BJT CE characteristics, and digital logic gates.

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

CO1: Apply electrical measuring instruments and circuit analysis methods to measure electrical quantities and verify circuit laws, theorems, mesh, and nodal analysis. **(Apply)**

CO2: Analyze the speed-control methods of DC shunt motor and analyze the characteristics of PN junction and Zener diodes. **(Apply)**

CO3: Analyze the operation of rectifier and transistor circuits, and basic & universal digital logic gates. **(Apply)**

List of Experiments

(Any 10 of the following experiments are to be conducted)

1. Verification of Kirchhoff's Laws in a DC circuit.
2. Measurement of voltage, current, and power in a DC circuit.
3. Measurement of voltage, current, power and power factor in a AC circuit.
4. Verification of Superposition theorem for a linear DC network containing multiple independent sources.
5. Measurement of voltages and currents using mesh and nodal analysis in a circuit.
6. Verification of Thevenin's theorem and determine its equivalent parameters.
7. Verification of Norton's theorem and determine its equivalent parameters.
8. Speed control of DC shunt motor using armature voltage method.
9. Speed control of DC shunt motor using field control method.
10. Investigate the characteristics of a Zener Diode as voltage regulator.
11. Plot the V-I characteristics of a PN junction diode.
12. Analyze the Input and Output waveforms of Half-Wave Rectifier.
13. Analyze the Input and Output waveforms of Full-Wave Rectifier.
14. Analyze the Input and Output characteristics of BJT in CE configuration.
15. Investigate logic behaviour of AND, OR, NAND, NOR, EX-OR and universal NAND gates.

Learning Resources:

Textbooks

1. Ed Hughes, (2016), Electrical & Electronic Technology, 12th Edition, Pearson Education
2. Vincent Del Toro,(2015), Electrical Engineering Fundamentals, 2nd Edition, Pearson Education.

Reference Books

1. Mehta, V. K., & Mehta, R. (2008). Principles of electrical engineering and electronics. S. Chand Publishing.
2. Charles K. Alexander and Mathew N.O. Sadiku, (2017), Fundamentals of Electrical Circuits, (6th edition.), McGraw-Hill Education, India.

Web Resources

1. https://bes-iitr.vlabs.ac.in/List%20of%20experiments.html
2. https://be-iitkgp.vlabs.ac.in/List%20of%20experiments.html

B.Tech. (II Sem.) **26XXX- ENGINEERING MECHANICS LAB**

L	T	P	C
0	0	3	1.5

Course Objectives: The students completing the course are expected to:

- Verify the Law of Parallelogram and Triangle of Forces.
- Determine the coefficients of friction of Static and Rolling friction and Centre of gravity of different plane Lamina.
- Analyse the system of Pulleys and Moment of Inertia of Compound Pendulum and Flywheel.

Course Outcomes:

CO's	CO Statements	BTL
CO1:	Determine the coefficient of friction between two different surfaces and between the inclined plane and the roller.	Applying-L3
CO2:	Verify Law of Polygon of forces and Law of Moment using force polygon and bell crank lever.	Applying-L3
CO3:	Determine the Centre of gravity and Moment of Inertia of different configurations.	Applying-L3
CO4:	Verify the equilibrium conditions of a rigid body under the action of different force systems.	Applying-L3

Students have to perform any 10 of the following Experiments:

List of Experiments:

1. Verification of Law of Parallelogram of Forces.
2. Verification of Law of Triangle of Forces.
3. Verification of the Law of polygon for coplanar-concurrent forces acting on a particle in equilibrium and to find the value of unknown forces considering particle to be in equilibrium using universal force table.
4. Determination of coefficient of Static and Rolling Frictions
5. Determination of Centre of Gravity of different shaped Plane Lamina.
6. Verification of the conditions of equilibrium of a rigid body under the action of coplanar non-concurrent, parallel force system with the help of a simply supported beam.
7. Study of the systems of pulleys and draw the free body diagram of the system.
8. Determine the acceleration due to gravity using a compound pendulum.
9. Determine the Moment of Inertia of the compound pendulum about an axis perpendicular to the plane of oscillation and passing through its centre of mass.
10. Determine the Moment of Inertia of a Flywheel.
11. Verification of Law of Moment using Rotation Disc Apparatus and Bell Crank Lever.

References:

1. S. Timoshenko, D. H. Young, J.V. Rao, S. Pati., Engineering Mechanics, 5th Edition, McGraw Hill Education.
2. Hibbeler R.C., Engineering Mechanics: Statics and Dynamics, 14th Edition, Pearson Education, Inc., New Delhi, 2022

B.Tech. (II Sem.) **26XXX- DESIGN THINKING & INNOVATION**

L	T	P	C
0	1	3	2.5

Course Philosophy

The course should progress through:

Understand People → Define Problems → Generate Ideas → Create & Validate Solutions → Innovate & Communicate Value

This is preferable to simply teaching the five conventional Design Thinking stages because the final unit explicitly takes students from a **prototype to an innovation opportunity**.

Course Objectives: At the end of the course, the teacher should be able to:

- Introduce students to the principles, mindset and methodologies of **Design Thinking and human-centered problem solving**.
- Develop students' ability to **observe, empathize, analyze user needs and formulate well-defined engineering and societal problems**.
- Develop students' **creative and innovative thinking abilities** through systematic ideation, concept generation and evaluation techniques.
- Enable students to **develop, prototype, test and iteratively improve solutions** using user feedback and appropriate physical/digital tools.
- Develop students' ability to **identify innovation opportunities, create value propositions, understand basic IPR and communicate innovative solutions effectively**.

Course Outcomes:

1. Explain the principles, processes and mindset of Design Thinking for engineering problem-solving and innovation (K2)
2. Apply empathy, observation and problem-framing techniques to identify user needs and define engineering problems (K3)
3. Apply creative and systematic ideation techniques to generate and select innovative solution concepts (K3)
4. Analyze solution concepts and prototypes using user feedback and appropriate design criteria for iterative improvement (K4)
5. Analyze the innovation potential of solutions considering value proposition, feasibility, sustainability, societal impact and basic IPR aspects (K4)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	M	L	–	–	L	–	–	L	L	M
CO2	M	H	H	L	L	H	M	L	M	M	M
CO3	L	M	H	L	M	L	L	–	H	M	M
CO4	H	H	H	M	H	M	M	L	H	M	M
CO5	L	M	H	L	M	H	H	M	M	H	H

UNIT I — Design Thinking Foundations & Empathy

Introduction to Design Thinking ; Design thinking mindset and principles ; Design thinking vs. conventional engineering problem-solving ; Human-centered design ; Five-stage design thinking process ; Creativity, curiosity and observation ; Understanding users and stakeholders ; Empathy and user research ; Interviews, observation and contextual inquiry ; Empathy mapping ; Personas and user journeys ; Identifying explicit and latent/unarticulated needs ; Ethical considerations in user research

Practical Activities

- Observation of a real-life problem
- Conducting user interviews
- Preparing an empathy map
- Developing a persona

- Preparing a user journey map

Unit Outcome

Students will be able to **understand users, identify their needs and translate observations into meaningful design opportunities**.

UNIT II — Problem Definition, Analysis & Opportunity Identification

From observations to insights ; Data synthesis and affinity mapping ; Identifying patterns and pain points ; Problem statements ; Point-of-View (POV) statements ; "How Might We" (HMW) questions ; Stakeholder mapping ; 5 Whys and root-cause analysis ; Problem prioritization ; Need–Opportunity mapping ; Problem validation ; Design constraints and specifications ; Social, environmental and sustainability considerations ; Identifying opportunities for innovation

Practical Activities

- Affinity mapping of interview data
- Develop three alternative problem statements
- Prepare POV and HMW statements
- Stakeholder map
- Root-cause analysis
- Select and validate one problem/opportunity

Unit Outcome

Students will be able to **analyze user research, identify root causes, frame well-defined problems and recognize opportunities for innovative solutions**.

UNIT III — Creativity, Ideation & Concept Development

Creativity and innovation mindset; Divergent and convergent thinking ; Brainstorming and brainwriting ; SCAMPER ; Mind mapping ; Reverse brainstorming ; Analogical thinking ; Biomimicry ; Lateral thinking ; Forced connections ; Morphological analysis ; TRIZ — basic principles ; Individual and collaborative ideation ; AI-assisted ideation: opportunities and limitations ; Idea clustering and screening ; Impact–feasibility matrix ; Concept selection ; Design criteria and decision matrix

Practical Activities

- Generate 20–30 ideas for a selected problem
- SCAMPER exercise
- Brainwriting exercise
- Biomimicry-based ideation
- AI-assisted idea generation and critical evaluation
- Prepare an idea-selection matrix
- Select the top 2–3 concepts

Unit Outcome

Students will be able to **generate diverse solution concepts using creative techniques and systematically select promising ideas based on defined criteria**.

UNIT IV — Prototyping, Experimentation & Validation

Concept development ; Prototype mindset ; Types of prototypes: Paper prototype, Physical prototype, Digital prototype, Storyboard, Role-play, Service prototype ; Low-fidelity and high-fidelity prototypes ; Rapid prototyping ; "Fail fast, learn fast" ; Minimum Viable Prototype (MVP) ; Design experimentation ; Prototype evaluation ; User testing ; Think-aloud method ; Feedback collection ; Usability and functionality testing; Iterative design ; Design critique ; Documentation of iterations ; Use of CAD, simulation and AI-assisted visualization tools

Practical Activities

- Develop a low-fidelity prototype
- Prepare a storyboard
- Build a physical/digital prototype
- Conduct user testing
- Collect structured feedback

- Modify the prototype
- Prepare an iteration log

UNIT V — Innovation, Value Creation & Communication

Innovation: meaning, characteristics and importance: Invention vs. innovation ; Incremental, disruptive and radical innovation ; Product, process, service and social innovation ; Technology-driven vs. need-driven innovation ; Sustainable and frugal innovation ; Innovation opportunities and emerging technologies ; From prototype to innovation ; Desirability, feasibility and viability ; Value Proposition ; Value Proposition Canvas ; Introduction to Business Model Canvas ; Customer segments and stakeholder value; Innovation validation; Market/user validation ; Intellectual Property Rights — introduction; Patents, copyright, trademarks and design protection ; Responsible innovation ; Inclusive and sustainable innovation ; Innovation ecosystem and entrepreneurship ; Communicating innovative ideas ; Innovation pitch

Practical Activities

1. Classify existing products/services as incremental, disruptive or radical innovations.
2. Identify three innovation opportunities from a campus/community problem.
3. Prepare a **Value Proposition Canvas**.
4. Validate the proposed innovation with potential users.
5. Prepare an introductory **Business Model Canvas**.
6. Identify possible IPR protection.
7. Prepare and deliver a **3-minute Innovation Pitch**.

Learning Resources:

Textbook:

1. Chandan Adhikari, Prabir Kumar Das & Tanay Pramanik, Textbook of Design Thinking and Innovation, S. Chand Publishing, 2026.
2. Shalini Rahul Tiwari & Rohit Rajendra Swarup, Design Thinking: A Comprehensive Textbook, Wiley India, 2024

Reference Books:

1. Soni, Pavan, Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-Solving, Penguin Random House India.
2. Jauhari, Vinnie & Sudhanshu Bhushan, Innovation Management, Oxford University Press India.

Web Resources:

1. Atal Innovation Mission, NITI Aayog – Innovation and Design Thinking Resources. https://aim.gov.in/
2. Institution's Innovation Council (IIC), Ministry of Education, Government of India, https://iic.mic.gov.in/
3. Startup India, Government of India – Innovation and Entrepreneurship Ecosystem, https://www.startupindia.gov.in/
4. National Innovation Foundation – India – Grassroots and Frugal Innovation, https://nif.org.in/
5. Stanford d.school – Design Thinking Bootleg and Design Thinking Resources, https://dschool.stanford.edu/resources/design-thinking-bootleg
6. IDEO.org – Human-Centered Design and Social Innovation Resources, https://www.ideo.org/
7. IDEO U – Design Thinking and Innovation Resources, https://www.ideou.com/pages/design-thinking

8. NPTEL – Online Courses on Design, Innovation, Creativity and Entrepreneurship, https://nptel.ac.in/
9. SWAYAM – Online Courses on Innovation, Entrepreneurship and Design Thinking, https://swayam.gov.in/

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B.Tech. (II Sem.) **26XXX- WORKSHOP PRACTICE**

Course Objectives

The course aims to:

1. Familiarize students with workshop tools, equipment, materials, and safety practices used in basic engineering activities.
2. Develop hands-on skills in wood working, sheet metal working, fitting, foundry, welding, and plumbing operations.
2. Provide practical experience in basic electrical wiring, soldering, and electrical circuit connections.
3. Introduce students to basic tinkering, sensors, actuators, microcontrollers, and IoT applications.
4. Develop students' practical problem-solving, fabrication, assembly, maintenance, and troubleshooting skills through hands-on activities.

Course Outcomes

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

CO's	CO Statements	BTL
CO1:	Identify and safely use common workshop tools, equipment, materials, and measuring instruments.	Understanding-L2
CO2:	Perform basic fabrication and manufacturing operations using carpentry, sheet metal, fitting, foundry, welding, and plumbing techniques.	Understanding-L2
CO3:	Apply basic workshop skills for assembling, maintaining, and repairing simple engineering components and systems.	Applying-L3
CO4:	Perform basic electrical wiring, circuit connections, soldering, and testing using appropriate electrical practices.	Understanding-L2
CO5:	Develop simple sensor-, actuator-, microcontroller-, and IoT-based applications through tinkering and hands-on experimentation.	Analyzing-L4

SYLLABUS

1. Demonstration: Safety practices and precautions to be observed in workshop.
2. Wood Working: Familiarity with different types of wood and tools used in wood working and make following joints.
   a) Half – Lap joint b) Mortise and Tenon joint c) Corner Dovetail joint or Bridle joint
3. Sheet Metal Working: Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets.
   a) Tapered tray b) Conical funnel c) Elbow pipe d) Brazing
4. Fitting: Familiarity with different types of tools used in fitting and do the following fitting exercises.
   a) V-fit b) Dovetail fit c) Semi-circular fit
5. Electrical Wiring: Familiarity with different types of basic electrical circuits and make the following connections.
   a) Parallel and series b) Two-way switch c) Godown lighting d) Soldering of wires.
6. Foundry Trade: Demonstration and practice on Moulding tools and processes, Preparation of Green Sand Moulds for given Patterns.
7. Welding Shop: Demonstration and practice on GTAW. Preparation of Lap joint and Butt joint.

8. Plumbing: Demonstration and practice of Plumbing tools, Preparation of Pipe joints with coupling for same diameter and with reducer for different diameters.
9. Assembly and dis assembly of Two-wheeler electric vehicle.
10. Tinkering Lab experiments:
    a) Build and demonstrate automatic street light using LDR.
    b) Simulate the AURDINO LED blinking activity in Tinkercad
    c) Interface a basic sensor and actuator with a microcontroller.

Textbooks:

1. Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published,2019. Workshop Processes, Practices and Materials; Bruce J. Black, Routledge publishers, 5th Edn. 2015.
2. A Course in Workshop Technology Vol I. & II, B.S. Raghuwanshi, Dhanpath Rai & Co., 2015 & 2017.

Reference Books:

1. Elements of Workshop Technology, Vol. I by S. K. Hajra Choudhury & Others, Media Promoters and Publishers, Mumbai. 2007, 14th edition
2. Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.
3. Wiring Estimating, Costing and Contracting; Soni P.M. & Upadhyay P.A.; Atul Prakashan, 2021-22.
4. https://aim.gov.in/pdf/equipment-manual-pdf.pdf - For Tinkering Lab

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B.Tech. (II Sem.) **A2620013- SPORTS AND YOGA OR NSS/NCC**

(Common to All branches of Engineering)

Course Objectives:

The main objective of introducing this course is to make the students maintain their mental and physical wellness by balancing emotions in their life. It mainly enhances the essential traits required for the development of the personality.

Course Outcomes: After completion of the course the student will be able to

CO1: Understand the importance of yoga and sports for Physical fitness and sound health. **(Understand)**

CO2: Demonstrate an understanding of health-related fitness components. **(Apply)**

CO3: Compare and contrast various activities that help enhance their health.**(Understand)**

CO4: Assess current personal fitness levels. **(Apply)**

CO5: Develop Positive Personality **(Apply)**

UNIT I

Concept of health and fitness, Nutrition and Balanced diet, basic concept of immunity Relationship between diet and fitness, Globalization and its impact on health, Body Mass Index(BMI) of all age groups.

Activities:

i) Organizing health awareness programmes in community
ii) Preparation of health profile
iii) Preparation of chart for balance diet for all age groups

UNIT II

Concept of yoga, need for and importance of yoga, origin and history of yoga in Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and meditation, stress management and yoga, Mental health and yoga practice.

Activities:

Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar

UNIT III

Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and Modern Olympics, Asian games and Commonwealth games.

Activities:

i) Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc. Practicing general and specific warm up, aerobics
ii) Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping andrunning.

Reference Books:

1. Gordon Edlin, Eric Golanty. Health and Wellness, 14th Edn. Jones & Bartlett Learning,2022
2. T.K.V.Desikachar. The Heart of Yoga: Developing a Personal Practice
3. Archie J.Bahm. Yoga Sutras of Patanjali, Jain Publishing Company, 1993
4. Wiseman, John Lofty, SAS Survival Handbook: The Ultimate Guide to Surviving Anywhere Third Edition, William Morrow Paperbacks, 2014
5. The Sports Rules Book/ Human Kinetics with Thomas Hanlon. -- 3rd ed. Human Kinetics, Inc.2014.