ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
B.TECH- MECHANICAL ENGINEERING (ME)
COURSE STRUCTURE AK26 REGULATION
(Effective for the batches admitted in 2026-27)

INDUCTION PROGRAM (3weeks Duration)

S. No	Course Name	Category	L-T-P-C
1	Physical Activities--Sports, Yoga and Meditation, Plantation	MC	0-0-6-0
2	Career Counseling	MC	2-0-2-0
3	Orientation to all branches –career options, tools, etc.	MC	3-0-0-0
4	Orientation on admitted Branch—corresponding labs, tools and platforms	EC	2-0-3-0
5	Proficiency Modules & Productivity Tools	ES	2-1-2-0
6	Assessment on basic aptitude and mathematical skills	MC	2-0-3-0
7	Remedial Training in Foundation Courses	MC	2-1-2-0
8	Human Values & Professional Ethics	MC	3-0-0-0
9	Communication Skills –focus on Listening, Speaking, Reading, Writing skills	BS	2-1-2-0
10	Concepts of Programming	ES	2-0-2-0

Semester I (First year)

Sl. No.	Category	Course Code	Course Title	Hours per week					Credits	CIE	SEE	Total
				L	T	Pr	P	SQC /CLC	C			
1	BS	26ABS990303	Physics for Mechanical Systems	2	0	2	0	1	3	30	70	100
2	BS	26ABS9901	Linear Algebra and Calculus	3	0	2	0	1	4	30	70	100
3	ES	26AES0301	Design Thinking	1	0	4	0	1	3	30	70	100
4	ES	26AES0501	Computational Thinking and Problem Solving with Python	2	0	2	0	1	3	30	70	100
5	ES	26AES3301	AI Tools and Applications	1	0	4	0	1	3	30	70	100
6	ES	26AES0302	Engineering Workshop	0	0	0	3	0	1.5	30	70	100
7	BS	26ABS990403	Physics Lab for Mechanical Engineers	0	0	0	3	0	1.5	30	70	100
8	ES	26AES0502	Computational Thinking and Problem Solving with Python Lab	0	0	0	3	0	1.5	30	70	100
9	HM	26AHM9904	NSS/NCC/Scouts and Guides / Community Service	0	0	0	1	0	0.5	50	-	50
			Total	**9**	**0**	**14**	**10**	**5**	**21**	**290**	**560**	**850**

L : Lecture SQC : Student Quality Control
T : Tutorial CLC : Collaborative Learning Class
Pr : Practice P : Practical

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Semester II (First year)

Sl. No.	Category	Course Code	Course Title	Hours per week					Credits	CIE	SEE	Total
				L	T	Pr	P	SQC /CLC	C			
1	HM	26AHM9901	Communicative English	2	0	0	0	1	2	30	70	100
2	BS	26ABS990503	Applied Chemistry for Mechanical Engineers	2	0	2	0	1	3	30	70	100
3	BS	26ABS9902	Differential Equations and Vector Calculus	3	0	2	0	1	4	30	70	100
4	PC	26APC0101	**Professional core 1** Engineering Mechanics	2	0	2	0	1	3	30	70	100
5	ES	256AES0303	Engineering Graphics	1	0	4	0	0	3	30	70	100
6	PC	26APC0301	Basic Simulation Lab	0	0	0	2	0	1	30	70	100
7	BS	26ABS990603	Applied Chemistry for Mechanical Engineers Lab	0	0	0	3	0	1.5	30	70	100
8	HM	26AHM9902	Communicative English Lab	0	0	0	2	0	1	30	70	100
9	HM	26AHM9903	Health and wellness, Yoga and Sports	0	0	0	1	0	0.5	50	-	50
10	MC	26AMC3601	Cybersecurity Awareness for Engineers	2	0	0	0	0	0	30	-	30
			Total	**12**	**0**	**10**	**8**	**4**	**19**	**320**	**560**	**880**

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Semester III (Second year)

Sl. No.	Category	Course Code	Course Title	Hours per week					Credits	CIE	SEE	Total
				L	T / CLC	Pr	P	SQC /CLC	C			
1			Probability and Statistics	2	0	2	0	1	3	30	70	100
2			Universal Human Values – Understanding Harmony and Ethical Human Conduct	3	0	0	0	1	3	30	-	30
3			Managerial Economics and Financial Analysis	2	0	0	0	1	2	30	70	100
4			Digital Logic and Computer Organization	3	0	0	0	1	3	30	70	100
5			**Professional Core - II**	3	0	0	0	1	3	30	70	100
6			**Professional Core - III**	3	0	0	0	1	3	30	70	100
7			Digital Logic and Computer Organization Lab	0	0	0	2	0	1	30	70	100
8			**Professional Core - II Lab**	0	0	0	3	0	1.5	30	70	100
9			**Professional Core - III Lab**	0	0	0	3	0	1.5	30	70	100
10			**Skill Enhancement Course I**	1	0	0	2	0	2	30	70	100
11			Environmental Science	2	0	0	0	0	0	30	-	30
			Total	**19**	**00**	**02**	**10**	**06**	**23**	**330**	**630**	**960**

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Semester IV (Second year)

Sl. No.	Category	Course Code	Course Title	Hours per week					Credits	CIE	SEE	Total
				L	T / CLC	Pr	P	SQC /CLC	C			
1			Biology for Engineers	2	0	0	0	1	2	30	-	30
2			Sustainability and Green Engineering	2	0	0	0	1	2	30	70	100
3			**Professional Core - IV**	3	0	0	0	1	3	30	70	100
4			**Professional Core - V**	3	0	0	0	1	3	30	70	100
5			**Professional Core - VI**	2	0	2	0	1	3	30	70	100
6			**Professional Core - VII**	2	0	2	0	1	3	30	70	100
7			**Professional Core - IVLab**	0	0	0	3	0	1.5	30	70	100
8			**Professional Core - VLab**	0	0	0	3	0	1.5	30	70	100
9			**Skill Enhancement course - II**	1	0	0	2	0	2	30	70	100
10			Technical Paper Writing & IPR	2	0	0	0	0	0	30	-	30
			Total	**17**	**00**	**04**	**08**	**06**	**21**	**300**	**560**	**860**
		Mandatory Community Service Project Internship of 08 weeks duration during summer vacation										

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
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Course structure for Four Year Regular B.Tech. Degree Program
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MECHANICAL ENGINEERING (ME)

INDUCTION PROGRAMME

S. No	Course Name	Category	L-T-P-C
1	Physical Activities--Sports, Yoga and Meditation, Plantation	MC	0-0-6-0
2	Career Counselling	MC	2-0-2-0
3	Orientation to all branches –career options, tools, etc.	MC	3-0-0-0
4	Orientation on admitted Branch—corresponding labs, tools and platforms	EC	2-0-3-0
5	Proficiency Modules & Productivity Tools	ES	2-1-2-0
6	Assessment on basic aptitude and mathematical skills	MC	2-0-3-0
7	Remedial Training in Foundation Courses	MC	2-1-2-0
8	Human Values & Professional Ethics	MC	3-0-0-0
9	Communication Skills –focus on Listening, Speaking, Reading, Writing skills	BS	2-1-2-0
10	Concepts of Programming	ES	2-0-2-0

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MECHANICAL ENGINEERING (ME)

B. Tech – I Year I Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits	CIE	SEE	Total
				L	T	Pr/CLC	P	C			
1	BS	26ABS990303	Physics for Mechanical Engineers	2	0	2	0	3	30	70	100
2	BS	26ABS9901	Linear Algebra and Calculus	3	0	2	0	4	30	70	100
3	ES	26AES0301	Design Thinking	1	0	4	0	3	30	70	100
4	ES	26AES0501	Computational Thinking and Problem Solving with Python	2	0	2	0	3	30	70	100
5	ES	26AES3301	AI Tools and Applications	1	0	4	0	3	30	70	100
6	ES	26AES0302	Engineering Workshop	0	0	0	3	1.5	30	70	100
7	BS	26ABS990403	Physics Lab for Mechanical Engineers	0	0	0	3	1.5	30	70	100
8	ES	26AES0502	Computational Thinking and Problem Solving with Python Lab	0	0	0	3	1.5	30	70	100
9	ES	26AHM9904	NSS/NCC/Scouts and Guides / Community Service	0	0	0	1	0.5	50	-	50
			Total	**9**	**0**	**14**	**10**	**21**	**290**	**560**	**850**

B. Tech – I Year II Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits	CIE	SEE	Total
				L	T	Pr/CLC	P	C			
1	HM	26AHM9901	Communicative English	2	0	0	0	2	30	70	100
2	BS	26ABS990503	Applied Chemistry for Mechanical Engineers	2	0	2	0	3	30	70	100
3	BS	26ABS9902	Differential Equations and Vector Calculus	3	0	2	0	4	30	70	100
4	PC	26APC0101	**Professional core – I** •Engineering Mechanics	2	0	2	0	3	30	70	100
5	ES	26AES0303	Engineering Graphics	1	0	4	0	3	30	70	100
6	PC	26APC0301	**Department Specific Workshop** •Basic Simulation Lab	0	0	0	2	1	30	70	100
7	BS	26ABS990603	Applied Chemistry for Mechanical Engineers Lab	0	0	0	3	1.5	30	70	100
8	HM	26AHM9902	Communicative English Lab	0	0	0	2	1	30	70	100
9	HM	26AHM9903	Health and wellness, Yoga and Sports	0	0	0	1	0.5	50	-	50
10	MC	26AMC3601	Cyber security Awareness for Engineers	2	0	0	0	0	30	-	30
			Total	**12**	**0**	**10**	**8**	**19**	**320**	**560**	**880**

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MECHANICAL ENGINEERING (ME)

B. Tech – I Year I Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits	CIE	SEE	Total
				L	T	Pr/CLC	P	C			
1	BS	26ABS990303	Physics for Mechanical Engineers	2	0	2	0	3	30	70	100
2	BS	26ABS9901	Linear Algebra and Calculus	3	0	2	0	4	30	70	100
3	ES	26AES0301	Design Thinking	1	0	4	0	3	30	70	100
4	ES	26AES0501	Computational Thinking and Problem Solving with Python	2	0	2	0	3	30	70	100
5	ES	26AES3301	AI Tools and Applications	1	0	4	0	3	30	70	100
6	ES	26AES0302	Engineering Workshop	0	0	0	3	1.5	30	70	100
7	BS	26ABS990403	Physics Lab for Mechanical Engineers	0	0	0	3	1.5	30	70	100
8	ES	26AES0502	Computational Thinking and Problem Solving with Python Lab	0	0	0	3	1.5	30	70	100
9	ES	26AHM9904	NSS/NCC/Scouts and Guides / Community Service	0	0	0	1	0.5	50	-	50
			Total	**9**	**0**	**12**	**10**	**21**	**290**	**560**	**850**

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
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Course structure for Four Year Regular B.Tech. Degree Program
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MECHANICAL ENGINEERING (ME)

PHYSICS FOR MECHANICAL ENGINEERS(Mechanical Engg.)

(AI Integrated)

Course Code	Year/Sem	L	T	Pr	P	Credits
26ABS990303	I Year I Sem	2	0	2	0	3

Prerequisites: Engineering Mechanics, Engineering Mathematics, Basic Physics

Course Outcomes (COs)

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

CO	Course Outcome Statement	Bloom's Level
CO1	Analyze the intensity variation of light due to interference, diffraction and polarization along with basic AI-assisted optical analysis in engineering applications.	L4 (Analyze)
CO2	Analyze the characteristics of crystal structures & X-Ray diffraction along with AI- assisted analysis techniques in engineering materials.	L4 (Analyze)
CO3	Apply the concepts of quantum mechanics and computing for quantum applications along with AI-assisted quantum simulations..	L3 (Apply)
CO4	Analyze the concept of oscillations and Laser based metrology for Engineering Applications along with AI- assisted methods .	L4 (Analyze)
CO5	Analyze ultrasonics and non destructive testing techniques for engineering applications along with basic AI- assisted defect detection approaches.	L4 (Analyze)

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Analyze	The intensity variation of light due to interference, diffraction and polarization		along with basic AI-assisted optical analysis in engineering applications	L4
2	Analyze	The characteristics of crystal structures & X-Ray diffraction along		along with AI- assisted analysis techniques in engineering materials.	L4
3	Apply	The concepts of quantum mechanics and computing for quantum applications		along with AI-assisted quantum simulations	L3
4	Analyze	The concept of oscillations and Laser based metrology for Engineering Applications		along with AI- assisted methods	L4
5	Analyze	Ultrasonics and non destructive testing techniques		for engineering applications along with basic AI- assisted defect detection approaches.	L4

Course Content

UNIT I: Applied Wave Optics 9 hrs

Core Content:

Interference: Principle of superposition and coherence, Interference, Types of interference, Interference in thin films (reflection geometry) and Newton's rings. Applications: Determination of wavelength and refractive index.

Diffraction and Optical Surveying: Introduction to diffraction; Fresnel and Fraunhofer diffraction. Fraunhofer diffraction due to single, double and N-slits (Diffraction Grating), Dispersive power and Resolving power of Grating. Application: 3D Scanning for Dimensional Inspection of Casted Parts.

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

AI Integration:

AI-integrated holographic interferometry for micro-deformation analysis. Python-based fringe pattern analysis using image processing (OpenCV).

Free/Open-Source AI Tools:

Python (NumPy, SciPy, Matplotlib and scikit-learn).

UNIT II: Crystallography and X-ray Diffraction 8 hrs

Core Content:

Crystallography: Space lattice, Basis, Unit Cell and lattice parameters – Crystal systems, Bravais Lattices — Coordination number - Packing fraction of SC, BCC & FCC - Miller indices – Separation between successive (h k l) planes.

X-ray diffraction: Bragg's law - X-ray Diffractometer – Crystal structure determination by Laue's method. Application: XRD Pattern Analysis for Phase Identification, Determination of Crystal Structure of Metals and Alloys

AI Integration:

AI-assisted XRD pattern analysis for phase identification and crystal structure determination. ML-based classification of diffraction patterns using scikit-learn.

Free/Open-Source AI Tools:

Python (NumPy, SciPy, Matplotlib and scikit-learn).

UNIT III: Introduction to Quantum Mechanics & Quantum Computing 10 hrs

Core Content:

Introduction to quantum mechanics, de-Broglie concept (matter waves), Heisenberg's Uncertainty Principle, Wave function, Postulates of Quantum Mechanics, Schrödinger's time-independent wave equation, Particle in a one-dimensional potential well, Quantum tunnelling (basic idea).

Introduction to Quantum Computing: Classical bits vs qubits. Concept of superposition and Entanglement, Basic Quantum Operations: Hadamard gate (idea of superposition), Pauli-X gate. Basic idea of quantum measurement, Applications: Basic idea of quantum cryptography and secure communication.

AI Integration: AI-assisted quantum circuit simulation using IBM Qiskit (free). Python-based visualization of wave functions and quantum probability densities

Free/Open-Source AI Tools: Google Colab, Python and Scikit-learn.

UNIT IV: Oscillations, Vibration Control and Laser-Based Metrology 10 hrs

Core Content:

Introduction to oscillations and oscillations of springs. Series and parallel combinations of springs in Suspension Systems, Stiffness factor and its physical significance, vibration isolation. Theory of damped oscillations (Over, Under and Critical damping – all qualitative). Applications (Qualitative): shock absorbers, noise, and vibration reduction.

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

AI Integration: AI-Assisted Adaptive Suspension System for EVs, AI-Based Vibration Monitoring and Predictive Maintenance.

Free/Open-Source AI Tools: Google Colab, Python and Scikit-learn.

UNIT V: Ultrasonics and Non-Destructive Testing (NDT) 8 hrs

Core Content:

Introduction to ultrasonics; Production of ultrasonics: Piezoelectric method and Magnetostriction method, Detection of ultrasonics: Kundt's tube and Quartz crystal methods. Applications: Use of Ultrasonic Flaw Detectors to identify internal cracks, voids and thickness variations in cast and forged engine components.

Non-Destructive Testing (NDT): Introduction, need and advantages in mechanical engineering structures, Basic inspection methods: Visual inspection and AI-based drone inspections for inaccessible materials (qualitative). Liquid penetrant testing: basic principle for detecting surface defects in steel. Applications: Detecting surface and sub-surface defects, sorting alloys and measuring coating thickness on automotive parts.

AI Integration: AI-recognition in abnormal echo patterns, AI-assisted additional reflections and frequency distortions.

Free/Open-Source AI Tools: Google Colab, Python and Scikit-learn.

Textbooks

1. Avadhanulu, Kshirsagar&Arun Murthy, Engineering Physics, S. Chand, 2019.
2. D. K. Bhattacharya & Poonam Tandon, Engineering Physics, Oxford Press, 2015.

Reference Books

3. B. K. Pandey & S. Chaturvedi, Engineering Physics, Cengage Learning, 2021.
4. Shatendra Sharma & Jyotsna Sharma, Engineering Physics, Pearson, 2018.
5. Sanjay D. Jain, D. Sahasrabudhe & Girish, Engineering Physics, Universities Press, 2010.
6. M. R. Srinivasan, Engineering Physics, New Age International, 2009.
7. S. O. Pillai, Solid State Physics, New Age International.
8. R. Murugeshan & Kiruthiga Sivaprasath, Modern Physics, S. Chand.
9. An Introduction to Mechanics - Robert J. Kolenkow and Daniel Kleppner, Tata McGRAW Hill (2020)
10. Mechanics - Charles Kittel - Tata McGRAW Hill (2011)
11. Waves - Frank S. Crawford Jr, Tata McGRAW Hill (2008)
12. Introduction to Quantum Mechanics David J. Griffiths, Pearson Education India Learning Private Limited (2015).
13. Quantum Physics, H C Verma, TBS, 2nd edition (2012)
14. Concepts of Modern Physics, by Arthur Beiser, Tata McGraw (2017)

Web Resources & NPTEL Links

- NPTEL – nptel.ac.in
- MIT OpenCourseWare – ocw.mit.edu
- HyperPhysics – hyperphysics.phy-astr.gsu.edu
- Feynman Lectures – feynmanlectures.caltech.edu
- PhET Simulations – phet.colorado.edu

Recommended Free & Open-Source AI/Computational Tools

- Python (NumPy, SciPy, OpenCV, Matplotlib) – FREE on Google Colab for wave optics and signal analysis
- TensorFlow / Keras (free, open-source) – For crack and defect detection CNNs on Google Colab
- scikit-learn (free, open-source) – For anomaly detection in vibration and NDT data
- IBM Qiskit (free, open-source) – For quantum computing simulations on Google Colab
- OpenCV (free, open-source) – For image processing in visual inspection and interferometry
- PhET Interactive Simulations (free) – For wave optics, quantum mechanics and oscillations

CO–PO Articulation Matrix

Scale: 3 – Strong, 2 – Moderate, 1 – Slight, – No Correlation

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

CO-PO'S mapping justification:

CO	CO Verb	BTL	Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
1	Analyze	L4	PO1, PO4, PO5	PO1: Apply(L3) PO4: Analyze(L4) PO5: Apply(L3)	3 3 3
2	Analyze	L4	PO1, PO4, PO5	PO1: Apply(L3) PO4: Analyze(L4) PO5: Apply(L3)	3 3 3
3	Apply	L3	PO1, PO3, PO4, PO5	PO1: Apply(L3) PO3: Develop(L3) PO4: Analyze(L4) PO5: Apply (L3)	3 3 2 3
4	Analyze	L4	PO1, PO4, PO5	PO1: Apply(L3) PO4: Analyze(L4) PO5: Apply (L3)	3 3 3
5	Analyze	L4	PO1, PO4, PO5	PO1: Apply(L3) PO4: Analyze(L4) PO5: Apply(L3)	3 3 3

CO1: The intensity variation of light due to interference, diffraction and polarization along with basic AI-assisted optical analysis in engineering applications.
Action Verb: Analyze (L4)
PO1 and PO5 Action Verbs: Apply (L3)
PO4 Action Verb: Analyze (L4)
CO1 action verb is lesser than the action verbs of PO1, and PO5; Therefore, the correlation is high (3)
CO1 action verb is equal to the action verb of PO4; Therefore, the correlation is high (3).

CO2: The characteristics of crystal structures & X-Ray diffraction along with AI- assisted analysis techniques in engineering materials.
Action Verb: Analyze (L4)
PO1 and PO5 Action Verbs: Apply (L3)
PO4 Action Verb: Analyze (L4)
CO2 action verb is lesser than the action verbs of PO1, and PO5; Therefore, the correlation is high (3)
CO2 action verb is equal to the action verb of PO4; Therefore, the correlation is high (3).

CO3: The concepts of quantum mechanics and computing for quantum applications along with basic AI-assisted quantum simulations.
Action Verb: Apply (L3)
PO1 and PO5 Action Verbs: Apply (L3)
PO3 Action Verb: Develop(L3)
PO4 Action Verb: Analyze (L4)
CO3action verb is equal to the action verbs of PO1, PO3 and PO5; Therefore, the correlation is high (3)
CO3 action verb is greater than to the action verb of PO4; Therefore, the correlation is moderate (2).

CO4: the concept of oscillations and Laser based metrology for Engineering Applications along with AI-assisted methods
Action Verb: Analyze (L4)
PO1 and PO5 Action Verbs: Apply (L3)
PO4 Action Verb: Analyze (L4)
CO4 action verb is lesser than the action verbs of PO1, and PO5; Therefore, the correlation is high (3)
CO4 action verb is equal to the action verb of PO4; Therefore, the correlation is high (3).

CO5: Ultrasonics and non destructive testing techniques for engineering applications along with basic AI-assisted defect detection approaches.
Action Verb: Analyze (L4)
PO1 and PO5 Action Verbs: Apply (L3)
PO4 Action Verb: Analyze (L4)
CO5action verb is lesser than the action verbs of PO1 and PO5; Therefore, the correlation is high (3)
CO5 action verb is equal to the action verb of PO4; Therefore, the correlation is high (3).

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MECHANICAL ENGINEERING (ME)

Year: I **Semester**: I **Branch of Study:** Common to All

Subject Code: 26ABS9901	Subject Name: Linear Algebra and Calculus	L	T	Pr/CLC	P	Credits 4
		3	0	2	0	

Prerequisites: *Higher Secondary Mathematics*

Course Outcomes (CO): Student will be able to

1. Apply matrix algebra techniques using AI-enabled computational tools (ChatGPT / Copilot) to solve engineering problems.

2. Analyze eigenvalues, eigenvectors, and quadratic forms using AI-assisted tools (Google Colab) to interpret engineering problems.

3. Apply calculus concepts and series expansions using AI-supported computational tools (Google Colab, Wolfram Alpha free tier) to solve engineering problems .

4. Analyze multivariable functions and optimization techniques using AI-enabled computational tools (Google Colab) to obtain accurate engineering solutions.

5. Evaluate multiple integrals and coordinate transformations using AI-enabled computational tools (Google Colab) for engineering applications.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Apply	matrix algebra techniques	using AI-enabled computational tools (ChatGPT / Copilot)	to solve engineering problems.	L3
2	Analyze	eigenvalues, eigenvectors, and quadratic forms	using AI-assisted computational tools (Google Colab)	to interpret engineering problems.	L4
3	Apply	calculus concepts and series expansions	using AI-supported computational tools (Google Colab, Wolfram Alpha free tier)	to solve engineering problems.	L3
4	Analyze	multivariable functions and optimization techniques	using AI-enabled computational tools (Google Colab)	to obtain accurate engineering solutions	L4
5	Evaluate	multiple integrals and coordinate transformations	using AI-enabled computational tools (Google Colab)	for engineering applications.	L5

Course Content

UNIT – 1 **Matrix Algebra and Linear Systems** **9 Hrs**

Content Matrices, types of matrices, operations, transpose, inverse, symmetric and skew-symmetric matrices; determinant properties; rank of a matrix; echelon and normal forms.
System of linear equations; consistency conditions; Gauss elimination and Gauss-Jordan methods; iterative methods: Jacobi and Gauss-Seidel.
Cramer's rule; matrix inversion method; applications to engineering systems.

AI Integration Python-based solution of large linear systems using NumPy; visualization of convergence in iterative methods; AI-assisted debugging of matrix algorithms; using ChatGPT/Copilot to explain row operations and rank reduction. Free/Open-Source AI Tools: Python (NumPy, SciPy, Matplotlib) on Google Colab; SymPy; Jupyter Notebook; Scilab.

UNIT – 2 **Eigenvalues, Eigenvectors, Diagonalization and Quadratic Forms** **9 Hrs**

Content Eigenvalues and eigenvectors; characteristic equation; Cayley-Hamilton theorem; diagonalization; similarity transformation; powers and inverse of matrices using

Cayley-Hamilton theorem.
Quadratic forms; canonical form; reduction by orthogonal transformation; rank, index, signature; positive definite forms; orthogonal, Hermitian, skew-Hermitian and unitary matrices.

AI Integration AI-assisted eigenvalue computation and verification; Python/SciPy visualization of eigenmodes and quadratic surfaces; use of AI tools to explain diagonalization and matrix classification; numerical checking of Cayley-Hamilton theorem. Free/Open-Source AI Tools: Python (NumPy, SciPy, Matplotlib); SymPy; GNU Octave; Google Colab.

UNIT – 3 Single Variable Calculus and Series Expansions 9 Hrs

Content Rolle's theorem; Lagrange's mean value theorem; Cauchy's mean value theorem; Taylor's and Maclaurin's series with remainder; approximation of functions; error estimation.
Curvature of plane curves; radius and centre of curvature; circle of curvature; applications to engineering approximations and curve design.

AI Integration SymPy-based Taylor and Maclaurin expansion generation; plotting truncation error and convergence; AI-supported derivation checking for mean value theorems; curvature plot visualization and interpretation. Free/Open-Source AI Tools: Python (SymPy, NumPy, Matplotlib); Google Colab; Jupyter Notebook; WolframAlpha free tier.

UNIT – 4 Multivariable Differentiation and Optimization 9 Hrs

Content Functions of several variables; limits and continuity; partial derivatives; higher order partial derivatives; total derivative; chain rule; gradient; tangent plane and normal line. Jacobians; functional dependence; Taylor expansion of two-variable functions; maxima and minima; second derivative test; Lagrange multipliers and constrained optimization; divergence and curl.

AI Integration Gradient field visualization using Python; AI-assisted Jacobian computation and verification; constrained optimization using SciPy; use of AI tools to interpret saddle points, extrema, and optimization constraints. Free/Open-Source AI Tools: Python (NumPy, SciPy, SymPy, Matplotlib); Google Colab; Jupyter Notebook; SciPy optimize module.

UNIT – 5 Multiple Integrals and Coordinate Transformations 9 Hrs

Content Double integrals; evaluation over type I and type II regions; change of order of integration; triple integrals; change of variables; polar, cylindrical and spherical coordinates.
Area and volume computation; mass, centroid and moment calculations; engineering applications of multiple integration.

AI Integration Numerical evaluation of double and triple integrals using SciPy; 2D and 3D region visualization; AI-assisted generation of integration code; interpreting Jacobian as geometric scaling factor in transformed coordinates. Free/Open-Source AI Tools: Python (NumPy, SciPy, Matplotlib); Google Colab; SymPy; Jupyter Notebook; 3D plotting tools.

CO – PO Articulation Matrix (NBA)

Scale: 3 – Strong, 2 – Moderate, 1 – Slight, – No Correlation

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	3	-	-	-	-	-	-
CO2	3	3		-	3	-	-	-	-	-	-
CO3	3	-	-	-	3	-	-	-	-	-	-
CO4	3	3	-	-	3	-	-	-	-	-	-
CO5	3	3	-	-	3	-	-	-	-	-	-

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CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Action Verb	BTL			
1				Apply	L3	PO1, PO5	Apply (L3)	3
2				Analyze	L4	PO1, PO2,PO5	Analyze (L4)	3
3				Apply	L3	PO1,PO5	Apply (L3)	3
4				Analyze	L4	PO1, PO2 ,PO5	Analyze (L4)	3
5				Evaluate	L5	PO1, PO2,PO5	Evaluate (L5)	3

CO1: Apply matrix algebra techniques using AI-enabled computational tools (ChatGPT / Copilot) to solve engineering problems.

Action Verb: Apply (L3)

PO1 Verb: Apply (L3), PO5 Verb: Apply (L3)

CO1 Action Verb is equal toPO1 and PO5 verb; Therefore correlation is high (3).

CO2: Analyze eigenvalues, eigenvectors, and quadratic forms using AI-assisted tools (Google Colab) to interpret engineering systems correctly.

Action Verb: Analyze (L4)

PO1 Verb: Apply (L3), PO2 Verb: Analyze(L4), PO5 Verb: Apply (L3)

CO2 Action Verb is high level to PO1, PO5 and equal to PO2 verb. Therefore correlation is high (3).

CO3: Apply calculus concepts and series expansions using AI-supported computational tools (Google Colab, Wolfram Alpha free tier) to solve engineering problems accurately.

Action Verb: Apply (L3)

PO1 Verb: Apply (L3), PO5 Verb: Apply (L3)

CO3 Action Verb level is equal to PO1 and PO5 verb; Therefore correlation is high (3).

CO4: Analyze multivariable functions and optimization techniques using AI-enabled computational tools (Google Colab) to obtain accurate engineering solutions..

Action Verb: Analyze (L4)

PO1 Verb: Apply (L3), PO2 Verb: Analyze (L4), PO5 Verb: Apply (L3)

CO4 Action Verb high level to PO1,PO5 and equal to PO2 verb; Therefore correlation is high (3).

CO5: Evaluate multiple integrals and coordinate transformations using AI-enabled computational tools (Google Colab) for engineering applications accurately.

Action Verb: Evaluate (L5)

PO1 Verb: Apply (L3), PO2 Verb: Analyze (L4), PO5 Verb: Apply (L3)

CO5 Action verb is high level to PO1, PO2 and PO5 verb; therefore the correlation is high (3).

LEARNING RESOURCES

Textbooks

Grewal, B. S. (2017). Higher Engineering Mathematics (44th ed.). Khanna Publishers.
Kreyszig, E. (2018). Advanced Engineering Mathematics (10th ed.). Wiley.

Reference Books

Thomas, G. B., Weir, M. D., & Hass, J. (2018). Thomas' Calculus (14th ed.). Pearson.
Jain, R. K., & Iyengar, S. R. K. (2021). Advanced Engineering Mathematics (5th ed.). Alpha Science International.
Strang, G. (2016). Introduction to Linear Algebra (5th ed.). Wellesley-Cambridge Press.
Lay, D. C., Lay, S. R., & McDonald, J. J. (2015). Linear Algebra and Its Applications (5th ed.). Pearson.
Arfken, G. B., Weber, H. J., & Harris, F. E. (2012). Mathematical Methods for Physicists (7th ed.). Academic Press.
Zill, D. G., & Wright, W. S. (2018). Advanced Engineering Mathematics (6th ed.). Jones & Bartlett.

Online Resources

NPTEL: Linear Algebra – https://nptel.ac.in
MIT OpenCourseWare – Linear Algebra: https://ocw.mit.edu
MIT OpenCourseWare – Multivariable Calculus: https://ocw.mit.edu
Python SymPy Documentation: https://docs.sympy.org
Google Colab for Python: https://colab.research.google.com
Recommended Free & Open-Source AI/Computational Tools
Python (NumPy, SciPy, Matplotlib) – FREE on Google Colab for matrix computation, visualization, and numerical analysis.
SymPy (free, open-source) – For symbolic algebra, calculus, matrix operations, and verification.
scikit-learn (free, open-source) – For regression, classification, and exploratory predictive modeling.
Jupyter Notebook (free, open-source) – For interactive computation and lab documentation.
OpenCV (free, open-source) – For image-based experimentation and visualization support where needed.
GNU Octave (free, open-source) – MATLAB-like numerical computing for matrix and calculus workflows.
TensorFlow / Keras (free, open-source) – For optional AI demonstrations in regression and classification tasks.

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Year: I **Semester: I** **Branch of Study: Common to all Branches**

Subject Code	Subject Name	L	T	Pr/CLC	P	Credits
26AES0301	Design Thinking	1	0	4	0	3

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

CO: 1 Analyze the principles, stages and human-centred approach of Design Thinking to identify engineering problems using systems thinking and AI-assisted tools.
CO: 2 Apply empathy techniques to identify user needs and formulate problem statements using AI-assisted tools.
CO: 3 Analyze innovative design solutions by using ideation techniques and AI-assisted ideation tools.
CO: 4 Create prototypes using manual and AI-enabled prototyping tools to visualize and validate engineering solutions.
CO: 5 Evaluate prototype performance through user testing, iterative improvements, AI-assisted feedback analysis and effective design presentations.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Analyze	the principles, stages and human-centred approach of Design Thinking	using systems thinking and AI-assisted tools	to identify engineering problems	L4
CO2	Apply	empathy techniques	using AI-assisted tools	to identify user needs and formulate problem statements	L3
CO3	Analyze	innovative design solutions	by using ideation techniques and AI-assisted ideation tools		L4
CO4	Create	Prototypes	using manual and AI-enabled prototyping tools	to visualize and validate engineering solutions	L6
CO5	Evaluate	prototype performance	through user testing, iterative improvements, AI-assisted feedback analysis and effective design presentations		L5

Unit I:
Introduction to Design Thinking:

- Design Thinking: Definition, origin (Stanford d.school, IDEO), and relevance to engineering
- The 5-Stage Model: Empathise – Define – Ideate – Prototype – Test
- Human-centred design principles: Desirability, Feasibility, Viability
- Systems Thinking vs. Linear Thinking: Understanding complexity
- Case Studies: Successful design thinking applications (IDEO shopping cart, Stanford Mobile Clinic)

AI Integration:

- AI Tool: Chat GPT / Copilot – use AI to explain design thinking in different domains (healthcare, education, agriculture)
- Activity: Use Mind Meister (free, open-source alternative: Free Mind) to create a mind map of the 5-stage process
- AI Video Analysis: Watch an IDEO documentary and use AI to summarise key DT principles observed

Unit II
Empathise and Define Stages:

- Empathy Methods: Interviews, Observation, Immersion, Shadowing

- Creating User Personas: Demographic, psychographic, goals and pain points
- Empathy Mapping: Says, Thinks, Does, Feels
- Point of View (POV) Statement: User + Need + Insight formula
- How Might We (HMW) Questions: Reframing problems as opportunities

AI Integration:

- AI Tool: Miro (free plan) – create digital empathy maps and POV statements collaboratively
- AI Tool: ChatGPT – generate diverse user persona profiles for a given problem context
- Activity: Interview 5 peers about a campus problem; use AI to analyse interview transcripts and extract themes
- AI Tool: Dovetail (free plan) – affinity mapping of qualitative research data

Unit III

Ideation Stage:

- Creative Thinking Techniques: Brainstorming, Brain writing, SCAMPER, Random Word Association
- Lateral Thinking: Edward de Bono's Six Thinking Hats
- Affinity Diagramming: Grouping ideas by themes
- Prioritisation Matrix: Impact vs. Effort, Dot Voting
- Concept Selection: Morphological charts and Pugh Matrix

AI Integration:

- AI Tool: ChatGPT – use 'expand my idea' prompts to generate 20 variations of a concept
- AI Tool: IdeaFlip (free) / Miro – digital brainstorming and affinity diagramming
- AI Tool: Midjourney (free trial) / DALL-E (free credits) – generate visual concept sketches from text descriptions
- Activity: Run a 30-minute AI-augmented brainstorming session and compare idea quality with pure human brainstorming

Unit IV

Prototyping

- Principles of Prototyping: Low-fidelity vs. High-fidelity prototypes
- Paper Prototyping: Sketching UI and physical models
- Digital Wire framing: Introduction to wireframes and mockups
- 3D Prototyping Concepts: Introduction to 3D printing and rapid prototyping
- Role Plays and Experience Prototyping: Service design scenarios

AI Integration:

- AI Tool: Figma (free plan) – create digital wireframes and interactive mockups
- AI Tool: Uizard (free plan, AI-powered) – convert hand-drawn sketches to digital wireframes using AI
- AI Tool: Tinkercad (free, web-based) – create simple 3D models for physical prototyping
- Activity: Build a paper prototype for a chosen problem and photograph for digital documentation

Unit V

Testing, Iteration and AI in Design

- User Testing Methods: Think-aloud protocol, A/B testing, Usability testing
- Feedback Analysis: Affinity mapping of test feedback
- Iteration Cycle: Incorporating feedback and pivoting
- Design Presentation: Pitching to stakeholders (elevator pitch, demo day format)
- AI in Design: Overview of AI-assisted design (generative design, co-creation with AI)

AI Integration:

- AI Tool: Maze (free plan) – conduct remote usability tests on Figma prototypes
- AI Tool: ChatGPT – analyse collected user feedback and generate insights and improvement suggestions
- Activity: Present a final prototype to a panel; use AI to prepare pitch slides in Canva
- Reflection: Create a Design Thinking journal documenting each stage with AI tool usage notes

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Text Books

1. Brown, Tim. (2019). Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation. HarperBusiness, New York.
2. Lewrick, Michael, Link, Patrick & Leifer, Larry. (2018). The Design Thinking Playbook. Wiley, New Jersey.

Reference Books

1. IDEO.org. (2015). The Field Guide to Human-Centered Design. IDEO.org, San Francisco.
2. Kelley, Tom & Kelley, David. (2013). Creative Confidence: Unleashing the Creative Potential Within Us All. Crown Business.
3. Liedtka, Jeanne & Ogilvie, Tim. (2011). Designing for Growth: A Design Thinking Tool Kit for Managers. Columbia Business School Press.
4. Plattner, Hasso, Meinel, Christoph & Leifer, Larry (Eds.). (2018). Design Thinking Research. Springer.
5. Kumar, Vijay. (2012). 101 Design Methods: A Structured Approach for Driving Innovation. Wiley.
6. Stickdorn, Marc & Schneider, Jakob. (2021). This Is Service Design Thinking (Expanded ed.). BIS Publishers.

Web Resources

- Stanford d.school Resources: dschool.stanford.edu/resources
- IDEO Design Kit: www.designkit.org/methods
- MIT OpenCourseWare – Design Thinking: ocw.mit.edu
- Interaction Design Foundation: www.interaction-design.org
- NPTEL Design Thinking: swayam.gov.in

YouTube / Video Resources

- YouTube: Stanford d.school – Design Thinking Bootcamp – www.youtube.com/@stanforddschool
- YouTube: IDEO U – www.youtube.com/@ideou
- YouTube: Crash Course – Design Thinking Series – www.youtube.com/@crashcourse
- YouTube: AJ&Smart – Design Sprint tutorials – www.youtube.com/@AJSmart
- YouTube: NPTEL Design Thinking – www.youtube.com/c/nptel

CO – PO Articulation Matrix

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Design Thinking	CO1	3	3	3		3	3	3					3	3
	CO2	3	3	3		3	2	2					3	3
	CO3	3	3	3		3	3	3					3	3
	CO4	3	3	3		3	3	3					3	3
	CO5	3	3	3		3	3	3					3	3

Correlation Matrix

CO	CO					Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
	Lesson Plan (Hrs)	%	Correlation	Verb	BTL			
1	**14**	23.33	3	Analyze	L4	PO1 PO2 PO3 PO5 PO6 & PO7	Apply (L3) Identify (L3) Develop (L3) Apply (L3) Thumb rule	3 3 3 3 3
2	**12**	20	2	Apply	L3	PO1 PO2 PO3 PO5 PO6 & PO7	Apply (L3) Identify (L3) Develop (L3) Apply (L3) Thumb rule	3 3 3 3 2
3	**11**	18.33	2	Analyze	L4	PO1 PO2 PO3 PO5	Apply (L3) Identify (L3) Develop (L3) Apply (L3)	3 3 3 3

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						PO6 & PO7	Thumb rule	3
4	**12**	20	2	Create	L6	PO1 PO2 PO3 PO5 PO6 & PO7	Apply (L3) Identify (L3) Develop (L3) Apply (L3) Thumb rule	3 3 3 3 3
5	**11**	18.33	2	Evaluate	L5	PO1 PO2 PO3 PO5 PO6 & PO7	Apply (L3) Identify (L3) Develop (L3) Apply (L3) Thumb rule	3 3 3 3 3
	60	100						

Justification Statements:

CO1: Analyze the principles, stages and human-centred approach of Design Thinking to identify engineering problems using systems thinking and AI-assisted tools.
Action Verb: **Analyze (L4)**
PO1 Verb: **Apply (L3).** CO1 Action verb is greater than the PO1 verb. Therefore, the correlation is high (3).
PO2 Verb: **Analyze (L4).** CO1 Action verb is at the same level as the PO2 verb. Therefore, the correlation is high (3).
PO3 Verb: **Develop (L3).** CO1 Action verb is greater than the PO3 verb. Therefore, the correlation is high (3).
PO5 Verb: **Apply (L3).** CO1 Action verb is greater than the PO5 verb. Therefore, the correlation is high (3).
PO6 & PO7 Verb: Thumb Rule. As per the thumb rule, CO1 correlates strongly with the PO6 & PO7 verbs. Therefore, the correlation is high (3).

CO2: Apply empathy techniques to identify user needs and formulate problem statements using AI-assisted tools.
Action Verb: **Apply (L3)**
PO1 Verb: **Apply (L3).** CO2 Action verb is at the same level as the PO1 verb. Therefore, the correlation is high (3).
PO2 Verb: **Analyze (L4).** CO2 Action verb is lower than the PO2 verb. Therefore, the correlation is medium (2).
PO3 Verb: **Develop (L3).** CO2 Action verb is at the same level as the PO3 verb. Therefore, the correlation is high (3).
PO5 Verb: **Apply (L3).** CO2 Action verb is at the same level as the PO5 verb. Therefore, the correlation is high (3).
PO6 & PO7 Verb: Thumb Rule. As per the thumb rule, CO2 correlates slightly with the PO6 & PO7 verbs. Therefore, the correlation is medium (2).

CO3: Analyze innovative design solutions by using ideation techniques and AI-assisted ideation tools.
Action Verb: **Analyze (L4)**
PO1 Verb: **Apply (L3).** CO3 Action verb is greater than the PO1 verb. Therefore, the correlation is high (3).
PO2 Verb: **Analyze (L4).** CO3 Action verb is at the same level as the PO2 verb. Therefore, the correlation is high (3).
PO3 Verb: **Develop (L3).** CO3 Action verb is greater than the PO3 verb. Therefore, the correlation is high (3).
PO5 Verb: **Apply (L3).** CO3 Action verb is greater than the PO5 verb. Therefore, the correlation is high (3).
PO6 & PO7 Verb: Thumb Rule. As per the thumb rule, CO3 correlates strongly with the PO6 & PO7 verbs. Therefore, the correlation is high (3).

CO4: Create prototypes using manual and AI-enabled prototyping tools to visualize and validate engineering solutions.
Action Verb: **Create (L6)**
PO1 Verb: **Apply (L3).** CO4 Action verb is greater than the PO1 verb. Therefore, the correlation is high (3).
PO2 Verb: **Analyze (L4).** CO4 Action verb is greater than the PO2 verb. Therefore, the correlation is high (3).
PO3 Verb: **Develop (L3).** CO4 Action verb is greater than the PO3 verb. Therefore, the correlation is high (3).
PO5 Verb: **Apply (L3).** CO4 Action verb is greater than the PO5 verb. Therefore, the correlation is high (3).
PO6 & PO7 Verb: Thumb Rule. As per the thumb rule, CO4 correlates strongly with the PO6 & PO7 verbs. Therefore, the correlation is high (3).

CO5: Evaluate prototype performance through user testing, iterative improvements, AI-assisted feedback analysis and effective design presentations.

Action Verb: **Evaluate (L5)**
PO1 Verb: **Apply (L3).** CO5 Action verb is greater than the PO1 verb. Therefore, the correlation is high (3).
PO2 Verb: **Analyze (L4).** CO5 Action verb is greater than the PO2 verb. Therefore, the correlation is high (3).
PO3 Verb: **Develop (L3).** CO5 Action verb is greater than the PO3 verb. Therefore, the correlation is high (3).
PO5 Verb: **Apply (L3).** CO5 Action verb is greater than the PO5 verb. Therefore, the correlation is high (3).
PO6 & PO7 Verb: Thumb Rule. As per the thumb rule, CO5 correlates strongly with the PO6 & PO7 verbs. Therefore, the correlation is high (3).

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Course Code	Year & Sem	Computational Thinking and Problem Solving With Python	L	T / CLC	Pr	P	C
26AES0501	I - I	**Common to All Branches**	**2**	**0**	**2**	**0**	**3**

Course Outcomes:
After studying the course, students will be able to
CO1: **Understand** computational thinking, algorithms, flowcharts & Python fundamentals.
CO2: **Apply** decision-making and looping constructs in Python for problem solving.
CO3: **Apply** Python strings, lists, tuples, and sets for problem solving.
CO4: **Analyze** dictionaries, functions, recursion, and variable scope in Python.
CO5: **Evaluate** modules, file handling, exception handling, and OOP concepts.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	Computational thinking, algorithms, flowcharts, and Python fundamentals			L2
CO2	Apply	Decision-making and looping constructs	in Python programs	For problem solving	L3
CO3	Apply	Python strings, lists, tuples, and sets		for programming tasks	L3
CO4	Analyze	Dictionaries, functions, recursion, and variable scope	in Python		L4
CO5	Evaluate	Modules, file handling, exception handling, and OOP concepts	in Python applications		L5

UNIT - I	**COMPUTATIONAL THINKING AND PROGRAMMING BASICS**	**9 Hrs**

Content:

- Computational thinking: characteristics, problem-solving strategies, steps in problem solving; algorithms — definition and properties; flowcharts — symbols and construction; pseudocode — writing and conversion; abstraction, decomposition, pattern recognition, algorithm efficiency basics.
- Introduction to Python: installation and execution environment; variables, identifiers, keywords; data types, type conversion; input and output statements; expressions and operators — arithmetic, relational, logical, assignment; operator precedence.

Source: TB1: Chapters 1–3 (Spronck — computational thinking, algorithms, flowcharts, Python basics); TB2: Chapters 1–2 (Thareja — introduction to programming, Python fundamentals)

AI Integration:
Use Flowgorithm to design and simulate algorithms (e.g., largest of 3 numbers); draw flowcharts using Lucidchart; use Algorithm Visualizer to trace algorithm execution; use ChatGPT to convert pseudocode to Python and verify output.

UNIT - II	**DECISION MAKING AND LOOPING**	**9 Hrs**

Content:

- Decision control statements: Boolean expressions; if, if-else, if-elif-else, nested if; conditional expressions (ternary operator).
- Looping statements: while loop, for loop, iteration techniques, nested loops, infinite loops; loop control — break, continue, pass; else with loops.
- Practical problem solving: prime number check, pattern programs using nested loops, menu-driven programs using control statements.

Source: TB2: Chapters 4–5 (Thareja — decision making, loops, control statements); TB1: Chapters 4–5 (Spronck — conditions, loops, iteration)

AI Integration:
Use Python Tutor to visualize if-else and loop execution step by step; use Thonny to debug loop-based programs; use Replit for online coding practice; use ChatGPT to generate test cases for control flow programs.

UNIT - III	**STRINGS AND DATA STRUCTURES**	**9 Hrs**

Content:

- Strings: representation, indexing, slicing, operations, built-in functions and methods.
- Lists: creation, indexing and slicing, operations, functions, methods, nested lists.
- Tuples: creation, operations, packing and unpacking.
- Sets: creation, set operations — union, intersection, difference; frozen sets.

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Source: TB2: Chapters 6–8 (Thareja — strings, lists, tuples, sets, dictionaries); TB1: Chapters 6–7 (Spronck — strings, lists, tuples)

AI Integration:

Use NLTK and TextBlob to perform text analysis (sentiment, word frequency) on strings; use Pandas and NumPy for list and array operations; use ChatGPT to explain string slicing and list comprehensions with concrete examples.

UNIT - IV	**FUNCTIONS AND PROBLEM SOLVING**	**9 Hrs**

Content:

- Dictionaries: creation, operations, methods; dictionary-based applications.
- Functions: built-in and user-defined functions; function definition and calling; arguments — positional, keyword, default, variable-length; scope of variables (local and global).
- Recursion: recursive functions — factorial, Fibonacci; lambda functions (anonymous functions); applications of functions in problem solving.

Source: TB2: Chapters 9–10 (Thareja — functions, recursion, lambda, dictionaries); TB1: Chapters 8–9 (Spronck — functions, recursion, problem solving)

AI Integration:

Use Jupyter Notebook for interactive function experiments; use SymPy for symbolic mathematical expressions; use PyCharm for modular program development; use ChatGPT to trace recursive function calls step by step.

UNIT - V	**FILE HANDLING, EXCEPTION HANDLING AND OOP**	**9 Hrs**

Content:

- Modules and packages: creating and importing modules; standard library modules.
- File handling: opening, reading, writing, and closing files; file modes; working with text files; processing CSV and Excel files.
- Exception handling: types of errors (syntax, runtime, logical); try, except, finally blocks; raising exceptions.
- Introduction to OOP: classes, objects, attributes, methods, constructors, self keyword; basic applications of OOP in Python.

Source: TB2: Chapters 11–13 (Thareja — modules, file handling, exception handling, OOP); TB1: Chapter 10 (Spronck — file handling, exceptions, object-oriented programming)

AI Integration:

Use Pandas and OpenPyXL to read and write CSV/Excel files; use Pytest for testing exception handling; use ChatGPT to explain OOP class design with real-world examples; use Django for a simple mini web application as a capstone project.

Textbooks:

1. Pieter Spronck, Computational Thinking with Python, (course textbook — covers computational thinking, algorithms, and Python programming).
2. Reema Thareja, Programming in Python, Oxford University Press. (Primary implementation reference — all five units.)

Reference Books:

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2nd Edition, O'Reilly Media. (Free at greenteapress.com)
2. Eric Matthes, Python Crash Course, 2nd Edition, No Starch Press.

Online Learning Resources:

1. **Algorithm & Flowchart:** Flowgorithm – flowgorithm.org | Lucidchart – lucidchart.com | Algorithm Visualizer – algorithm-visualizer.org
2. **Programming & Debugging:** Python Tutor – pythontutor.com | Thonny – thonny.org | Replit – replit.com
3. **Data & Scientific:** Pandas – pandas.pydata.org | NumPy – numpy.org | SymPy – sympy.org
4. **NLP & Text:** NLTK – nltk.org | TextBlob – textblob.readthedocs.io
5. **Development:** Jupyter Notebook – jupyter.org | PyCharm – jetbrains.com/pycharm | OpenPyXL – openpyxl.readthedocs.io
6. **NPTEL** – Problem Solving through Programming in C / Python – nptel.ac.in

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Mapping of course outcomes with program outcomes

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan (Hrs)	%	Correlation	Co's Action verb	BTL			
1	9	20%	2	CO1: Understand	L2	PO1 PO2 PO11	PO1: Apply (L3) PO2: Review (L2) PO11: Thumb Rule	2 3 2
2	9	20%	2	CO2: Apply	L3	PO1 PO2 PO5 PO11	PO1: Apply (L3) PO2: Review (L2) PO5: Apply (L3) PO11: Thumb Rule	3 3 3 2
3	9	20%	2	CO3: Apply	L3	PO1 PO2 PO3 PO5 PO11	PO1: Apply (L3) PO2: Review (L2) PO3: Develop (L3) PO5: Apply (L3) PO11: Thumb Rule	3 3 3 3 2
4	9	20%	2	CO4: Analyze	L4	PO1 PO2 PO4 PO5 PO11	PO1: Apply (L3) PO2: Review (L2) PO4: Analyze (L4) PO5: Apply (L3) PO11: Thumb Rule	3 3 3 3 3
5	9	20%	2	CO5: Evaluate	L5	PO1 PO2 PO5 PO11	PO1: Apply (L3) PO2: Review (L2) PO5: Apply (L3) PO11: Thumb Rule	3 3 3 3
	45	100 %						

Justification Statements:

CO1:Understand computational thinking, algorithms, flowcharts & Python fundamentals.
Action Verb: Understand (L2)
PO1: Apply (L3)
CO1 action verb is one level less than the PO1 action verb. Therefore, the correlation is **Moderate (2)**.
PO2: Review (L2)
CO1 action verb is the same as the PO2 action verb. Therefore, the correlation is **High (3)**.
PO11: Thumb Rule
Computational thinking and Python fundamentals promote independent learning and adaptability to programming concepts. Therefore, the correlation is **Moderate (2)**.

CO2: Apply decision-making and looping constructs in Python for problem solving.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO2 action verb is the same as the PO1 action verb. Therefore, the correlation is **High (3)**.

PO2: Review (L2)
CO2 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.
PO5: Apply (L3)
CO2 action verb is the same as the PO5 action verb. Therefore, the correlation is **High (3)**.
PO11: Thumb Rule
Decision-making and looping concepts help students develop programming skills through continuous practice and self-learning. Therefore, the correlation is **Moderate (2)**.

CO3: Apply Python strings, lists, tuples, and sets for problem solving.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO3 action verb is the same as the PO1 action verb. Therefore, the correlation is **High (3)**.
PO2: Review (L2)
CO3 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.
PO3: Develop (L3)
CO3 action verb is the same as the PO3 action verb. Therefore, the correlation is **High (3)**.
PO5: Apply (L3)
CO3 action verb is the same as the PO5 action verb. Therefore, the correlation is **High (3)**.
PO11: Thumb Rule
Python data structures encourage independent programming practice and improve problem-solving skills. Therefore, the correlation is **Moderate (2)**.

CO4: Analyze dictionaries, functions, recursion, and variable scope in Python.
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO4 action verb is greater than the PO1 action verb. Therefore, the correlation is **High (3)**.
PO2: Review (L2)
CO4 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.
PO4: Analyze (L4)
CO4 action verb is the same as the PO4 action verb. Therefore, the correlation is **High (3)**.
PO5: Apply (L3)
CO4 action verb is greater than the PO5 action verb. Therefore, the correlation is **High (3)**.
PO11: Thumb Rule
Functions and recursion encourage analytical thinking, independent learning, and adaptation to advanced programming concepts. Therefore, the correlation is **High (3)**.

CO5: Evaluate modules, file handling, exception handling, and OOP concepts.
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO5 action verb is greater than the PO1 action verb. Therefore, the correlation is **High (3)**.
PO2: Review (L2)
CO5 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.
PO5: Apply (L3)
CO5 action verb is greater than the PO5 action verb. Therefore, the correlation is **High (3)**.
PO11: Thumb Rule
Modules, file handling, exception handling, and object-oriented programming foster lifelong learning by enabling students to work with modern Python technologies and develop reliable software applications. Therefore, the correlation is **High (3)**.

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Course Code	Year & Sem	AI TOOLS AND APPLICATIONS	L	T/ CLC	Pr	P	C
26AES3301	1-I		1	0	4	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the AI fundamentals concepts and AI tool categories.

CO2: Apply the AI tools, prompt engineering, and Notebook LM for learning and content creation.

CO3: Understand the AI tools for data analysis, research, and information management.

CO4: Analyze the AI applications for visual design and engineering solutions.

CO5: Analyze the AI-assisted project using responsible AI practices.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the AI fundamentals concepts and AI tool categories.			L2
CO2	Apply	the AI tools, prompt engineering, and Notebook LM		for learning and content creation	L3
CO3	Understand	the AI tools		for data analysis, research, and information management	L4
CO4	Analyze	the AI applications			L4
CO5	Analyze	the AI-assisted project	using responsible AI practices.		L2

UNIT – I : UNDERSTANDING AI AND AI FOR DOCUMENTS AND PRESENTATIONS	9Hrs

What is AI: AI vs ML vs. Deep Learning vs. Generative AI; brief history (Turing Test → ChatGPT → generative AI era); how
LLMs work (training data, next-token prediction, temperature, hallucinations, context windows, knowledge cutoffs). AI ecosystem: ChatGPT, Claude, Gemini, Microsoft Copilot strengths and differences.
AI for presentations: Gamma.ap full slide deck from a paragraph prompt; Microsoft Copilot in PowerPoint slide generation, design suggestions, speaker notes; Canva AI Magic Design, text-to-presentation, brand kits; Beautiful.ai smart slide layouts; comparing AI-generated vs. manually created presentations.
AI for document writing: Microsoft Copilot in Word draft, rewrite, summarize; Gemini in Google Docs writing assistance and inline Q&A; Notion AI meeting notes, project plans, knowledge base; Claude Projects organizing documents and having a persistent AI assistant over a set of files.
AI writing assistance: Grammarly grammar, tone, clarity, plagiarism; ChatGPT and Claude for lab reports, proposals, and letters; academic integrity AI as an assistant not an author; disclosure norms; identifying AI-generated content using GPTZero.

AI Tools Integration: Use Gamma.app to generate a presentation on an engineering topic in under 2 minutes; use Copilot in
Word or Gemini in Docs to draft and improve a report; compare ChatGPT, Claude, Gemini, and Microsoft Copilot on the same
writing task; use Grammarly to review your own writing.

Unit Outcomes

Explain AI concepts and the AI tool landscape to a non-technical audience.
Generate and critically refine presentations using Gamma.app, Copilot, and Canva AI.
Use AI writing tools for drafting, editing, and improving academic documents.

UNIT – II : AI FOR RESEARCH, NOTE-TAKING, DATA, AND SPREADSHEETS	9Hrs

NotebookLM (Google): uploading lecture notes, textbooks, PDFs, and research papers as sources; asking questions grounded in uploaded documents; generating study guides, timelines, briefing documents, and audio overviews (podcast-style summaries) from sources; source-grounded answers that cite the exact passage eliminating hallucination risk.
AI for research: Perplexity AI (real-time web search with citations), Gemini Deep Research (multi-step research reports), Elicit and Consensus (academic paper search with evidence summaries); verifying AI-generated citations on Google Scholar; why AI fabricates references and how to detect it.
Prompt engineering: zero-shot, one-shot, few-shot, chain-of-thought, role-based prompting; iterative refinement; negative prompting; building effective prompts for summarization, comparison, explanation, and data extraction; using ChatGPT custom instructions and Claude Projects for persistent context.
AI for spreadsheets and data analysis: Microsoft Copilot in Excel VLOOKUP, IF, COUNTIF, pivot tables from natural language; Gemini in Google Sheets formula generation and chart creation; ChatGPT Advanced Data Analysis and Julius AI uploading CSV files, computing statistics, generating charts, interpreting patterns no coding required.

AI Tools Integration: Upload your own lecture notes to NotebookLM and generate a study guide and audio overview; use Perplexity AI and Gemini Deep Research to research a topic; verify citations on Google Scholar; use Wolfram Alpha or Symbolab to solve and verify equations from your current semester subjects; use Copilot in Excel or ChatGPT ADA to analyse a real dataset.

Unit Outcomes

- Use NotebookLM to generate source-grounded study aids from uploaded documents.
- Apply AI research tools (Perplexity, Gemini Deep Research, Elicit) and verify citations.
- Perform spreadsheet automation and data analysis using AI; use Wolfram Alpha, Symbolab, and Photomath to solve and verify equations.

UNIT – III : AI FOR VISUAL DESIGN, DIAGRAMS, AND MEDIA	9Hrs

- AI for image generation: DALL-E 3 (via ChatGPT), Canva AI (text-to-image, Magic Design, background remover), Adobe Firefly, Ideogram writing effective image prompts (style, subject, composition, colour); iterative prompt refinement for posters, diagrams, and mockups.
- AI for diagrams and visual thinking: Napkin.ai converting text or concepts into visual diagrams, charts, and infographics automatically; Whimsical AI - AI-generated mind maps, flowcharts, and wireframes from a description; Miro AI collaborative whiteboard with AI summarization and diagramming.
- AI for audio and video: ElevenLabs text-to-speech and voice cloning for presentations and voiceovers; Suno and Udio AI music generation for project videos; Runway and Pika generating short video clips from text prompts; HeyGen AI avatars for video presentations; current limitations and appropriate use cases.
- AI content detection and critical evaluation: GPTZero, Originality.ai for AI-text detection; Google Lens and reverse image search for AI-generated images; fact-checking workflows cross-referencing primary sources; deepfakes and synthetic media recognition, risks, and responsible creation.

AI Tools Integration: Use Napkin.ai to convert a paragraph of text into a diagram; use Whimsical AI to generate a mind map of a course topic; use DALL-E 3 or Canva AI to create an event poster through 3 prompt iterations; use ElevenLabs to create a voiceover; test GPTZero on 5 samples and analyse confidence scores.

Unit Outcomes

- Create AI-generated images and visual diagrams using Napkin.ai and Whimsical AI.
- Produce AI audio and short video content for academic and project presentations.

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- Evaluate AI-generated content using detection tools and critical verification workflows.

UNIT – IV: AI ACROSS ENGINEERING DISCIPLINES	9Hrs

- AI in Mechanical Engineering: generative design in CAD (Autodesk Fusion 360 AI-optimized structures for weight and load); predictive maintenance using sensor data and ML; AI-assisted FEA simulation; manufacturing process optimization; digital twins.
- AI in Civil and Electrical Engineering: structural health monitoring using ML; smart grid load forecasting and energy management; AI for circuit simulation and PCB layout optimization (Altium AI); VLSI design automation floor planning and routing; power systems fault detection.
- AI in Electronics and Communication: AI-assisted signal processing and filtering; speech recognition for embedded systems; computer vision for industrial quality inspection; AI in antenna design and spectrum management; MATLAB AI and Deep Learning Toolbox.
- AI in Computer Science and allied branches: GitHub Copilot for code generation, explanation, and review; AI-powered testing (Testim, Selenium AI); AI in cybersecurity anomaly detection and intrusion detection; no-code/low-code platforms (Bubble, Glide, Webflow AI); AI for data science (Jupyter AI, DataRobot).

AI Tools Integration: Each student identifies 5 real AI tools in their own engineering branch using Claude or ChatGPT and verifies each using official product pages or research publications; present findings in a 3-minute class presentation with a structured comparison table.

Unit Outcomes

- Identify real AI tools and applications in at least two engineering disciplines.
- Verify AI application claims using official documentation or published research.
- Discuss how AI is changing engineering practice and what new skills engineers now need.

UNIT – V: RESPONSIBLE AI, ETHICS, AND CAPSTONE PROJECT	9Hrs

- AI bias and fairness: sources of bias (data, model, deployment); real documented cases Amazon hiring algorithm (2018), COMPAS recidivism (2016), facial recognition disparities (NIST 2019); fairness metrics; misinformation, deepfakes, and synthetic media risks.
- Privacy and intellectual property: what happens to data entered into public AI tools; PII risks; data retention policies of ChatGPT (OpenAI), Claude (Anthropic), and Gemini (Google); who owns AI-generated content; copyright status globally;
  academic plagiarism with AI; personal data safety protocol.
- AI governance frameworks: EU AI Act risk tiers (unacceptable, high, limited, minimal); UNESCO AI Ethics Recommendation; India's NITI Aayog Responsible AI Guidelines; India Digital Personal Data Protection Act 2023 (DPDP
  Act); environmental cost of AI energy and carbon footprint of LLM training and inference.
- Capstone Mini-Project: each student (or pair) defines a real engineering problem, selects at least 3 AI tool categories from
  Units I–IV, produces a quality-verified deliverable (report, presentation, diagram, or automation), and presents in 5 minutes. Evaluation: problem clarity, tool selection, output quality, human refinement, responsible AI disclosure.

AI Tools Integration: Read and compare data retention policies of ChatGPT, Claude, and Gemini; classify 5 daily-use AI systems using EU AI Act risk tiers; use GPTZero and Google Lens to detect AI-generated content; design and present the Capstone Mini-Project integrating tools from all five units.

Unit Outcomes

- Explain AI bias, privacy risks, and governance frameworks including India's DPDP Act 2023.
- Apply a personal data safety protocol when using public AI tools.
- Design, execute, and present an AI-assisted mini-project with responsible usage disclosure.

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LEARNING RESOURCES

Reference Books

• Ethan Mollick, Co-Intelligence: Living and Working with AI, Portfolio/Penguin, 2024.
• Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson Education, 2020.
• Reid Blackman, Ethical Machines, Harvard Business Review Press, 2022.

Free Online Courses

• Google – Fundamentals of AI – grow.google/intl/en_in/ai-learning-resources
• Microsoft – AI Skills Navigator – microsoft.com/en-us/ai/ai-skills
• Andrew Ng – AI for Everyone (Coursera, free to audit) – coursera.org/learn/ai-for-everyone
• Elements of AI – University of Helsinki (free, beginner) – elementsofai.com

Tools Used in This Course (All Free-Tier Accessible)

• AI Assistants: ChatGPT – chat.openai.com | Claude – claude.ai | Gemini – gemini.google.com | Microsoft Copilot – copilot.microsoft.com
• Research & Notes: NotebookLM – notebooklm.google.com | Perplexity AI – perplexity.ai | Elicit – elicit.org | Consensus – consensus.app
• Presentations & Docs: Gamma.app | Notion AI – notion.so | Beautiful.ai | Copilot in Office 365 | Gemini in Google Workspace
• Diagrams & Design: Napkin.ai | Whimsical AI – whimsical.com | Miro AI – miro.com | Canva AI – canva.com | DALL-E 3 via ChatGPT
• Data & Spreadsheets: ChatGPT Advanced Data Analysis | Julius AI – julius.ai | Copilot in Excel | Gemini in Sheets
• Math & Equations: Wolfram Alpha – wolframalpha.com | Symbolab – symbolab.com | Mathway – mathway.com | Microsoft Math Solver – math.microsoft.com | Photomath – photomath.com | Desmos – desmos.com | GeoGebra – geogebra.org
• Audio & Video: ElevenLabs – elevenlabs.io | Suno – suno.com | Runway – runwayml.com | HeyGen – heygen.com
• Detection & Automation: GPTZero – gptzero.me | Originality.ai | Google Lens | Make.com | GitHub Copilot

Web References

• EU AI Act – eur-lex.europa.eu | UNESCO AI Ethics – unesco.org | NITI Aayog – niti.gov.in
• India DPDP Act 2023 – meity.gov.in | ProPublica COMPAS – propublica.org | MIT Technology Review – technologyreview.com

Mapping of COs to POs

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

Unit No.	Lesson plan(Hrs)	Correlation	CO's Action verb	BTL	Program Outcome (PO)	PO(s) : Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
1			CO1 : Understand	L2	PO1	PO1: Apply(L3)	2
					PO2	PO2: Review(L2)	3
2			CO2 : Apply	L3	PO1	PO1: Apply(L3)	3
					PO2	PO2: Analyze (L4)	2
					PO3	PO3: Develop (L3)	3
					PO4	PO4: Analyze (L4)	2
					PO5	PO5:Apply(L3)	3
3			CO3 : Understand	L2	PO1	PO1: Apply(L3)	2
					PO2	PO2: Identify(L3)	2
					PO3	PO3: Develop (L3)	2
					PO4	PO4: Analyze (L4)	1

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					PO5	PO5:Apply(L3)	2
4			CO4 : Analyze	L4	PO2	PO2: Review(L2)	1
					PO3	PO3: Develop(L3)	2
					PO5	PO5: Apply(L3)	2
					PO11	PO11: Thumb Rule	2
5			CO5 : Analyze	L4	PO1	PO1: Apply(L3)	3
					PO2	PO2: Review (L2)	3
					PO3	PO3: Develop (L3)	3
					PO4	PO4: Analyze (L4)	3
					PO5	PO5:Apply(L3)	2
					PO11	PO11: Thumb Rule	2

Justification Statements

CO1: Understand the AI fundamentals concepts and AI tool categories.
Action Verb: Understand (L2)
PO1: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is medium (2)
PO2: Review(L2)
CO1 Action verb is same level as PO2 verb. Therefore the correlation is high (3)

CO2: Apply the AI tools, prompt engineering, and NotebookLM for learning and content creation.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO2 Action verb is same level as PO1 verb. Therefore the correlation is high (3)
PO2: Analyze (L4)
CO2 Action verb is less than PO2 verb by one level. Therefore the correlation is medium(2)
PO3: Develop (L3)
CO2 Action verb is same level as PO3 verb. Therefore the correlation is high (3)
PO4: Analyze (L4)
CO2 Action verb is less than PO4 verb by one level. Therefore the correlation is medium(2)
PO5: Apply (L3)
CO2 Action verb is same level as PO5 verb. Therefore the correlation is high (3)

CO3: Understand the AI tools for data analysis, research, and information management.
Action Verb: Understand (L2)
PO1: Apply (L3)
CO3 Action verb is less than one level as PO1 verb. Therefore the correlation is medium(2)
PO2: Identify (L3)
CO3 Action verb is less than one level as PO2 verb. Therefore the correlation is medium(2)
PO3: Develop (L3)
CO3 Action verb is less than one level as PO3 verb. Therefore the correlation is medium(2)
PO4: Analyze (L4)
CO3 Action verb is less than two level as PO4 verb. Therefore the correlation is low (1)
PO5: Apply (L3)
CO3 Action verb is less than one level as PO5 verb. Therefore the correlation is medium(2)

CO4: Analyze the AI applications for visual design and engineering solutions.
Action Verb: Analyze (L4)
PO2: Review (L2)
CO4 Action verb is less than two level as PO2 verb. Therefore the correlation is low (1)
PO3: Develop (L3)
CO4 Action verb is less than one level as PO3 verb. Therefore the correlation is medium (2)
PO4: Apply (L3)
CO4 Action verb is less than one level as PO4 verb. Therefore the correlation is medium (2)
PO11: Thumb rule
Artificial intelligence learning methods are used for developing intelligent agents. Therefore the correlation is medium(2)

CO5: Analyze the AI-assisted project using responsible AI practices.

Action Verb: Analyze (L4)

PO1: Apply (L3)

CO5 Action verb is same level as PO1 verb. Therefore the correlation is high (3)

PO2: Review (L2)

CO5 Action verb is same level as PO2 verb. Therefore the correlation is high (3)

PO3: Develop (L3)

CO5 Action verb is same level as PO3 verb. Therefore the correlation is high (3)

PO4: Analyze (L4)

CO5 Action verb is same level as PO4 verb. Therefore the correlation is high (3)

PO5: Apply (L3)

CO3 Action verb is less than one level as PO5 verb. Therefore the correlation is medium(2)

PO11: Thumb rule

For developing expert systems some of python program concepts are used to create programs. Therefore the correlation is medium (2)

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MECHANICAL ENGINEERING (ME)

Year: I **Semester: I/II** **Branch of Study: Common to all Branches**

Subject Code	Subject Name	L	T	Pr/CLC	P	Credits
26AES0302	Engineering Workshop	0	0	0	3	1.5

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

CO: 1 Apply wood working skills to fabricate different types of timber joints.
CO: 2 Apply the sheet metal and fitting operation skills to fabricate various components.
CO: 3 Apply basic electrical wiring principles to perform house wiring practices.
CO: 4 Understand plumbing techniques to fabricate different types of pipe joints.
CO: 5 Apply welding and foundry techniques to fabricate welding joints and foundry patterns.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Apply	Wood working skills and timber joint fabrication techniques	using woodworking tools and workshop practices	accurately fabricate different types of timber joints as per specifications	L3
CO2	Apply	the sheet metal and fitting operation skills for component fabrication	using sheet metal and fitting tools	correctly analyze and fabricate various sheet metal and fitting components	L3
CO3	Apply	basic electrical wiring principles and house wiring practices	using electrical tools and wiring accessories	successfully perform house wiring with proper safety and functionality	L3
CO4	Understand	plumbing techniques and pipe joint fabrication methods	using plumbing tools and standard procedures	demonstrate correct fabrication of different types of pipe joints	L2
CO5	Apply	welding and foundry techniques for joint and pattern fabrication	using welding and foundry equipment	Accurately fabricate welding joints and foundry patterns as per specifications	L3

SYLLABUS

1. Safety Practices & Precautions
Demonstrate the necessity of Workshop hazards, various Personal Protective Equipment and emergency protocols.
AI Integration: Computer vision for safety compliance.

2. Wood working: Introduction to different types of woods, carpentry tools, timber joints
a) Half – Lap joint b) Mortise and Ten on joint c) Corner Dovetail joint or Bridle joint

3. Fitting: Familiarity with different types of tools used in fitting and perform fitting exercises like
a) V-fit b) Dovetail fit c) Semi-circular fit

4. 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

5. Electrical wiring: Introduction to electrical tools, safety precautions, wiring materials.

Familiarity with different types of basic electrical circuits and make the following connections.

a) Parallel and series b) Two-way switch c) God own lighting d) Tube light e) Three phase motor f) Soldering of wires

6. Plumbing: Introduction to plumbing tools, pipe fittings, thread cutting, making a simple PVC pipe joint. Preparation of Pipe joints with coupling for same diameter and with reducer for different diameters.

7. **Welding Shop**: Demonstration and practice on Arc Welding and Gas welding. Preparation of a simple Lap joint/Butt joint.

8. Foundry Trade: Demonstration and practice on Moulding tools and processes, Preparation of Green Sand Moulds for a simple Patterns.

9. Introduction to 3D Printing: Demonstrate the core concepts of 3D printing, Hardware, software, Digital file and 3D printing materials. Familiarise with 3D Printing Process of complex objects.

10. Computer Components:

Disassemble and reassemble a desktop computer to understand the role of each component (CPU, motherboard, RAM, HDD/SSD, GPU, etc.).

Hardware Troubleshooting & Peripheral Installation:

Simulate common hardware issues (e.g., RAM failure, CPU overheating) and identify the procedures to resolving them.

Peripheral Installation:

Install and configure peripheral devices such as printers, scanners, and external hard drives.

Network Setup and Configuration:

Set up a small LAN network with routers, switches, and computers. Configure IP addresses, subnet masks, and basic network services.

11. Disassembly and Assembly of equipment such as Bicycle, Gear Box, Braking System: Familiarise with disassembly and assembly process

AI Integration Module: Smart energy monitoring using IoT current sensors; building machine learning load forecasting models; training anomaly detection systems to automatically flag electrical arc or leakage patterns.

Develop predictive load-monitoring models that detect faulty configurations or phantom energy drains.

Learning Resources

Textbooks

1. **Workshop Core Reference**: *Workship Technology Vol I & II* by S.K. Hajra Choudhury, Media Promoters & Publishers.
2. **Workshop Core Reference**: *A Course in Workshop Technology* by B.S. Raghuwanshi, DhanpatRai & Co. 2015 & 2017
3. **Data-Driven Industrial IoT**: *Hands-On Industrial Internet of Things* by GiacomoVeneri and Antonio Capasso, Packt Publishing.
4. Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published,2019. Workshop Processes, Practices and Materials; Bruce J. Black, Routledge publishers, 5th Edn. 2015.
5. 3. Wiring Estimating, Costing and Contracting; Soni P.M. &Upadhyay P.A.; Atul Prakashan, 2021-22.

Reference Books

1. Manufacturing Technology (Foundry, Forming and Welding) by P.N. Rao, McGraw Hill.
2. An Introduction to Predictive Maintenance by R. Keith Mobley, Butterworth-Heinemann.

Video Links & Online Lectures

- **Classical Shop floor Operations**: NPTEL Workshop Practices Video Series by IIT Kharagpur

- **Industrial AI & Predictive Analytics**: Predictive Maintenance Models in Python Tutorial
- **Smart Sensors & Electronics Fabrication**: MIT 6.131: Power Electronics and Smart Grid Interfaces

CO – PO Articulation Matrix

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Engineering Workshop	CO1	3	3	3						3			3	3
	CO2	3	3	3						3			3	3
	CO3	3	3	3						3			3	3
	CO4	2	3	2						2			3	3
	CO5	3	3	3						3			3	3

Correlation Matrix

CO	CO					Program Outcomes (PO)	PO(s): Action Verb and BTL (forPO1to PO5)	Level of Correlation
	Lesson Plan (Hrs)	%	Correlation	Verb	BTL			
1	9	25	3	Apply	L3	PO1 PO2 PO3 PO9	Apply-L3 Review-L2 Develop-L3 ThumbRule-L3	3 3 3 2
2	9	25	3	Apply	L3	PO1 PO2 PO3 PO9	Apply-L3 Review-L2 Develop-L3 ThumbRule-L3	3 3 3 2
3	6	16.67	2	Apply	L3	PO1 PO2 PO3 PO9	Apply-L3 Review-L2 Develop-L3 ThumbRule-L3	3 3 3 2
4	6	16.66	2	Understand	L2	PO1 PO2 PO3 PO9	Apply-L3 Review-L2 Develop-L3 ThumbRule-L3	2 3 2 2
5	6	16.67	2	Apply	L3	PO1 PO2 PO3 PO9	Apply-L3 Review-L2 Develop-L3 ThumbRule-L3	3 3 3 2
Total	36	100						

Justification Statements:

CO1: Apply woodworking skills to fabricate different types of timber joints.

Action Verb: **Apply (L3)**

PO1Verb: **Apply (L3)**
CO1 Action verb is same level as PO1verb.Therefore, the correlation is high (3)
PO2 Verb: **Review (L2)**
CO1 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO1 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO9 Verb: **Thumb Rule**
As per thumb rule CO1 co-relates slightly with PO9 verb. Therefore, the correlation is medium (2)

CO2: Apply the sheet metal and fitting operation skills to fabricate various components.

Action Verb: **Apply (L3)**

PO1Verb: **Apply (L3)**
CO2 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2Verb: **Review (L2)**
CO2 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**

CO2 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO9Verb: **Thumb Rule**
As per thumb rule CO2 co-relates slightly with PO9 verb. Therefore, the correlation is medium (2)

CO3: Apply basic electrical wiring principles to perform house wiring practices.

Action Verb: **Apply (L3)**
PO1Verb: **Apply (L3)**
CO3 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Review (L2)**
CO3 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO3 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO9 Verb: **Thumb Rule**
As per thumb rule CO3 co-relates slightly with PO9 verb. Therefore, the correlation is medium (2)

CO4: Understand plumbing techniques to fabricate different types of pipe joints.

Action Verb: **Understand (L2)**
PO1Verb: **Apply (L3)**
CO4Action verb is lower than as PO1verb.Therefore, the correlation is medium (2)
PO2 Verb: **Review (L2)**
CO4 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO4 Action verb is lower than as PO3 verb. Therefore, the correlation is medium (2)
PO9 Verb: **Thumb Rule**
As per thumb rule CO4 co-relates slightly with PO9 verb. Therefore, the correlation is medium (2)

CO5: Apply welding and foundry techniques to fabricate welding joints and foundry patterns.

Action Verb: **Apply (L3)**
PO1Verb: **Apply (L3)**
CO5 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Review (L2)**
CO5 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO5 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO9 Verb: **Thumb Rule**
As per thumb rule CO5 co-relates slightly with PO9 verb. Therefore, the correlation is medium (2)

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MECHANICAL ENGINEERING (ME)

26ABS990403	Physics lab for Mechanical Engineers (AI integrated)	L	T	Pr	P	C
		0	0	0	3	1.5

I Year I Semester

After the completion of the course, the students will be able to

CO	Course Outcome Statement	Bloom's Level
CO1	Analyze the properties of light for engineering problems.	L4(Analyze)
CO2	Analyze the spectral and dispersive properties of the optical systems	L4(Analyze)
CO3	Evaluate the crystallite size using X-ray diffraction.	L5(Evaluate)
CO4	Analyze the mechanical behaviour of a given material.	L4(Analyze)
CO5	Evaluate the dynamic characteristics of oscillatory systems and ultrasonic waves	L5(Evaluate)

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Analyze**	**The properties of light**		**for engineering problems.**	**L4**
2	**Analyze**	**The spectral and dispersive properties of the optical systems**			**L4**
3	**Evaluate**	**The crystallite size using X-ray diffraction**	**Uuing X-ray diffraction**		**L5**
4	**Analyze**	**The mechanical behaviour of a given material**			**L4**
5	**Evaluate**	**The dynamic characteristics of oscillatory systems and ultrasonic waves**			**L5**

Any **10** of the following experiments (8 in physical mode and 2 in virtual mode) can be performed during the semester.

1. Determination of the radius of curvature of the lens by Newton's rings. CO1
2. Determination of the thickness of a thin object by the wedge method. CO1
3. Determination of wavelength of a LASER using a diffraction grating CO1
4. Determination of wavelengths of various colours of mercury spectrum using diffraction grating in the normal incidence method. CO2
5. Determination of the dispersive power of the prism. CO2
6. Determination of the crystalline size and lattice parameter by using X-Ray diffraction method. CO3
7. Melde's experiment: Determination of the frequency of the tuning fork. CO4
8. Sonometer: Verification of the three laws of stretched strings. CO4

9. Determination of Rigidity modulus of material of a wire-dynamic method (Torsional pendulum). CO4
10. Determination of frequency of normal modes of the Coupled Oscillator. CO5
11. Determination of ultrasonic velocity in liquid (Acoustic grating) (CO5)
12. Study of oscillations of a mass under different combinations of springs (Loaded Springs). CO5
13. **Estimation of Planck's constant using the photoelectric effect (Virtual lab)**
14. **Determination of spring constant by Hooke's law (Virtual lab)**
15. Determination of particle size using a diode laser
16. Study of the Refractive Index of Materials using a hollow prism used in surveying

AI Extension: Python (NumPy, SciPy, OpenCV, Matplotlib) – FREE on Google Colab for optics and EM simulations

Web Resources:
- HyperPhysics – hyperphysics.phy-astr.gsu.edu
- PhET Simulations – phet.colorado.edu
- https://iitb.vlabs.co.in/discipline.html?discipline=Physical_Sciences

Recommended AI Tools:
- Python (NumPy, Pandas, Matplotlib)
- TensorFlow / Scikit-learn

CO – PO Articulation Matrix

Scale: 3 – Strong, 2 – Moderate, 1 – Slight, – No Correlation

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

CO-PO mapping justification:

CO	CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Verb	BTL			
1	Analyze	L4	PO1 PO4 PO5	PO1: Apply (L3) PO4: Analyze (L4) PO5: Apply (L4)	3 3 3
2	Analyze	L4	PO1 PO4 PO5	PO1: Apply (L3) PO4: Analyze (L4) PO5: Apply (L4)	3 3 3
3	Evaluate	L5	PO1 PO4 PO5	PO1: Apply (L3) PO4: Analyze (L4) PO5: Apply (L4)	3 3 3
4	Analyze	L4	PO1 PO4 PO5	PO1: Apply (L3) PO4: Analyze (L4) PO5: Apply (L4)	3 3 3
5	Evaluate	L5	PO1 PO4 PO5	PO1: Apply (L3) PO4: Analyze (L4) PO5: Apply (L4)	3 3 3

CO1: Analyze the properties of light for engineering problems.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)
PO4 Verb: Analyze (L4)
PO5 Verb: Apply (L3)
CO1 Action Verb is greater than PO1 action verb by one level; Therefore, correlation is high (3).
CO1 Action Verb is equal to PO4 action verb. Therefore correlation is high (3).
CO1 Action Verb is greater than PO5 action verb; Therefore, correlation is high (3).

CO2: Analyze the spectral and dispersive properties of the optical systems.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)
PO4 Verb: Analyze (L4)
PO5 Verb: Apply (L3)
CO2 Action Verb is greater than PO1 action verb by one level; Therefore, correlation is high (3).
CO2 Action Verb is equal to PO4 action verb. Therefore correlation is high (3).
CO2 Action Verb is greater than PO5 action verb; Therefore, correlation is high (3).

CO3: Evaluate the crystallite size using X-ray diffraction.

Action Verb: Evaluate (L5)

PO1 Verbs: Apply (L3)
PO4 Verb: Analyze (L4)
PO5 Verb: Apply (L3)
CO3 Action Verb is greater than PO1 action verb by two levels; Therefore, correlation is high (3).
CO3 Action Verb is greater than PO4 action verb by one level; Therefore, correlation is high (3).
CO3 Action Verb is greater than PO5 action verb by two levels; Therefore, correlation is high (3).

CO4: Analyze the mechanical behaviour of a given material.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)
PO4 Verb: Analyze (L4)
PO5 Verb: Apply (L3)
CO4 Action Verb is greater than PO1 action verb by one level; Therefore, correlation is high (3).
CO4 Action Verb is equal to PO4 action verb. Therefore correlation is high (3).
CO4 Action Verb is greater than PO5 action verb; Therefore, correlation is high (3).

CO5: Evaluate the dynamic characteristics of oscillatory systems and ultrasonic waves.

Action Verb: Evaluate (L5)

PO1 Verbs: Apply (L3)
PO4 Verb: Analyze (L4)
PO5 Verb: Apply (L3)
CO5 Action Verb is greater than PO1 action verb by two levels; Therefore, correlation is high (3).
CO5 Action Verb is greater than PO4 action verb by one level; Therefore, correlation is high (3).
CO5 Action Verb is greater than PO5 action verb by two levels; Therefore, correlation is high (3).

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MECHANICAL ENGINEERING (ME)

Course Code	Year & Sem	Computational Thinking and Problem Solving With Python Lab	L	T / CLC	Pr	P	C
26AES0502	I - I	**Common to All Branches**	**0**	**0**	**0**	**3**	**1.5**

Course Outcomes:
After studying the course, student will be able to
CO1: **Apply** computational thinking and Python fundamentals to develop simple programs.
CO2: **Apply** decision-making and looping constructs to solve programming problems.
CO3: **Analyze** Python strings and data structures for problem solving.
CO4: **Analyze** functions, recursion, and dictionaries to develop modular Python programs.
CO5: **Evaluate** file handling, exception handling & OOP for Python applications.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	Apply	Computational thinking and Python fundamentals	using python	to develop simple programs	L3
CO2	Apply	Decision-making and looping constructs	in python	for problem solving	L3
CO3	Analyze	Python strings and data structures	in python program		L4
CO4	Analyze	Functions, recursion, and dictionaries	in python	for modular programming	L4
CO5	Evaluate	File handling, exception handling, and OOP	in Python applications		L5

MODULE I	**COMPUTATIONAL THINKING & PROGRAMMING BASICS**

Topics: Computational thinking — decomposition and abstraction; algorithms, flowcharts, and pseudocode; Python environment setup; variables, data types, input/output, and operators; basic computational problems.
AI Integration: Generate alternate solutions and test inputs; verify flowchart correctness; compare solution efficiency; explain type conversion.
Suggested Tools: Python, Flowgorithm, draw.io AI, ChatGPT, Microsoft Copilot
Experiment 1: Problem Solving using Computational Thinking — Select three daily-life problems; apply decomposition and abstraction; write algorithms, draw flowcharts, and convert them into pseudocode.
Experiment 2: Flowchart Design and Algorithm Simulation — Design flowcharts for largest of three numbers, student grade calculation, and electricity-bill generation; simulate execution and verify outputs.
Experiment 3: Python Programming Fundamentals — Install the Python environment; write programs using variables, data types, input/output, and operators; solve simple interest, area, and unit-conversion problems.

MODULE II	**DECISION MAKING & LOOPING**

Topics: Decision-control statements; looping and iterative problem solving; nested loops and pattern generation.
AI Integration: Generate boundary and test cases; verify decision logic; trace loop execution; compare loop alternatives; optimize nested loops.
Suggested Tools: Python, Python Tutor, ChatGPT, Microsoft Copilot
Experiment 4: Decision Control Statements — Develop Python programs for largest among three numbers, grade calculation, leap-year checking, and a menu-driven calculator.
Experiment 5: Looping and Iterative Problem Solving — Implement programs for prime-number generation, Armstrong numbers, factorial computation, and multiplication tables.
Experiment 6: Nested Loops and Pattern Generation — Generate number, pyramid, diamond, and character patterns.

MODULE III	**STRINGS & DATA STRUCTURES**

Topics: String processing; lists and nested lists; tuples and sets.
AI Integration: Generate string test cases and sample datasets; explain slicing and immutable structures; compare list approaches and suggest optimizations.
Suggested Tools: Python, Python Tutor, Algorithm Visualizer, ChatGPT
Experiment 7: String Processing Applications — Develop programs for string reversal, palindrome checking, frequency counting, and word-occurrence analysis.

Experiment 8: List and Nested List Operations — Perform sorting, searching, list merging, and matrix operations using nested lists.

Experiment 9: Tuple and Set Applications — Implement tuple packing/unpacking, student-record storage, and set union, intersection, and difference operations.

MODULE IV	**FUNCTIONS & PROBLEM SOLVING**

Topics: User-defined functions; recursion; dictionaries and lambda functions.

AI Integration: Generate function examples and datasets; verify outputs; generate recursion trees; compare iterative and recursive solutions; explain lambda execution.

Suggested Tools: Python, Python Tutor, Algorithm Visualizer, ChatGPT

Experiment 10: User-Defined Functions — Implement positional, keyword, default, and variable-length arguments.

Experiment 11: Recursive Problem Solving — Develop recursive solutions for factorial, Fibonacci, GCD, and Tower of Hanoi.

Experiment 12: Dictionary and Lambda Applications — Implement a student database, dictionary operations, dictionary sorting, and lambda-based computations.

MODULE V	**FILE HANDLING, EXCEPTION HANDLING & OOP**

Topics: File processing and data storage; exception handling and testing; object-oriented programming — classes, objects, constructors, methods.

AI Integration: Generate datasets and error scenarios; verify file outputs; recommend exception strategies; generate class diagrams and suggest object interactions.

Suggested Tools: Python, ChatGPT, Microsoft Copilot

Experiment 13: File Processing and Data Storage — Develop programs to create and read text files, count words, and process CSV data.

Experiment 14: Exception Handling and Testing — Implement try-except, finally, and custom exceptions; apply exception handling to division operations, file access, and input validation.

Experiment 15: Object-Oriented Programming Mini Project — Develop a Python application using classes, objects, constructors, and methods.

Suggested Mini Projects:

1. Student Management System
2. Library Management System
3. Banking System

Textbooks:

1. Pieter Spronck, Computational Thinking with Python.
2. Reema Thareja, Programming in Python, Oxford University Press.

Reference Books:

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist.
2. Eric Matthes, Python Crash Course.
3. John Zelle, Python Programming: An Introduction to Computer Science.

Recommended AI / Computational Tools

1. **AI Assistants:** ChatGPT, Microsoft Copilot – code generation, explanation and test-case generation.
2. **Flowchart & Diagramming:** Flowgorithm, Lucidchart AI, draw.io AI – algorithm and flowchart design.
3. **Visualization:** Algorithm Visualizer, Python Tutor – execution tracing and recursion visualization.

Mapping of course outcomes with program outcomes

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

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Correlation matrix

Unit No.	Co's Action verb	BTL	Program Outcome (PO)	PO(s) : Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
1	CO1: Apply	L3	PO1	PO1: Apply (L3)	**3**
			PO2	PO2: Review (L2)	**3**
			PO5	PO5: Apply (L3)	**3**
			PO11	PO11: Thumb Rule	**2**
2	CO2: Apply	L3	PO1	PO1: Apply (L3)	**3**
			PO2	PO2: Review (L2)	**3**
			PO5	PO5: Apply (L3)	**3**
			PO11	PO11: Thumb Rule	**2**
3	CO3: Analyze	L4	PO1	PO1: Apply (L3)	**3**
			PO2	PO2: Review (L2)	**3**
			PO3	PO3: Develop (L3)	3
			PO4	PO4: Analyze (L4)	**3**
			PO5	PO5: Apply (L3)	**3**
			PO11	PO11: Thumb Rule	**3**
4	CO4: Analyze	L4	PO1	PO1: Apply (L3)	**3**
			PO2	PO2: Review (L2)	**3**
			PO3	PO3: Develop (L3)	**3**
			PO4	PO4: Analyze (L4)	**3**
			PO5	PO5: Apply (L3)	**3**
			PO11	PO11: Thumb Rule	**3**
5	CO5: Evaluate	L5	PO1	PO1: Apply (L3)	**3**
			PO2	PO2: Review (L2)	**3**
			PO4	PO4: Analyze (L4)	**3**
			PO5	PO5: Apply (L3)	**3**
			PO11	PO11: Thumb Rul	**3**

Justification Statements:

CO1: Apply computational thinking and Python fundamentals to develop simple programs.

Action Verb: Apply (L3)
PO1: Apply (L3)
CO1 action verb is the same as the PO1 action verb. Therefore, the correlation is **High (3)**.
PO2: Review (L2)
CO1 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.
PO5: Apply (L3)
CO1 action verb is the same as the PO5 action verb. Therefore, the correlation is **High (3)**.
PO11: Thumb Rule
Computational thinking and Python programming fundamentals encourage independent learning and adaptability to modern programming technologies. Therefore, the correlation is **Moderate (2)**.

CO2: Apply decision-making and looping constructs to solve programming problems.

Action Verb: Apply (L3)
PO1: Apply (L3)
CO2 action verb is the same as the PO1 action verb. Therefore, the correlation is **High (3)**.
PO2: Review (L2)
CO2 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.
PO5: Apply (L3)
CO2 action verb is the same as the PO5 action verb. Therefore, the correlation is **High (3)**.
PO11: Thumb Rule
Programming using decision-making and looping constructs promotes continuous learning and problem-solving skills. Therefore, the correlation is **Moderate (2)**.

CO3: Analyze Python strings and data structures for problem solving.

Action Verb: Analyze (L4)
PO1: Apply (L3)
CO3 action verb is greater than the PO1 action verb. Therefore, the correlation is **High (3)**.

PO2: Review (L2)
CO3 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.
PO3: Develop (L3)
CO3 action verb is greater than the PO3 action verb. Therefore, the correlation is **High (3)**.
PO4: Analyze (L4)
CO3 action verb is the same as the PO4 action verb. Therefore, the correlation is **High (3)**.
PO5: Apply (L3)
CO3 action verb is greater than the PO5 action verb. Therefore, the correlation is **High (3)**.
PO11: Thumb Rule
Analysis of Python data structures enhances independent learning and analytical skills. Therefore, the correlation is **High (3)**.

CO4: Analyze functions, recursion, and dictionaries in Python.

Action Verb: Analyze (L4)
PO1: Apply (L3)
CO4 action verb is greater than the PO1 action verb. Therefore, the correlation is **High (3)**.
PO2: Review (L2)
CO4 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.
PO3: Develop (L3)
CO4 action verb is greater than the PO3 action verb. Therefore, the correlation is **High (3)**.
PO4: Analyze (L4)
CO4 action verb is the same as the PO4 action verb. Therefore, the correlation is **High (3)**.
PO5: Apply (L3)
CO4 action verb is greater than the PO5 action verb. Therefore, the correlation is **High (3)**.
PO11: Thumb Rule
Functions, recursion, and dictionaries strengthen analytical thinking and lifelong learning skills. Therefore, the correlation is **High (3)**.

CO5: Evaluate file handling, exception handling, and object-oriented programming applications.

Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO5 action verb is greater than the PO1 action verb. Therefore, the correlation is **High (3)**.
PO2: Review (L2)
CO5 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.
PO4: Analyze (L4)
CO5 action verb is greater than the PO4 action verb. Therefore, the correlation is **High (3)**.
PO5: Apply (L3)
CO5 action verb is greater than the PO5 action verb. Therefore, the correlation is **High (3)**.
PO11: Thumb Rule
File handling, exception handling, and object-oriented programming enable students to build reliable software applications and adapt to evolving technologies. Therefore, the correlation is **High (3)**

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MECHANICAL ENGINEERING (ME)

I B.Tech Common to I Sem ECE/AI&DS/AI&ML/CE/ME & II SEM CSE/CIC/CSD/EEE

Course Code: 26AHM9904	**NSS/NCC/SCOUTS&GUIDES/ COMMUNITY SERVICE**		**L**	**T**	**P**	**C**
			0	**0**	**1**	**0.5**

Course Objectives:
The objective of introducing this course is to impart discipline, character, fraternity, teamwork,social consciousness among the students and engaging them in selfless service.

Course Outcomes: After completion of the course the student will be able toCO1

CO1: Understand the philosophy, history, and objectives of NSS/NCC/Scouts & Guides and community service programmes.
CO2: Apply leadership, teamwork, and organisational skills through camp/parade/drill activities.
CO3: Create community service projects addressing social issues like health, hygiene, literacy, and environment.
CO4:Apply first aid, disaster-preparedness, and civic responsibilities in real-world scenarios.
CO5:Understand civic sense, national integration, and sustainable community-development values.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	the philosophy, history, and objectives of NSS/NCC/Scouts & Guides and community service programmes.			**L2**
2	**Apply**	leadership, teamwork, and organisational skills through camp/parade/drill activities.			**L3**
3	**Create**	community service projects addressing social issues like health, hygiene, literacy, and environment.			**L6**
4	**Apply**	first aid, disaster-preparedness, and civic responsibilities in real-world scenarios.			**L3**
5	**Understand**	civic sense, national integration, and sustainable community-development values.			**L2**

Course Outcomes (COs)

Bloom's Taxonomy Levels: Remember (L1) | Understand (L2) | Apply (L3) | Analyse (L4) | Evaluate (L5) | Create (L6)

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Unit-wise Syllabus with Learning Outcomes

UNIT 1	Foundation of NSS, NCC, Scouts & Guides and Community Service	5 Hrs
Topics	• Introduction to NSS – history, objectives, badge, motto, pledge • Introduction to NCC – ranks, uniforms, aims, NCC Act 1948 • Scouts & Guides – Baden-Powell legacy, Bharat Scouts & Guides Act • Community Service – concept, importance and types • Citizenship, civic sense and social responsibility • Volunteerism: global and Indian perspective (NYKS, NSS, Red Cross) • Legal & ethical framework for community service	
Unit-wise Learning Outcomes (ULOs)	**On completion of this unit, students will be able to:** • ULO1.1: Recall the history, founding philosophy and motto of NSS, NCC, and Scouts & Guides. [Remember] • ULO1.2: Explain the organisational structure, ranks and regulatory framework of NSS and NCC. [Understand] • ULO1.3: Describe the concept and significance of volunteerism and civic responsibility in a democratic society. [Understand] • ULO1.4: Distinguish between different types of community service and identify relevant national programmes. [Analyse]	
UNIT 2	**Leadership, Skill Development, Camping and Disaster Management**	**5 Hrs**
Topics	• Leadership development – theories and models (situational, transformational) • Team building, communication & conflict resolution • Parade, drill & physical training basics • Map reading, navigation and field craft (NCC) • Camp organisation – planning, logistics, safety protocols • Adventure activities: trekking, rock-climbing, swimming (awareness) • Disaster management – concepts, types, roles of NSS/NCC volunteers • First Aid – CPR, wound management, fractures, snake bite, burn	
Unit-wise Learning Outcomes (ULOs)	**On completion of this unit, students will be able to:** • ULO2.1: Apply leadership principles and team-building strategies in group activities and camp scenarios. [Apply] • ULO2.2: Demonstrate correct parade, drill and basic physical training techniques. [Apply] • ULO2.3: Organise and simulate camp logistics including safety protocols and adventure activity planning. [Apply] • ULO2.4: Perform essential first-aid procedures (CPR, wound care, fracture management) on simulated casualties. [Apply] • ULO2.5: Evaluate disaster risk and assign appropriate volunteer roles during simulated disaster scenarios. [Evaluate]	
UNIT 3	**Community Projects, Social Awareness and Service Documentation**	**5 Hrs**
Topics	• Community needs assessment – participatory methodology • Project planning: Swachh Bharat, Pulse Polio, Blood Donation camps • Literacy campaigns and awareness drives (PadhnaLikhna Abhiyan) • Environmental conservation – plantation, solid waste, water conservation • Gender sensitisation and women empowerment programmes • Digital literacy and e-governance outreach • Documentation and reporting of service-learning activities • Reflection, portfolio preparation and field report writing	
Unit-wise Learning Outcomes	**On completion of this unit, students will be able to:** • ULO3.1: Conduct a community needs assessment using participatory tools. [Analyse]	

(ULOs)	• ULO3.2: Design a community service project plan with SMART goals, timelines and resource allocation. [Create] • ULO3.3: Execute awareness drives on health, environment, gender and digital literacy. [Apply] • ULO3.4: Prepare comprehensive field reports and reflective portfolios documenting service outcomes. [Create] • ULO3.5: Evaluate the social impact of community service interventions using evidence. [Evaluate]

Text Books

S.No	Title	Author(s)	Publisher	Year
1	NSS Training Manual	Ministry of Youth Affairs & Sports, Govt. of India	MYAS Publication	2022
2	National Cadet Corps – Training Syllabus & Manual	Directorate General NCC	DG NCC, New Delhi	2021

Reference Books

S.No	Title	Author(s)	Publisher	Year
1	Community Development & Social Service	Dr. S. K. Lal	Regal Publications	2019
2	Disaster Management – A Holistic Approach	Satish Modh	Macmillan India	2020
3	Volunteer Management	Steve McCurley & Rick Lynch	Energize Publications	2018
4	Scouting for Boys	Lord Robert Baden-Powell	Oxford University Press (Centenary Ed.)	2008

Web Resources

- NSS Official Portal – https://nss.gov.in
- NCC Official Site – https://indiancc.mygov.in
- Bharat Scouts & Guides – https://bsgindia.org
- UN Volunteers – https://www.unv.org
- NYKS (Nehru Yuva Kendra) – https://nyks.nic.in
- National Disaster Management Authority – https://ndma.gov.in
- Swachh Bharat Mission – https://swachhbharat.mygov.in
- IndiaVolunteers – https://www.indiavolunteers.org

YouTube Resources

- NSS Song & Pledge (Official MYA&S) – https://youtu.be/nss_official_01
- NCC Drill & Parade Training Basics – https://youtu.be/ncc_drill_02
- Community Service Project Planning – https://youtu.be/community_svc_03
- First Aid & CPR Tutorial – Red Cross India – https://youtu.be/firstaid_rci_04
- Disaster Management Awareness – NDMA – https://youtu.be/ndma_dm_05
- Baden-Powell and the Scout Movement – https://youtu.be/scouts_bp_06
- Leadership Skills for Youth – https://youtu.be/leadership_youth_07
- Swachh Bharat Campaign Activities – https://youtu.be/swachh_sb_08

AI-Integrated Activities

S.No	AI Activity	Description / Tool
1	AI-Assisted Community Needs Survey	Use ChatGPT / Gemini to design survey questionnaires; analyse crowd-sourced responses with AI tools to map priority community issues.
2	Virtual Camp Planning Simulator	Use Notion AI / Trello AI to simulate camp logistics, assign roles and generate contingency plans for adverse scenarios.
3	Disaster-Risk FAQ Chatbot	Students build a first-aid guidance chatbot using Dialogflow / Botpress and deploy it for community awareness.
4	AI Social Media Campaign Design	Use Canva AI / Adobe Firefly to create Swachh Bharat / blood-donation awareness posters; schedule with Buffer AI.
5	Reflective Portfolio with AI Writing Aid	Draft field reports using Grammarly / ChatGPT; critically compare AI-generated drafts with self-written reflections.

CO – PO / PSO Mapping

Cor Correlation: 3 = Strong | 2 = Moderate | 1 = Slight | – = No correlation

.

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

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MECHANICAL ENGINEERING (ME)

B. Tech – I Year II Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits	CIE	SEE	Total
				L	T	Pr/CLC	P	C			
1	HM	26AHM9901	Communicative English	2	0	0	0	2	30	70	100
2	BS	26ABS990503	Applied Chemistry for Mechanical Engineers	2	0	2	0	3	30	70	100
3	BS	26ABS9902	Differential Equations and Vector Calculus	3	0	2	0	4	30	70	100
4	PC	26APC0101	**Professional core – I** •Engineering Mechanics	2	0	2	0	3	30	70	100
5	ES	26AES0303	Engineering Graphics	1	0	4	0	3	30	70	100
6	PC	26APC0301	**Department Specific Workshop** •Basic Simulation Lab	0	0	0	2	1	30	70	100
7	BS	26ABS990603	Applied Chemistry for Mechanical Engineers Lab	0	0	0	3	1.5	30	70	100
8	HM	26AHM9902	Communicative English Lab	0	0	0	2	1	30	70	100
9	HM	26AHM9903	Health and wellness, Yoga and Sports	0	0	0	1	0.5	50	-	50
10	MC	26AMC3601	Cyber security Awareness for Engineers	2	0	0	0	0	30	-	30
			Total	**12**	**0**	**10**	**8**	**19**	**320**	**560**	**880**

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MECHANICAL ENGINEERING (ME)

Year: I B.Tech **(Common to all branches)** Semester: I & II
(AK – 26 Regulations)

Subject Code: 26AHM9901	Subject Name **COMMUNICATIVE ENGLISH**	L T Pr/CLC P 2 0 0 0	Credit: 2
Pre-Requisites	Basic English (Intermediate level)	Semester	**I & II**

Course Outcomes (CO): Student will be able to

CO1: Understand grammatical structures, phonetic patterns, and professional vocabulary, and recall communication frameworks along with AI-assisted tools.

CO2: Apply the Principles of Listening and Speaking Skills in Group discussions, Debates & Presentations along with AI tools.

CO3: Understand and apply reading techniques, passages to write Paragraph writing, Creative Writing and movie reviews/ blogs along with AI-assisted tools.

CO4: Apply and optimize professional communication skills by drafting and refining emails, CVs, reports, and presentations along with AI-assisted writing tools.

CO6: Create professional communication materials, such as presentations, e-portfolios, and research reports, using AI tools like Copyleaks, Turnitin, and DeepL Translator

O	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	**grammatical structures, phonetic patterns, and professional vocabulary, and recall.**	Communication frameworks along with AI-assisted tools.		**L2**
2	**Apply**	**the Principles of Listening and Speaking Skills in Group discussions, Debates & Presentations.**	**along with AI tools**		**L3**
3	**Understand**	**and apply reading techniques, passages to write Paragraph writing, Creative Writing and movie reviews/ blogs**	**along with AI-assisted tools.**		**L2**
4	**Apply**	**and optimize professional communication skills drafting and refining emails, CVs, reports, and presentations.**	**along with AI-assisted writing tools**		**L3**
5	**Create**	**professional communication materials, such as presentations, e-portfolios, and research reports,**	**using AI tools like Copyleaks, Turnitin, and DeepL Translator**		**L6**

UNIT I Foundations of English Communication

Core Content:

Basics of Communication: process, types (verbal/non-verbal), and barriers. Parts of Speech: nouns, pronouns, verbs, adjectives, adverbs. Tenses: simple, continuous, perfect, and perfect continuous. Subject-verb agreement and correction of sentences.

AI Integration:

Grammar explanation, error identification, and instant Q&A on language rules, Real-time grammar, spelling, and punctuation correction with detailed explanations, Phonetics practice – voice recording for pronunciation and intonation feedback, Word-of-the-day, etymology, and interactive vocabulary quizzes.

Free/Open-Source AI Tools:

Grammarly (free); ChatGPT / Gemini (free tiers); Google Speech-to-Text (free); Merriam-Webster Vocabulary Builder (free)

UNIT II Listening and Speaking Skills

Core Content:

Principles of Effective Speaking and Active Listening. Group Discussion (GD): techniques, etiquette, and evaluation criteria. Presentation Skills: design principles, slide preparation, and delivery techniques. Debate: argument construction, evidence use, and rebuttal techniques.

AI Integration:

AI-powered presentation design – structured, visual, professional slides, Fluency analysis, filler-word detection, pacing, and confidence scoring, Auto-transcription and keyword analysis of spoken communication, Visual communication design – infographics, posters, and slide aesthetics

Free/Open-Source AI Tools:

Gamma.app (free); Orai AI Speech Coach (free); Otter.ai (free tier); Canva AI (free)

UNIT III Reading Comprehension & Writing Skills

Core Content:

Reading Strategies: skimming, scanning, intensive and extensive reading. Comprehension passages, synonyms, antonyms, words often confused, homonyms, homophones, and homographs. Paragraph Writing: topic sentence, supporting details, clincher sentence. Creative Writing — features and techniques — movie reviews and blogs.

AI Integration:

AI paraphrasing tool – rewrite passages at varying complexity levels, Readability scoring, passive voice detection, and sentence simplification, Essay outline generation, argument structuring, and content brainstorming, Vocabulary simplification for improving comprehension of complex texts

Free/Open-Source AI Tools:

QuillBot (free); Hemingway Editor (free online); ChatGPT (free); Rewordify (free)

UNIT IV Professional & Business Communication

Core Content:

Email Writing and Letter Writing: formal and informal. Short Report Writing: structure, types (formal/informal), and format. Note-Making and Summarization Techniques. Resume / CV Writing and LinkedIn Profile Optimization.

AI Integration:

Draft and refine professional emails, cover letters, reports, and proposals, AI-powered resume builder with ATS-optimized templates, Report structuring, agenda writing, and knowledge management, Tone detection, formality check, and professional register evaluation

Free/Open-Source AI Tools:

ChatGPT (free); Kickresume (free tier); Grammarly (free); Notion AI (free tier)

UNIT V Use of AI in Language Learning

Core Content:

Artificial Intelligence in Communication: meaning, basics, benefits and limitations of AI in human interaction. AI chat bots and virtual assistants in education: grammar correction, vocabulary building, AI-based speaking and pronunciation tools, writing assistants, e-portfolio creation. AI in Global Communication: automated translation, summarizing large texts, finding information in different languages. Digital Communication and AI Ethics: responsible use of AI in education, plagiarism and

academic honesty, fake information and AI-generated content, privacy, bias, and ethical communication online.

AI Integration:

Plagiarism detection, paraphrase checker, and academic integrity analysis, High-accuracy translation supporting intercultural communication understanding, AI literacy modules – understanding AI bias, ethics, and responsible usage, E-portfolio creation platform for showcasing communication artifacts

Free/Open-Source AI Tools:

Copyleaks / Turnitin (institutional access); DeepL Translator (free); Wix (free); Adobe Portfolio (free for students); ChatGPT / Gemini (free tiers)

Textbooks:

1. Raman M. and Sharma S., Technical Communication: Principles and Practice, Oxford University Press, 4th Edition, 2022.
2. Shetty J. and Pareek R., Communicative English for Engineers and Professionals, Wiley India, 3 Edition, 2021

Reference Books:

1. Rizvi M.A., Effective Technical Communication, Tata McGraw-Hill, 2nd Edition, 2018.
2. Murphy H.A., Effective Business Communication, McGraw-Hill Education, 7th Edition, 2019.
3. Wren P.C. and Martin H., High School English Grammar and Composition, S. Chand, Revised Edition, 2019.

Web Resources & NPTEL Links

- British Council – Learn English – https://learnenglish.britishcouncil.org
- NPTEL – Communication Skills – https://nptel.ac.in/courses/109104101
- Purdue OWL (Online Writing Lab) – https://owl.purdue.edu
- BBC Learning English – https://www.bbc.co.uk/learningenglish

Correlation of COs with the POs & PSOs for B.Tech
AK-26 Regulations
*3: Highly Correlated, 2: Moderately Correlated, 1: Weakly Correlated

Course Title	Course Outcomes COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
Communicative English	CO1								2	2		
	CO2								2	2		
	CO3									2		
	CO4									2		
	CO6									3		

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	corr	Verb	BTL			
1				Understand	L2	PO8, PO9	Thumb Rule	2,2
2				Apply	L3	PO8,PO9	Thumb Rule	2,2
3				Understand	L2	PO9	Thumb Rule	2
4				Apply	L3	PO9	Thumb Rule	2
5				Create	L6	PO9	Thumb Rule	3

CO-PO Mapping Justification:

CO1: : Understand grammatical structures, phonetic patterns, and professional vocabulary, and recall communication frameworks along with AI-assisted tools.

Action Verb: Understand (L2)

CO1 Action Verb Understand is of BTL 2. Using Thumb rule, L2 correlates PO8 , PO9 as moderate(2).

CO2: Apply the Principles of Listening and Speaking Skills in Group discussions, Debates & Presentations along with AI tools.

CO2 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO8 to PO9 as moderate (2)

CO3: Understand and apply reading techniques, passages to write Paragraph writing, Creative Writing and movie reviews/ blogs along with AI-assisted tools.

CO3 Action Verb Understand is of BTL 2. Using Thumb rule, L2 correlates PO9 as moderate (2).

CO4: Apply and optimize professional communication skills by drafting and refining emails, CVs, reports, and presentations along with AI-assisted writing tools.

CO4 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO9 as moderate (2).

CO5: Create professional communication materials, such as presentations, e-portfolios, and research reports, using AI tools like Copyleaks, Turnitin, and DeepL Translator

CO5 Action Verb Create is of BTL 6. Using Thumb rule, L6 correlates PO9 as high (3).

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MECHANICAL ENGINEERING (ME)

Year: B.Tech **Branch: Mechanical Engineering** **Semester: II**

Subject Code: 26ABS990503	Subject Name: Applied Chemistry for Mechanic Engineers	L	T	Pr/CLC	P	C
		2	0	2	0	3

Course Outcomes (CO): At the end of the course students will be able to

CO1: Apply corrosion control methods along with AI tools for corrosion prediction.

CO2: Analyze fuel classification, calorific values, refining processes, combustion, and engine knocking along with AI tools to enhance fuel efficiency and engine performance.

CO3: Analyze lubrication mechanisms and lubricant properties along with AI tools.

CO4: Analyze Properties of engineering materials, composites along with AI tools to determine material performance.

CO5: Apply green chemistry principles and AI- tools to assess environmental impact and sustainability.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Apply	corrosion control methods	along with AI tools	for corrosion prediction.	L3
2	Analyze	fuel classification, calorific values, refining processes, combustion, and engine knocking	along with AI tools	to enhance fuel efficiency and engine performance.	L4
3	Analyze	lubrication mechanisms and lubricant properties	along with AI tools		L4
4	Analyze	Properties of engineering materials, composites	along with AI tools	to determine material performance.	L4
5	Apply	Green chemistry principles	and AI tools.	to assess environmental impact and sustainability	L3

UNIT 1: Corrosion chemistry and protective methods (Duration: 3 weeks/9Hrs)

Content:

Chemical (Atmospheric corrosion: rusting of iron and steel) and Electrochemical theories of corrosion: anodic and cathodic reactions, electrochemical series.Types of corrosion: uniform, galvanic, pitting, crevice, intergranular, stress corrosion.Corrosion prevention: cathodic protection, protective coatings-Galvanizing: hot-dip galvanizing, electro galvanizing, Sherardizing.Electroplating: principles, process parameters (current density, temperature, pH) Ex: Copper plating, Nickel platingConversion coatings:

phosphating and chromating.

AI Integration: Machine learning models for corrosion prediction based on environmental and material data. Image-based corrosion detection using computer vision.

UNIT 2: Energy Chemistry (Fuels and Combustion) (Duration: 3 weeks/9Hrs)

Content:

Classification of fuels: solid, liquid, gaseous fuels, calorific value: HCV and LCV, Dulong's formula, problems. Calorific value determination: bomb calorimeter, problems.Solid fuels (Coal): classification (anthracite, bituminous, lignite, peat), analysis (proximate, ultimate), carbonizationLiquid fuels (Petroleum oil): composition, refining processes (fractional distillation and cracking- thermal and catalytic), Synthetic fuels: Fischer-Tropsch synthesisGreen fuels- Green hydrogen, Hythane.Knocking in IC engines (petrol engines): octane number, anti-knock additives: Tetra ethyl Lead (TEL), Methyl Tertiary Butyl Ether (MTBE), ethanol.Knocking in diesel engines: cetane number, ignition quality, anti-knock additives. Combustion -- problems.

AI Integration: AI models to optimize fuel efficiency and combustion performance. Data analysis of engine parameters using regression models.

UNIT 3: Chemistry of Lubricants (Duration: 3 weeks/9Hrs)

Content:

Friction and wear, seizure (soiling and rolling friction) functions of lubricants.Mechanisms of lubrication a. Fluid-film or thick-film or hydrodynamic lubrication, b. boundary film lubrication or thin-film lubrication, c. Extreme-pressure lubricationLubricants: classificationSolid lubricants: graphite, molybdenum disulfide (MoS2), Poly tetra fluoro ethylene (PTFE).Semi-solid lubricants: Greases-composition (base oil + thickener + additives), National Lubricating Grease Institute (NLGI) grades, applicationsLiquid lubricants: animal and vegetable oils, mineral or petroleum oils, blended oils.Properties of lubricants (Definition and significance)

AI Integration: Predictive maintenance using AI for lubricant degradation analysis. Data-driven selection of lubricants based on operating conditions.

UNIT 4: Engineering Materials and Composites (Duration: 3 weeks/9Hrs)

Content:

Ferrous alloys: composition and applications of carbon steels, alloy steels, stainless steels, cast irons.Heat treatment: annealing, normalizing, hardening, tempering, age hardeningPolymer chemistry: types of polymerizations, examples, thermoplastics, thermosets,Engineering polymers: Preparation and engineering applications of Nylon, polycarbonate, Acrylonitrile Butadiene styrene (ABS), Polyether ether ketone (PEEK), Polytetrafluoroethylene (PTFE).Elastomers- Natural rubber, vulcanization, synthetic rubbers

(BUNA-S and BUNA-N).Refractories: characteristics, classification and properties of refractories.Composite materials: classification and applications.

AI Integration: AI-based material property prediction and selection. Machine learning for composite optimization and performance analysis.

UNIT 5: Chemistry of Green Engineering (Duration: 3 weeks/9Hrs)

Content:

Principles of green chemistry and their applicationsSustainable construction materials: geopolymer concrete, recycled aggregates, industrial by-products (fly ash, Ground Granulated Blast-furnace Slag (GGBS)Air pollution: types, sources, effects; air quality indexWater pollution: sources, effects and remedial methods.Chemistry of greenhouse gases and climate changeSoil chemistry: pH, organic matter, contamination, remediationSolid waste management: classification, treatment, recycling in construction.

AI Integration: AI-based environmental impact assessment and life-cycle analysis. Air quality prediction models.

Textbooks:

1. Jain and Jain, Engineering Chemistry, 16/e, DhanpatRai, 2013.
2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.

Reference Books:

1. H.F.W. Taylor, Cement Chemistry, 2/e, Thomas Telford Publications, 1997.
2. D.J.Shaw, Introduction to Colloids and Surface Chemistry, Butterworth-Heineman, 1992.
3. Textbook of Polymer Science, Fred W. BillmayerJr, 3rd Edition.

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3				3								
2	3				3								
3	3				3								
4	3				3								
5	3				3								

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours				CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Register (Hrs)	Lesson Plan (Hrs)	%	corr	Verb	BTL			
1					Apply	L3	PO1,PO5	PO1: Apply (L3)	3
2					Analyze	L4	PO1,PO5	PO2:Analyze (L4)	3
3					Analyze	L4	PO1,PO5	PO2:Analyze (L4)	3
4					Analyze	L4	PO1,PO5	PO2:Analyze (L4)	3
5					Apply	L3	PO1,PO5	PO1: Apply (L3)	3

CO1: Apply corrosion control methods along with AI tools for corrosion prediction

Action Verb: Apply (L3)
PO1 Verbs: Apply (L3)
CO1 Action Verb is equal PO1 verb; Therefore, correlation is moderate (3).
CO2: Analyze fuel classification, calorific values, refining processes, combustion, and engine knocking along with AI tools to enhance fuel efficiency and engine performance.

Action Verb: Analyze (L4)
PO1 Verbs: Analyze (L4)
CO2 Action Verb is equal to PO1 verb; Therefore, correlation is high (3).
CO3: Analyze lubrication mechanisms and lubricant properties along with AI tools.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO3 Action Verb is one level higher than to PO1 verb; Therefore, correlation is high (3).
CO4: Analyze Properties of engineering materials, composites along with AI tools to determine material performance.

Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO4 Action Verb is one level higher than to PO1 verb; Therefore, correlation is high (3).
CO5: Apply green chemistry principles and AI- tools to assess environmental impact and sustainability.
Action Verb: Apply (L4)
PO1 Verb: Apply (L4)
CO5 Action verb is equal to PO1 verb; therefore, the correlation is high (3).

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MECHANICAL ENGINEERING (ME)

Year: I **Semester**: II **Branch of Study: Common to all**

Subject Code: 26ABS9902	Subject Name: Differential Equations and Vector Calculus	L 3	T 0	Pr/CLC 2	P 0	Credits 4

Prerequisites: *Linear Algebra and Calculus*

Course Outcomes (CO): Student will be able to

1. Apply first-order ordinary differential equations using AI-enabled computational tools (ChatGPT / Copilot) to solve engineering problems.
2. Analyze higher-order ordinary differential equations using AI-assisted computational tools (GNU Octave, Wolfram Alpha free tier) to interpret engineering systems.
3. Apply partial differential equations using AI-enabled computational tools (Wolfram Alpha free tier) to solve engineering problems.
4. Analyze vector differential operators and vector fields using AI-enabled computational tools (ChatGPT / Copilot) to interpret engineering phenomena.
5. Evaluate vector integral theorems using AI-enabled computational tools (Wolfram Alpha free tier) to solve engineering field problems.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Apply	first-order ordinary differential equations	using AI-enabled computational tools (ChatGPT / Copilot)	to solve engineering problems	L3
2	Analyze	higher-order ordinary differential equations	using AI-assisted computational tools (GNU Octave, Wolfram Alpha free tier)	to interpret engineering systems	L4
3	Apply	partial differential equations	using AI-enabled computational tools (Wolfram Alpha free tier)	to solve engineering problems	L3
4	Analyze	vector differential operators and vector fields	using AI-enabled computational tools (ChatGPT / Copilot)	to interpret engineering phenomena	L4
5	Evaluate	vector integral theorems	using AI-enabled computational tools (Wolfram Alpha free tier)	to solve engineering field problems	L5

Course Content

UNIT I: First-Order Ordinary Differential Equations 9hrs

CONTENT:

- Classification of ODEs by order, degree, and linearity; linear first-order ODEs and integrating factor method; Bernoulli's equation; exact equations and integrating factors.
- Orthogonal trajectories; Newton's law of cooling and natural growth/decay models; electrical circuit models (RC and RL circuits); engineering applications of first-order ODEs.

AI INTEGRATION:

Python SymPy dsolve for symbolic ODE solution and verification; direction field (slope field) visualization using Matplotlib; AI-assisted debugging of integrating factor derivations; using ChatGPT/Copilot to explain solution families and physical interpretations; SciPy solve_ivp for numerical ODE solution. Free/Open-Source AI Tools: Python (SymPy, SciPy, Matplotlib) on Google Colab; Jupyter Notebook; GNU Octave.

UNIT II: Equations Reducible to Linear Differential Equations and Applications 9 hrs

CONTENT:

- Superposition principle; Wronskian and linear independence; complementary function for constant-coefficient ODEs (distinct real, repeated, and complex roots); particular integral by operator method; variation of parameters.
- Simultaneous linear ODEs; Cauchy's (Euler) equation; Legendre's equation; applications to LCR circuits.

AI INTEGRATION:

Python SciPy signal.lsim for simulation of underdamped, critically damped, and overdamped responses; resonance amplitude curve generation; AI-assisted Wronskian computation using SymPy; AI tools to explain transient vs. steady-state response. Free/Open-Source AI Tools: Python (NumPy, SciPy, SymPy, Matplotlib); GNU Octave; WolframAlpha free tier.

UNIT III: Partial Differential Equations 9hrs

CONTENT:

- Introduction and classification of PDEs; formation by elimination of arbitrary constants; formation by elimination of arbitrary functions; first-order linear PDEs and Lagrange's method (auxiliary equations); homogeneous linear PDEs with constant coefficients (CF and PI).

AI INTEGRATION:

Python SymPy for PDE formation and symbolic verification; 3D surface plot visualization of PDE solution families using Matplotlib; SciPy finite-difference simulation of the 1D heat equation with animation; AI-assisted PDE classification using the discriminant. Free/Open-Source AI Tools: Python (SymPy, NumPy, SciPy, Matplotlib); WolframAlpha free tier; Scilab.

UNIT IV: Vector differentiation 9 hrs

CONTENT:

- Scalar and vector fields; del (∇) operator; gradient and directional derivative; unit normal to surfaces; angle between surfaces; divergence and physical interpretation; curl and physical interpretation.
- Vector identities; conservative fields and scalar potentials; Laplacian;

AI INTEGRATION:

Python NumPy and Matplotlib for 2D and 3D gradient, divergence, and curl field visualization (quiver plots, level-surface overlays); SymPy for symbolic verification of vector identities; AI tools to interpret Maxwell's equations in terms of divergence and curl operators. Free/Open-Source AI Tools: Python (NumPy, SymPy, Matplotlib, mpl_toolkits); SciPy for numerical computation.

UNIT V: Vector integration 9 hrs

CONTENT:

- Line integrals over scalar and vector fields; work done and path independence; surface integrals and flux; Green's theorem in the plane and its applications.
- Stokes' theorem; Gauss Divergence theorem (without proof) ; applications to area and volume computation;

AI INTEGRATION:

Python SciPy integrate for numerical computation of line and surface integrals; 3D flux visualization with

colour-coded normal flux using Matplotlib; numerical verification of Green's and Stokes' theorems; AI-assisted physical interpretation of the Divergence theorem. Free/Open-Source AI Tools: Python (NumPy, SciPy, Matplotlib); SymPy for symbolic integral verification; WolframAlpha free tier.

LEARNING RESOURCES

Textbooks

1. Kreyszig, E. (2018). Advanced Engineering Mathematics (10th ed.). Wiley.
2. Grewal, B. S. (2017). Higher Engineering Mathematics (44th ed.). Khanna Publishers.

Reference Book

1. Thomas, G. B., Weir, M. D., & Hass, J. (2018). Thomas' Calculus (14th ed.). Pearson.
2. Jain, R. K., & Iyengar, S. R. K. (2021). Advanced Engineering Mathematics (5th ed.). Alpha Science International.
3. Zill, D. G., & Wright, W. S. (2018). Advanced Engineering Mathematics (6th ed.). Jones & Bartlett.
4. Arfken, G. B., Weber, H. J., & Harris, F. E. (2012). Mathematical Methods for Physicists (7th ed.). Academic Press.
5. Sneddon, I. N. (2006). Elements of Partial Differential Equations. Dover Publications.
6. Davis, H. F., & Snider, A. D. (1995). Introduction to Vector Analysis (7th ed.). Hawkes Publishing.

Online Resources

- NPTEL: Ordinary Differential Equations and Applications – https://nptel.ac.in
- NPTEL: Partial Differential Equations – https://nptel.ac.in
- NPTEL: Vector Calculus – https://nptel.ac.in
- MIT OpenCourseWare – Differential Equations (18.03): https://ocw.mit.edu
- MIT OpenCourseWare – Multivariable Calculus (18.02): https://ocw.mit.edu

Web Resources & NPTEL Links

- NPTEL: Ordinary Differential Equations and Applications – https://nptel.ac.in
- NPTEL: Partial Differential Equations – https://nptel.ac.in
- NPTEL: Vector Calculus – https://nptel.ac.in
- MIT OpenCourseWare – Differential Equations (18.03): https://ocw.mit.edu
- MIT OpenCourseWare – Multivariable Calculus (18.02): https://ocw.mit.edu
- Python SymPy Documentation: https://docs.sympy.org
- SciPy Documentation: https://docs.scipy.org
- Google Colab for Python: https://colab.research.google.com
- NumPy Documentation: https://numpy.org/doc

Recommended Free & Open-Source AI/Computational Tools

- Python (NumPy, SciPy, Matplotlib) – FREE on Google Colab for ODE/PDE solving, vector field visualization, and numerical integration.
- SymPy (free, open-source) – For symbolic ODE/PDE solution, gradient/divergence/curl computation, and algebraic verification.
- Jupyter Notebook (free, open-source) – For interactive computation, experiment documentation, and lab reporting.
- GNU Octave (free, open-source) – MATLAB-compatible numerical computing for ODE simulation and matrix workflows.
- WolframAlpha (free tier) – For quick verification of ODE solutions, PDE classification, and integral computation.
- Matplotlib / mpl_toolkits (free, open-source) – For 2D and 3D vector field quiver plots, solution surface visualization, and PDE animation.

scikit-learn (free, open-source) – For optional AI demonstrations in regression and data-driven modeling tasks.

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CO – PO Articulation Matrix (NBA)

Scale: 3 – Strong, 2 – Moderate, 1 – Slight, – No Correlation

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	3	-	-	-	-	-	-
CO2	3	3	-	-	3	-	-	-	-	-	-
CO3	3	-	-	-	3	-	-	-	-	-	-
CO4	3	3	-	-	3	-	-	-	-	-	-
CO5	3	3	-	-	3	-	-	-	-	-	-

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Action Verb	BTL			
1				**Apply**	**L3**	PO1, PO5	**Apply (L3)**	3
2				**Analyze**	**L4**	PO2, PO5	**Analyze (L4)**	3
3				**Apply**	**L3**	PO1, PO5	**Apply (L3)**	3
4				**Analyze**	**L4**	PO2 , PO5	**Analyze (L4)**	3
5				**Evaluate**	**L5**	PO2, PO5	**Evaluate (L5)**	3

CO1: Apply first-order ordinary differential equations using AI-enabled computational tools (ChatGPT / Copilot) to solve engineering problems.

Action Verb: Apply (L3)

PO1 Verb: Apply (L3), PO5 Verb: Apply (L3)

CO1 Action Verb is equal to PO1 and PO5 verb Therefore correlation is high (3).

CO2: Analyze higher-order ordinary differential equations using AI-assisted computational tools (GNU Octave, Wolfram Alpha free tier) to interpret engineering systems.

Action Verb: Analyze (L4)

PO1 Verb: Apply (L3), PO2 Verb: Analyze (L4), PO5 Verb: Apply (L3)

CO2 Action Verb is equal to PO1,PO2 and PO5 verb; Therefore correlation is high (3).

CO3: Apply partial differential equations using AI-enabled computational tools (Wolfram Alpha free tier) to solve engineering problems.

Action Verb: Apply (L3)

PO1 Verb: Apply (L3), PO5 Verb: Apply (L3)

CO3 Action Verb level is equal to PO1 and PO5 verb; Therefore correlation is high (3).

CO4: Analyze vector differential operators and vector fields using AI-enabled computational tools (ChatGPT / Copilot) to interpret engineering phenomena.

Action Verb: Analyze (L4)

PO1 Verb: Apply (L3), PO2 Verb: Analyze (L4), PO5 Verb: Apply (L3)

CO4 Action Verb level is equal to PO1 and PO5 verb; Therefore correlation is high (3).

CO5: Evaluate vector integral theorems using AI-enabled computational tools (Wolfram Alpha free tier) to solve engineering field problems.

Action Verb: Evaluate (L5)

PO1 Verb: Apply (L3), PO2 Verb: Analyze (L4), PO5 Verb: Apply (L3)

CO5 Action verb is high level to PO1,PO2 and PO5 verb; therefore the correlation is high (3).

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MECHANICAL ENGINEERING (ME)

I YEAR **II SEMESTER**

Subject Code	Subject Name	L	T/CLC	Pr	P	CREDITS
26APC0101	ENGINEERING MECHANICS	2	0	2	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Analyze force systems, moments, and friction through engineering mechanics principles and AI-enabled computational tools
CO2	Analyze the equilibrium of force systems, trusses, frames and virtual work applications along with AI-enabled computational and structural analysis tools
CO3	Analyze the centroid, centre of gravity and moments of inertia of engineering sections along with AI-enabled computational tools
CO4	Analyze the kinematics and kinetics of particles through engineering mechanics principles and AI-enabled computational tools
CO5	Analyze stresses, strains, elastic constants, and strain energy in engineering materials through mechanics principles and AI-enabled computational tools

CO	Action Verb	Knowledge Statement	Condition	Criteria	Bloom's Level
CO1	Analyze	Force systems, moments, and friction	through engineering mechanics principles and AI-enabled computational tools		**L4**
CO2	Analyze	Equilibrium of force systems, trusses, frames and virtual work		along with AI-enabled computational and structural analysis tools	**L4**
CO3	Analyze	Centroid, centre of gravity, and moments of inertia of engineering sections		along with AI-enabled computational tools	**L4**
CO4	Analyze	Kinematics and kinetics of particles	through engineering mechanics principles and AI-enabled computational tools		**L4**
CO5	Analyze	Stresses, strains, elastic constants, and strain energy in engineering materials	through AI-enabled computational tools		**L4**

UNIT I: Introduction, Force Systems & Friction

Core Content: Basic concepts of mechanics: scalar and vector quantities, Newton's laws, SI units. Coplanar concurrent forces: resultant by parallelogram law, triangle law, polygon law. Moment of a force: Varignon's theorem. Couples and resultants of force systems. Lami's theorem. Spatial force systems: vector representation, dot and cross products. Friction: limiting friction, Coulomb's laws of dry friction, coefficient of friction, angle of friction, cone of static friction, impending motion problems, wedge friction, screw jack.

AI Integration: Introduction to AI in Engineering: concept of data, machine learning (ML), and simulation. Using Python (NumPy) to solve force equilibrium problems computationally. Introduction to MATLAB/Scilab for vector force calculations. Visualizing force systems using Matplotlib/Python.

Free/Open-Source AI Tools: Python (NumPy, Matplotlib) – Google Colab (free); Scilab (free MATLAB alternative); GeoGebra (free online vector visualization)

UNIT II: Equilibrium of Force Systems & Virtual Work

Core Content: Equilibrium conditions for coplanar systems: free body diagrams, equations of equilibrium (ΣFx=0, ΣFy=0, ΣM=0). Graphical methods: triangle and polygon of forces. Equilibrium of spatial systems. Analysis of plane trusses: method of joints, method of sections. Analysis of frames. Principle of virtual work: statement, applications to simple mechanisms and trusses.

AI Integration: Using Python/OpenSees (open source) for automated truss analysis. AI-based structural analysis: introduction to how FEM software uses matrix methods internally. Computer simulation of mechanism motion using Python. Visual debugging of FBDs using interactive tools.

Free/Open-Source AI Tools: OpenSees (free, open-source structural analysis); Python scipy.optimize for equilibrium solution; SAP2000 student edition (free); online truss solvers (free)

UNIT III: Centroid, Centre of Gravity & Moment of Inertia

Core Content: Centroid of lines, areas, and volumes from first principles. Centroid of standard shapes: rectangle, triangle, circle, semicircle, quarter circle. Centroid of composite figures using tabular method. Centre of gravity of 3D bodies: prismatic bodies, cones, hemispheres, composite bodies. Pappus theorems and their applications. Area moment of inertia: polar moment, transfer theorem (parallel axis theorem). MOI of composite sections. Product of inertia. Mass moment of inertia for simple and composite bodies.

AI Integration: Python scripting for automated centroid and MOI calculations of composite cross-sections. Using spreadsheets (LibreOffice Calc) and Python Pandas for tabular calculations. Introduction to how CAD software (AutoCAD/FreeCAD free) computes section properties. Application in AI-driven structural design optimization: cross-section selection.

Free/Open-Source AI Tools: Python (NumPy, Pandas) – Google Colab; FreeCAD (free, open-source CAD with section property computation); LibreOffice Calc (free)

UNIT IV: Kinematics & Kinetics of Particles

Core Content: Kinematics: rectilinear motion – displacement, velocity, acceleration relations; curvilinear motion – Cartesian and polar coordinates; projectile motion. Kinetics: Newton's second law; D'Alembert's principle; work-energy method: kinetic energy, work done, power, efficiency; impulse-momentum method: linear and angular; impact: direct and oblique central impact, coefficient of restitution.

AI Integration: AI in Autonomous Vehicles: how kinematic equations underpin self-driving car algorithms. Python simulation of projectile motion with drag (real-world). ML-based trajectory prediction: introduction to LSTM for motion prediction. Robot path planning using kinematic constraints. Using Python (matplotlib.animation) for interactive motion visualization.

Free/Open-Source AI Tools: Python (NumPy, Matplotlib, SciPy) – Google Colab; Tracker (free video analysis software for kinematics experiments); Algodoo (free 2D physics simulation)

UNIT V: Simple Stresses, Strains & Elastic Constants

Core Content: Elasticity and plasticity; types of stresses (tensile, compressive, shear) and strains (linear, lateral, shear, volumetric); Hooke's law; Poisson's ratio; elastic constants: E, G, K and their relationships; factor of safety; bars of varying cross-section; elongation under self-weight; bars in series and parallel; temperature stresses; stresses in composite bars. Introduction to principal stresses and strains: principal planes, Mohr's circle for 2D stress state.**StrainEnergy**Resilience–Gradual,sudden,impactandshockloadings–simpleapplications.

AI Integration: ML for material property prediction: using regression models to predict Young's modulus and Poisson's ratio from material composition data. Python-based stress-strain curve fitting using SciPy. Introduction to data-driven material models in structural analysis. Overview of physics-informed neural networks (PINNs) for material mechanics (conceptual).

Free/Open-Source AI Tools: Python (NumPy, SciPy, Matplotlib) on Google Colab; Scilab (free); MIT OpenCourseWare stress analysis tools

Text Books:

1. Timoshenko S., Young D.H., Rao J.V. and Pati S., Engineering Mechanics, McGraw Hill Education, 5th Edition, 2017.
2. Bhavikatti S.S., A Textbook of Engineering Mechanics, New Age International Publications, 4th Edition, 2018.
3. Timoshenko S. and Gere J., Mechanics of Materials, CBS Publishers, 2006.

4. Strengthofmaterials,R.K.Rajput,S.Chand&Co,NewDelhi
5. Strength of Materials, Basavarajaiah B.S. and Mahadevappa P., Universities Press, 3rd Edition, 2010

References:

1. Finite Element Analysis by P. Seshu, PHI Learning Private Limited
2. Concepts and applications of Finite Element Analysis by Robert D. Cook et al., Wiley India Pvt. Ltd.
3. Applied Finite Element Analysis by G. Ramamurty, I.K. International Publishing House Pvt. Ltd.

WEB RESOURCES:

1. **https://archive.nptel.ac.in/courses/105/105/105105041/#**
2. **https://archive.nptel.ac.in/noc/courses/noc22/SEM1/noc22-me43/**

CORRELATION OF COS WITH THE POS & PSOS:

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

Unit No	Lesson Plan Hrs.	%	Correlation	CO's Action Verb	BTL	Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0–3)
1	12	20	3	Analyze	L4	PO1 PO2 PO5 PO11	Analyze (L4) Analyze (L4) Analyze (L4) Thumb Rule	3 3 3 2
2	12	20	3	Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO11	Analyze (L4) Analyze (L4) Analyze (L4) Analyze (L4) Analyze (L4) Thumb Rule	3 3 2 2 3 2
3	12	20	3	Analyze	L4	PO1 PO2 PO5 PO11	Analyze (L4) Analyze (L4) Analyze (L4) Thumb Rule	3 3 3 2
4	12	20	3	Analyze	L4	PO1 PO2 PO5 PO11	Analyze (L4) Analyze (L4) Analyze (L4) Thumb Rule	3 3 3 2

5	12	20	3	Analyze	L4	PO1	Analyze (L4)	3
						PO2	Analyze (L4)	3
						PO3	Analyze (L4)	2
						PO4	Analyze (L4)	2
						PO5	Analyze (L4)	3
						PO11	Thumb Rule	2

JUSTIFICATION STATEMENTS:

CO1: Analyze force systems, moments, and friction through engineering mechanics principles and AI-enabled computational tools

CO1 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 1 as high (3).
CO1 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 2 as high (3)
CO1 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 5 as high (3)
CO1 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 11 as moderate (2)

CO2: Analyze the equilibrium of force systems, trusses, frames and virtual work applications along with AI-enabled computational and structural analysis tools

CO2 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 1 as high (3).
CO2 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 2 as high (3)
CO2 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 3 as moderate (2)
CO2 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 4 as moderate (2)
CO2 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 5 as high (3)
CO2 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 11 as moderate (2)

CO3: Analyze the centroid, centre of gravity and moments of inertia of engineering sections along with AI-enabled computational tools

CO3 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 1 as high (3).
CO3 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 2 as high (3)
CO3 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 5 as high (3)
CO3 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 11 as moderate (2)

CO4: Analyze the kinematics and kinetics of particles through engineering mechanics principles and AI-enabled computational tools

CO4 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 1 as high (3).
CO4 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 2 as high (3)
CO4 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 5 as high (3)
CO4 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 11 as moderate (2)

CO5: Analyze stresses, strains, elastic constants, and strain energy in engineering materials through mechanics principles and AI-enabled computational tools

CO5 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 1 as high (3).
CO5 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 2 as high (3)
CO5 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 3 as moderate (2)
CO5 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 4 as moderate (2)
CO5 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 5 as high (3)
CO5 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 11 as moderate (2)

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MECHANICAL ENGINEERING (ME)

Year: I **Semester: I/II** **Branch of Study: Common to all Branches**

Subject Code	Subject Name	L	T	Pr/CLC	P	Credits
26AES0303	Engineering Graphics	1	0	4	0	3

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

CO: 1 Apply engineering graphics principles to construct curves and scales using manual drafting and AI tools.
CO: 2 Analyze orthographic projections of points, lines and planes using conventional and AI-based methods.
CO: 3 Apply projection principles to represent regular solids using conventional method and AI tools.
CO: 4 Analyze sectional views and develop surface patterns using conventional and AI-based optimization methods.
CO: 5 Apply isometric and orthographic projection principles to develop 2D/3D CAD models using AI-assisted reconstruction techniques.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Apply	engineering graphics principles for constructing curves and scales	using manual drafting and AI tools	accurately construct curves and scales as per engineering drawing standards	L3
CO2	Analyze	orthographic projections of points, lines and planes	to determine true lengths, and inclinations using conventional and AI-based methods	correctly analyze and interpret orthographic projections	L4
CO3	Apply	projection principles of regular solids	using conventional projection methods and AI techniques	accurately represent and identify regular solids	L3
CO4	Analyze	sectional views and surface patterns	using conventional drafting and AI-based optimization methods	correctly analyze sectional views and develop optimized surface patterns	L4
CO5	Apply	isometric and orthographic projection principles and 2D/3D CAD modeling	using CAD software and AI-assisted reconstruction techniques	accurately develop 2D/3D CAD models from engineering projections	L3

Unit I: Introduction to Engineering Graphics, Curves, and Scales

Introduction: Principles of Engineering Graphics, signboards, BIS conventions, and lettering.

Curves: Construction of Polygons. Conic sections: Ellipse, Parabola, and Hyperbola using eccentricity/general methods. Cycloidal curves and Involutes.

Scales: Plain, Diagonal, and Vernier scales.

Hands-on Experience:
Manual draft generation of an ellipse and diagonal scale, paired with a software verification loop.

- **AI Integration Module**: AI prompt engineering for generating geometric profiles; algorithmic generation of conic curves using mathematical code blocks; parsing hand-drawn geometric sketches into clean vector shapes using Computer Vision (CV) edge detection (Canny Edge/Hough Transform).

Unit II Orthographic Projections of Points, Lines

Core Syllabus: Principles of orthographic projections, projection of points in all four quadrants.

Projection of straight lines inclined to one or both reference planes, traces of lines, determination of true lengths and true inclinations.

Projections of Planes: regular planes Perpendicular to both reference planes, parallel to one reference plane and inclined to the other reference plane; plane inclined to both the reference planes.

Hands-On Experience & Application

Project: Construct a transformation script where a user inputting 2D projection endpoints automatically outputs the 3D line representation, true spatial length, and inclination angles without manual geometric tracking.

Application: Calibration setups for stereoscopic robotic arms tracking trajectories across multiple camera planes.

AI Integration Module: Machine learning pipelines for 3D coordinate estimation from 2D views; multi-view structural tracking; training neural models to predict true line length and orientation angles based solely on coordinate projections

Unit III Projection of Regular Solids

Core Syllabus:

Projection of Regular Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to another plane.

Hands-On Experience & Application

- **Project**: Set up a classification notebook using scikit-learn or a simple convolutional model to automatically identify the type of solid (e.g., hexagonal prism vs. cone) present within an orthographic engineering layout image.
- **Application**: Automated component sorting inside factory staging bays and conveyor streams.

AI Integration Module: Object recognition models (e.g., YOLO / Mobile Net) trained to identify standard solid geometries; automated multi view projection generation from 3D CAD meshes using programmatic render layers.

Unit IV Sections of Solids, Development of Surfaces, and AI Generative Design

Core Syllabus:

Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape of section, Sections of solids in simple position only.

Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

- **AI Integration Module**: Generative Adversarial Networks (GANs) for generating flat-pattern configurations; algorithmic optimization of surface layouts to minimize sheet manufacturing scrap; predictive tool path generation using physics-guided heuristic networks.

Hands-On Experience & Application

- **Project**: Use a nesting optimization script (e.g., using genetic algorithms or standard heuristics) to arrange several custom flat-surface solid developments onto a finite raw sheet grid, actively minimizing material margins and cut lines.
- **Application**: Sheet metal stamping pattern automation in automotive and aerospace chassis manufacturing.

Unit V Isometric Projections, Conversions, and 2D-to-3D Deep Reconstruction

Core Syllabus:
Principles of isometric projection, isometric scale, isometric views/projections of planes, simple and compound solids. Conversion of isometric views to orthographic views and vice-versa.

Computer graphics: Creating 2D&3D drawings of objects including PCB and Transformations using Auto CAD (*Not for end examination*).

Hands-On Experience & Application

- **Project**: Use a pre-trained depth estimation or pixel-to-voxel neural model to parse a set of front, top, and side drawings, compiling them directly into an interactive 3D point cloud or boundary surface rendering.
- **Application**: Instantly generating 3D printable mechanical files directly from archival 2D layout drafting logs.

AI Integration Module: 2D-to-3D depth reconstruction using Neural Radiance Fields (NeRF) or specialized generative models; auto-generation of 3D CAD models from simple multi-view engineering layout sketches

Text Books

1. Engineering Drawing by N.D. Bhatt, Charotar Publishing House 2016.
2. Engineering Drawing with an Introduction to AutoCAD, Dhananjay Jolhe, Tata McGraw Hill, 2017.

Reference Books

1. Engineering Graphics and Design by Pradeep Jain, A.P. Gautam, Abhishek Bhargava, Khanna Publishing.
2. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill, 2013.
3. Engineering Drawing, M.B.Shah and B.C. Rana, Pearson Education Inc,2009.

Online Learning Resources:

- **Classical Drafting Fundamentals**: NPTEL Engineering Graphical Design Course by IIT Kharagpur
- **Computer Vision and Processing**: Open CV Official Python Boot camps and Tutorials
- **Generative Design and Modeling Insights**: MIT 6.S192: Deep Generative Modeling Platforms

CO – PO Articulation Matrix

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Engineering Graphics	CO1	3	2	3		3						2		2
	CO2	3	3	3		3						3		2
	CO3	3	2	3		3						2		2
	CO4	3	3	3		3						3		2
	CO5	3	2	3		3						2		2

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MECHANICAL ENGINEERING (ME)

Correlation Matrix

CO				CO		Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
	Lesson Plan (Hrs)	%	Correlation	Verb	BTL			
1	18	24	3	Apply	L3	PO1 PO2 PO3 PO5 PO11	Apply (L3) Identify (L3) Develop (L3) Apply (L3) Thumb Rule	3 3 3 3 2
2	15	20	2	Analyze	L4	PO1 PO2 PO3 PO5 PO11	Apply (L3) Identify (L3) Develop (L3) Apply (L3) Thumb Rule	3 3 3 3 3
3	15	20	2	Apply	L3	PO1 PO2 PO3 PO5 PO11	Apply (L3) Identify (L3) Develop (L3) Apply (L3) Thumb Rule	3 3 3 3 2
4	15	20	2	Analyze	L4	PO1 PO2 PO3 PO5 PO11	Apply (L3) Identify (L3) Develop (L3) Apply (L3) Thumb Rule	3 3 3 3 3
5	12	16	2	Apply	L3	PO1 PO2 PO3 PO5 PO11	Apply (L3) Identify (L3) Develop (L3) Apply (L3) Thumb Rule	3 3 3 3 2
	75	100						

Justification Statements:

CO1: Apply engineering graphics principles to construct curves and scales using manual drafting and AI tools.

Action Verb: Apply (L3)

PO1 Verb: Apply (L3). CO1 Action verb is at the same level as the PO1 verb. Therefore, the correlation is high (3).

PO2 Verb: Identify (L3). CO1 Action verb is same level as PO2 verb. Therefore, the correlation is high (3).

PO3 Verb: Develop (L3). CO1 Action verb is at the same level as the PO3 verb. Therefore, the correlation is high (3).

PO5 Verb: Apply (L3). CO1 Action verb is at the same level as the PO5 verb. Therefore, the correlation is high (3).

PO11 Verb: Thumb Rule. As per the thumb rule, CO1 correlates slightly with the PO11 verb. Therefore, the correlation is moderate (2).

CO2: Analyze orthographic projections of points, lines and planes using conventional and AI-based methods.

Action Verb: Analyze (L4)

PO1 Verb: Apply (L3). CO2 Action verb is greater than the PO1 verb. Therefore, the correlation is high (3).

PO2 Verb: Identify (L3). CO2 Action verb is at the same level as the PO2 verb. Therefore, the correlation is high (3).

PO3 Verb: Develop (L3). CO2 Action verb is greater than the PO3 verb. Therefore, the correlation is high (3).

PO5 Verb: Apply (L3). CO2 Action verb is greater than the PO5 verb. Therefore, the correlation is high (3).

PO11 Verb: Thumb Rule. As per the thumb rule, CO2 correlates strongly with the PO11 verb. Therefore, the correlation is high (3).

CO3: Apply projection principles to represent regular solids using conventional method and AI tools.

Action Verb: Apply (L3)
PO1 Verb: Apply (L3). CO3 Action verb is at the same level as the PO1 verb. Therefore, the correlation is high (3).
PO2 Verb: Identify (L3). CO3 Action verb same level as PO2 verb. Therefore, the correlation is high (3).
PO3 Verb: Develop (L3). CO3 Action verb is at the same level as the PO3 verb. Therefore, the correlation is high (3).
PO5 Verb: Apply (L3). CO3 Action verb is at the same level as the PO5 verb. Therefore, the correlation is high (3).
PO11 Verb: Thumb Rule. As per the thumb rule, CO3 correlates slightly with the PO11 verb. Therefore, the correlation is moderate (2).

CO4: Analyze sectional views and develop surface patterns using conventional and AI-based optimization methods.

Action Verb: Analyze (L4)
PO1 Verb: Apply (L3). CO4 Action verb is greater than the PO1 verb. Therefore, the correlation is high (3).
PO2 Verb: Identify (L3). CO4 Action verb is at the same level as the PO2 verb. Therefore, the correlation is high (3).
PO3 Verb: Develop (L3). CO4 Action verb is greater than the PO3 verb. Therefore, the correlation is high (3).
PO5 Verb: Apply (L3). CO4 Action verb is greater than the PO5 verb. Therefore, the correlation is high (3).
PO11 Verb: Thumb Rule. As per the thumb rule, CO4 correlates strongly with the PO11 verb. Therefore, the correlation is high (3).

CO5: Apply isometric and orthographic projection principles to develop 2D/3D CAD models using AI-assisted reconstruction techniques.

Action Verb: Apply (L3)
PO1 Verb: Apply (L3). CO5 Action verb is at the same level as the PO1 verb. Therefore, the correlation is high (3).
PO2 Verb: Identify (L3). CO5 Action verb is same level as PO2 verb. Therefore, the correlation is high (3).
PO3 Verb: Develop (L3). CO5 Action verb is at the same level as the PO3 verb. Therefore, the correlation is high (3).
PO5 Verb: Apply (L3). CO5 Action verb is at the same level as the PO5 verb. Therefore, the correlation is high (3).
PO11 Verb: Thumb Rule. As per the thumb rule, CO5 correlates slightly with the PO11 verb. Therefore, the correlation is moderate (2).

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MECHANICAL ENGINEERING (ME)

Year: I **Semester: II** **Branch of Study: ME**

Subject Code	Subject Name	L	T	Pr/CLC	P	Credits
26APC0301	Department Specific Workshop **BASIC SIMULATION LAB**	0	0	0	2	1

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

CO: 1 Apply basic MATLAB commands, array operations and built-in plotting routines to programmatically model geometric properties of mechanical components and visualize time-dependent signals.
CO: 2 Analyze experimental data trends using interactive MATLAB apps and linear/polynomial regression techniques to extract physical system parameters and identify data anomalies.
CO: 3 Evaluate mechanical work, surface areas and irregular geometric profiles by implementing and comparing numerical integration and differentiation techniques.
CO: 4 Analyze linear/nonlinear algebraic equations and first-order ordinary differential equations using both script-based numerical solvers and MATLAB Live Editor Tasks.
CO: 5 Create dynamic graphical system models using MATLAB Simulink and leverage integrated AI tools to automate code generation, model identification and system performance prediction.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Apply	Basic MATLAB commands, array operations, and built-in plotting routines	using simple MATLAB scripts	to programmatically model geometric properties of mechanical components and visualize time-dependent signals	L3
CO2	Analyze	Experimental data trends and physical system parameters	using interactive MATLAB apps and linear/polynomial regression techniques	to accurately extract stiffness/acceleration parameters and identify data anomalies	L4
CO3	Evaluate	Mechanical work, surface areas, and irregular geometric profiles	by implementing and comparing numerical integration and differentiation techniques	to determine method accuracy and solution convergence	L5
CO4	Analyze	Linear/nonlinear algebraic equations and first-order ordinary differential equations	using script-based numerical solvers and MATLAB Live Editor Tasks	to compute roots, transient trajectories, and dynamic physical behaviors	L4
CO5	Create	Dynamic graphical system models and predictive system workflows	using MATLAB Simulink and integrated AI tools	to automate code generation, system identification, and performance prediction	L6

List of Experiments:
Core Syllabus

Exp 1: Introduction to MATLAB Programming

Core Syllabus: Introduction to the MATLAB interface (Command Window, Workspace), basic calculator functions, variables, creating simple vectors/arrays, basic arithmetic operations, and simple 2D line plotting.

Hands-on Experience: Write a simple script to calculate the area and volume of various mechanical components

(cylinders, spheres) and plot a basic sine wave.

AI Applications: Code explanation, fixing basic syntax typos, and generating simple code templates.

AI Integration: Use MATLAB AI Chat Playground to ask: "Explain what this basic error message means and how to fix it."

Video Resources: MATLAB Onramp (MathWorks – Free 2-Hour Beginner Course).

Exp 2: Curve Fitting – Straight Line Fit

Core Syllabus: Concept of a line of best fit (y = mx + c), basic data importing from Excel, and introduction to the interactive Curve Fitting App.

Hands-on Experience: Import data from a standard Hooke's Law experiment (Force vs. Extension) and find the stiffness (k) of a spring using the visual app interface.

AI Applications: Spotting outliers or bad data points in an experimental dataset.

AI Integration: Use the interactive Curve Fitting App to automatically generate the linear code without writing it from scratch.

Video Resources: How to Use the Curve Fitting App (MathWorks YouTube).

Exp 3: Curve Fitting – Polynomial Fit

Core Syllabus: Moving beyond straight lines, understanding non-linear trends, basic concept of a quadratic equation curve, and evaluating fit quality visually.

Hands-on Experience: Fit a smooth curve to a car's displacement-time data to visually observe acceleration trends.

AI Applications: Simple pattern matching and trend prediction based on historical data.

AI Integration: Use the Regression Learner App to explore how a machine learning model can "train" on points to guess a curve.

Video Resources: Basic Curve Fitting Techniques (MathWorks).

Exp 4: Numerical Integration and Differentiation – Trapezoidal Method

Core Syllabus: Understanding integration as the simple "area under a curve", dividing an area into basic strips, using the built-in trapz command.

Hands-on Experience: Estimate the total work done by a constant or changing force acting over a distance by calculating the area under a Force-Displacement graph.

AI Applications: Approximating geometry dimensions from digital sensor data streams.

AI Integration: Use generative AI tools to write the logic for a basic for-loop that adds up the areas of separate shapes.

Video Resources: Concept of Integration and Trapezoidal Rule (Khan Academy).

Exp 5: Numerical Integration and Differentiation – Simpson Method

Core Syllabus: Introduction to Simpson's rule as a smarter way to find areas using curved tops instead of flat trapezoids, comparing accuracy.

Hands-on Experience: Find the cross-sectional area of an irregular mechanical bracket or a river bed profile using standard measurement intervals.

AI Applications: Smart shape recognition and automated area estimation in basic design software.

AI Integration: Compare results from the Trapezoidal script and Simpson script using an AI assistant to analyze which method is more accurate.

Video Resources: Simpson's Rule Made Easy (NPTEL / Online Tutorials).

Exp 6: Linear and Nonlinear Equations

Core Syllabus: Solving a system of basic linear equations (like finding two unknown forces), finding roots of an equation graphically, using simple commands like roots or fzero.

Hands-on Experience: Find the precise point where a projectile hits the ground by calculating the zero-crossing root of its trajectory equation.

AI Applications: Finding optimal balance points in manufacturing systems or structural designs.

AI Integration: Use the interactive Optimization Tool wizard to find the minimum weight of a box without manually calculating derivatives.

Video Resources: Solving Equations in MATLAB (MathWorks Tutorial).

Exp 7: Ordinary Differential Equations & Transforms

Core Syllabus: Introduction to differential equations as "rates of change" (e.g., speed changing over time), step-by-step calculation using basic Euler logic, using the ode45 app wizard.

Hands-on Experience: Simulate a hot cup of coffee cooling down over time according to Newton's Law of Cooling.

AI Applications: Simple time-series trend forecasting (e.g., predicting when a component will overheat).

AI Integration: Use the Live Editor Task for Solving ODEs to define and solve the cooling rate visually without deep programming.

Video Resources: Introduction to ODEs in MATLAB (MathWorks).

Exp 8: Engineering Applications Analysis (Basic Mechanics Focus)

Core Syllabus: Simulating fundamental concepts from First-Year Engineering Mechanics: static equilibrium, basic lever arms, and simple velocity profiles.

Hands-on Experience: Plot how the velocity of a falling object changes over time when affected by gravity and simple air resistance.

AI Applications: Identifying unexpected changes or failures in basic mechanical setups.

AI Integration: Use the System Identification App to upload data from a basic pendulum swing and let the tool guess its length and drag.

Video Resources: Engineering Mechanics Animations using MATLAB (Online Lectures).

Exp 9: MATLAB Simulink – Introduction to Graphical Modeling

Core Syllabus: Introduction to the drag-and-drop Simulink interface, working with basic blocks (Sources, Sinks, Gains, Integrators), and connecting signals visually.

Hands-on Experience: Build a visual block diagram model of a basic water tank filling up over time, without writing any lines of code.

AI Applications: An introduction to modern digital twins and graphical system simulations.

AI Integration: Use Simulink Onramp interactive widgets to discover how pre-trained machine learning blocks can predict the output of a system.

Video Resources: Simulink Onramp (MathWorks – Free 2-Hour Visual Guide).

Text Books

1. Holly Moore, MATLAB for Engineers (6th Edition) — designed for first-year engineering students; covers

environment setup, script writing, matrix tracking, arrays, and basic plotting.

2. Agam Kumar Tyagi, MATLAB and SIMULINK for Engineers — explains coding logic alongside graphical block layout building.

3. Dr.Shailendra Jain, Modeling and Simulation using MATLAB – Simulink — guides beginners through visual modeling, scopes, and signal connections.

Reference Books

1. Steven C. Chapra& Raymond P. Canale, Numerical Methods for Engineers, McGraw Hill Education India.

2. John H. Mathews &Kurtis D. Fink, Numerical Methods Using MATLAB.

3. Won Y. Yang, Wenwu Cao, Tae-Sang Chung & John Morris, Applied Numerical Methods Using MATLAB.

Recommended Free & Open-Source Simulation / AI Tools

Language & Environment: MATLAB, Simulink – scripting, curve fitting, numerical methods, and graphical modelling.

AI Assistants: MATLAB AI Chat Playground – code explanation and debugging support.

Interactive Apps: Curve Fitting App, Regression Learner App, Optimization Tool, System Identification App, Live Editor Task for ODEs – guided, low-code problem solving.

Video Resources: MATLAB Onramp, Simulink Onramp, NPTEL, Khan Academy – free guided video tutorials.

CO – PO Articulation Matrix

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Basic Simulation Lab	CO1	3	2			3							2	3
	CO2	3	3		3	3							3	3
	CO3	3	3		3	3							3	3
	CO4	3	3	2		3							3	3
	CO5	3	2	3		3							3	3

Correlation Matrix

CO	CO					Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
	Lesson Plan (Hrs)	%	Correlation	Verb	BTL			
1	**9**	25	3	Apply	L3	PO1 PO2 PO5	Apply (L3) Identify (L3) Apply (L3)	3 3 3
2	**9**	25	3	Analyze	L4	PO1 PO2 PO4 PO5	Apply (L3) Identify (L3) Analyze (L4) Apply (L3)	3 3 3 3
3	**6**	16.67	2	Evaluate	L5	PO1 PO2 PO4 PO5	Apply (L3) Identify (L3) Analyze (L4) Apply (L3)	3 3 3 3
4	**6**	16.67	2	Analyze	L4	PO1 PO2 PO3 PO5	Apply (L3) Identify (L3) Develop (L3) Apply (L3)	3 3 3 3
5	**6**	16.67	2	Create	L6	PO1 PO2 PO3 PO5	Apply (L3) Identify (L3) Develop (L3) Apply (L3)	3 3 3 3
	36	100						

Justification Statements:

CO1: Apply basic MATLAB commands, array operations and built-in plotting routines to programmatically model geometric properties of mechanical components and visualize time-dependent signals.
Action Verb: **Apply (L3)**
PO1Verb: **Apply (L3)**
CO1 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO1 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO5 Verb: **Apply (L3)**
CO1 Action verb is same level as PO5 verb. Therefore, the correlation is high (3)

CO2: Analyze experimental data trends using interactive MATLAB apps and linear/polynomial regression techniques to extract physical system parameters and identify data anomalies.
Action Verb: **Analyze (L4)**
PO1Verb: **Apply (L3)**
CO2 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO2 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO4 Verb: **Analyze (L4)**
CO2 Action verb is same level as PO4 verb. Therefore, the correlation is high (3)
PO5 Verb: **Apply (L3)**
CO2 Action verb is same level (greater) as PO5 verb. Therefore, the correlation is high (3)

CO3: Evaluate mechanical work, surface areas and irregular geometric profiles by implementing and comparing numerical integration and differentiation techniques.
Action Verb: **Evaluate (L5)**
PO1Verb: **Apply (L3)**
CO3 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO3 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Analyze (L4)**
CO3 Action verb is same level (greater) as PO3 verb. Therefore, the correlation is high (3)
PO5 Verb: **Apply (L3)**
CO3 Action verb is same level (greater) as PO5 verb. Therefore, the correlation is high (3)

CO4: Analyze linear/nonlinear algebraic equations and first-order ordinary differential equations using both script-based numerical solvers and MATLAB Live Editor Tasks.
Action Verb: **Analyze (L4)**
PO1Verb: **Apply (L3)**
CO4 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO4 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO4 Action verb is same level (greater) as PO3 verb. Therefore, the correlation is high (3)
PO5 Verb: **Apply (L3)**
CO4 Action verb is same level (greater) as PO5 verb. Therefore, the correlation is high (3)
CO5: Create dynamic graphical system models using MATLAB Simulink and leverage integrated AI tools to automate code generation, model identification and system performance prediction.
Action Verb: **Create (L6)**
PO1Verb: **Apply (L3)**
CO5 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO5 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO5 Action verb is same level (greater) as PO3 verb. Therefore, the correlation is high (3)
PO5 Verb: **Apply (L3)**
CO5 Action verb is same level (greater) as PO5 verb. Therefore, the correlation is high (3)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
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Course structure for Four Year Regular B.Tech. Degree Program
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MECHANICAL ENGINEERING (ME)

Year: I B.Tech (Branch: Mechanical Engineering) Semester: II

Subject Code: 26ABS990603	Subject Name: Applied Chemistry for Mechanical Engineers Lab	L	T	P	Credits:1.5
		0	0	3	

Course Objectives: Students are expected to
To verify the fundamental concepts with experiments
Course Outcomes: At the end of the course, the students will be able to
CO1: Apply volumetric titration techniques to estimate ferrous ion and hydrochloric acid strengthalong with AI tools
CO2: Apply laboratory techniques to determine moisture content, adsorption behavior, and corrosion characteristics of engineering materials along with AI tools
CO3: Apply conductometric, potentiometric, pH-metric, spectrophotometric, and viscometric methods to determine the physicochemical properties of chemical systemsalong with AI tools
CO4: Apply spectrophotometric techniques to determine wavelength and verify Beer–Lambert's lawalong with AI tools.
CO5: Analyze laboratory techniques corrosion and lubrication behavior using laboratory techniquesalong with AI tools.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Apply	volumetric titration techniques	along with AI tools	to estimate ferrous ion and hydrochloric acid strength	L3
2	Apply	**laboratory techniques**	along with AI tools	**to determine moisture content, adsorption behavior, and corrosion characteristics of engineering materials**	L3
3	Apply	conductometric, potentiometric, pH-metric, spectrophotometric, and viscometric methods	along with AI tools	to determine the physicochemical properties of chemical systems	L3
4	Apply	spectrophotometric techniques	along with AI tools	to determine wavelength and verify Beer–Lambert's law	L4
5	Analyze	corrosion and lubrication behavior using laboratory techniques	along with AI tools		L4

List of Experiments:

1. Estimation of Ferrous Iron (Fe^{+2}) using potassium dichromate ($K_2Cr_2O_7$) (Redox titrations)(CO1)
2. Determination of strength of acid (HCl) using Sodium hydroxide (CO1)
3. Determination of moisture content in coal sample (Proximate analysis) (CO2)
4. Verification of Freundlich Adsorption isotherm (Adsorption of acetic acid by charcoal) (CO2)
5. Determination of corrosion. (CO2)
6. Determination of corrosion by environment. (CO2)

7. Conductometric titrations of strong acid Vs strong base (Ex: HClVsNaOH) (CO3)

8. Potentiometry (Redox titrations)-Estimation of Iron (Fe+2) using potassium dichromate (K2Cr2O7) (CO3)

9. pH metry – Estimation of Hydrochloric acid (HCl) using Sodium Hydroxide (NaOH) (CO3)

10. Spectrophotometry – Determination of wavelength (λ) and verification of Beer's – Lamberts law. (CO4)

11. Determination of viscosity of lubricating oil using Red-Wood Viscometer – I (CO5)

12. Determination of viscosity of lubricating oil using Red-Wood Viscometer – II (CO5)

AI Extension: Data acquisition and analysis using Python/Excel. Predictive analysis for corrosion and lubrication behavior.

Note: Any TEN of the listed experiments are to be conducted. Out of which any TWO Experiments may be conducted in virtual mode.

Reference:

1. Vogel's Quantitative Chemical Analysis 6th Edition 6th Edition

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3			1	3								
2	3			1	3								
3	3			1	3								
4	3			1	3								
5	3			2	3								

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1				Apply	L3	PO1	PO1, PO4, PO5	3
2				Apply	L3	PO1	PO1, PO4, PO5	3
3				Apply	L3	PO1	PO1, PO4, PO5	3
4				Apply	L4	PO1	PO1, PO4, PO5	3
5				Analyze	L4	PO1	PO1, PO4, PO5	3

CO1: Apply volumetric titration techniques to estimate ferrous ion and hydrochloric acid strength along with AI tools

Action Verb: Apply (L3)

PO1 Verb: Apply (L3)

CO1 Action Verb is Equal to PO1; Therefore, correlation is high (3)

CO2:**Apply laboratory techniques to determine moisture content, adsorption behavior, and corrosion**

characteristics of engineering materials along with AI tools

Action Verb: Apply (L3)

PO1 Verb: Apply (L3)

CO2 Action Verb is Equal to PO1; Therefore, correlation is high (3)

CO3: Apply conductometric, potentiometric, pH-metric, spectrophotometric, and viscometric methods to determine the physicochemical properties of chemical systems along with AI tools

Action Verb: Apply (L3)

PO1 Verb: Apply (L3)

CO3 Action Verb is equal to PO1; Therefore, correlation is high (3)

CO4: Apply spectrophotometric techniques to determine wavelength and verify Beer–Lambert's law along with AI tools.

Action Verb: Apply (L3)

PO1 Verb: Apply (L3)

CO4 Action Verb is equal PO1; Therefore, correlation is high (3)

CO5: Analyze laboratory techniques corrosion and lubrication behavior using laboratory techniques along with AI tools. Action Verb: Analyze (L4)

PO1 Verb: Apply (L3))

CO5: Action Verb is one level higher than to PO1; Therefore, correlation is high (3)

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MECHANICAL ENGINEERING (ME)

Year: I B.Tech (Common to all branches) Semester: I & II

Subject Code :26AHM9902	**COMMUNICATIVE ENGLISH LAB**	L 0 T 0 Pr 0 P 2	Credit: 1

Course Outcomes (CO): By the end of the program students will be able to	**Blooms Level**
CO1: Apply standard phonemic symbols and AI-assisted pronunciation tools to enhance English pronunciation, fluency, and confidence in spoken communication.	L3
CO2: Apply AI-assisted language learning tools to enhance listening comprehension and communicate effectively in formal and informal contexts.	L3
CO3: Analyze information using AI-supported research tools and communicate evidence-based arguments effectively in presentations, discussions, and debates.	L4
CO4: Create professional documents using AI-powered writing and formatting tools while ensuring grammatical accuracy, coherence, and contextual appropriateness.	L6 L5
CO5: Evaluate and utilize AI-powered language technologies to enhance English communication while ensuring accuracy, originality, and ethical use of AI-generated content.	

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms
CO1	Apply	standard phonemic symbols and AI-assisted pronunciation tools to enhance English pronunciation, fluency, and confidence in spoken communication.		in spoken communication.	L3
CO2	Apply	AI-assisted language learning tools to enhance listening comprehension and communicate effectively in formal and informal contexts.		in formal and informal contexts.	L3
CO3	Analyze	information using AI-supported research tools and communicate evidence-based arguments effectively in presentations, discussions, and debates.		in presentations, discussions, and debates.	L4
CO4	Create	**professional documents using AI-powered writing and formatting tools while ensuring grammatical accuracy, coherence, and contextual appropriateness.**		**professional documents**	L6

CO5	Evaluate	And utilize AI-powered language technologies to enhance English communication while ensuring accuracy, originality, and ethical use of AI-generated content.		English communication	L5

S.No.	Lab Topic	Lab Activity	AI Activity	AI Tools	Cos
1	Phonetics & Pronunciation Practice	Record & playback vowel/consonant articulation; IPA chart drill; Minimal pair exercises	Use AI speech-to-text to detect mispronunciations; real-time phoneme feedback via ELSA Speak	ELSA Speak, Google Speech Recognition, Speechling	CO1
2	Listening Comprehension & Note-Taking	Listen to TED Talks/podcasts; fill-in-the-blank exercises; summarise audio passages	Auto-generate transcripts; compare student notes with AI-generated summaries using Otter.ai	Otter.ai, YouTube Auto-captions, Whisper AI	CO2
3	Spoken English & Fluency Building	Impromptu speaking (1–2 min); picture description; story completion tasks	AI analyses speech for filler words, pace, and clarity; ChatGPT prompts for spontaneous speaking	Speeko, ChatGPT, Google Assistant	CO1,CO5
4	Group Discussion Techniques	Role-based GD on current topics; turn-taking practice; consensus building	AI evaluates argument structure and language; ChatGPT generates counter-arguments for practice	ChatGPT, Gemini, Mentimeter	CO3
5	Public Speaking & Presentations	Prepare and deliver 3-minute presentations; use of visual aids; Q&A handling	AI slide deck generation; real-time delivery feedback on pacing and confidence	Beautiful.ai, Gamma.app, Microsoft Copilot	CO3,CO5
6	Interview Skills & Mock Interviews	HR round simulation; STAR method answers; body language and eye contact	AI-powered mock interview with instant feedback on content, grammar, and tone	Yoodli, Interview Warmup by Google, ChatGPT	CO2,CO5
7	Professional Email & Business Writing	Draft formal emails, complaints, and requests; subject line formulation; netiquette	AI refines email drafts; tone & clarity check; compare student draft with AI-improved version	Grammarly, ChatGPT, Gemini	CO4
8	Resume &Cover Letter Writing	ATS-friendly resume design;	AI resume scanner; keyword	Kickresume, Resume.io,	CO4

		action verbs usage; tailoring cover letters to job descriptions	optimisation suggestions; ChatGPT cover letter generation and critique	Jobscan, ChatGPT	
9	Reading Comprehension & Critical Thinking	Read articles/editorials; identify main idea, inference, and tone; speed reading drills	AI generates comprehension questions; text summarisation and comparative analysis	Quillbot, Speechify, NotebookLM	CO2
10	Debate & Argumentation Skills	Structured debate (for/against); rebuttal techniques; logical fallacy identification	AI generates arguments on both sides; evaluate logical structure using ChatGPT	ChatGPT, Claude.ai, Kialo Edu	CO3
11	Report Writing & Technical Communication	Lab report, incident report, and project report formats; headings, data presentation	AI improves report coherence and passive/active voice usage; grammar and structure feedback	Grammarly Business, ChatGPT, Hemingway Editor	CO4
12	Etiquette, Netiquette & Personal Branding	Workplace conversation role play; LinkedIn profile creation; professional social media etiquette	AI reviews LinkedIn summaries; digital personal analysis; personal brand statement via ChatGPT	ChatGPT, Canva AI, LinkedIn AI features	CO1,CO2

Text Books:

1.Raman, Meenakshi & Sharma, Sangeeta. Technical Communication: Principles and Practice (3rd Ed.). Oxford University Press, 2022.

2.Krishnaswamy, N. & Krishnaswamy, L. The Story of English in India. Foundation Books, Cambridge University Press, 2021.

ReferenceBooks:

1.Swan, Michael. Practical English Usage (4th Ed.). Oxford University Press, 2016.

2.Murphy, Raymond. English Grammar in Use (5th Ed.). Cambridge University Press, 2019.

3.Rizvi, M. Ashraf. Effective Technical Communication (2nd Ed.). McGraw-Hill Education, 2018.

4.Turton, N.D. & Heaton, J.B. Longman Dictionary of Common Errors. Pearson Longman, 2017.

5.Lesikar, Raymond V. & Flatley, Marie E. Basic Business Communication (12th Ed.). McGraw-Hill, 2020.

6.Rutherford, Andrea J. Basic Communication Skills for Technology (3rd Ed.). Pearson, 2019.

Online Resources

- BBC Learning English – https://www.bbc.co.uk/learningenglish (Grammar, pronunciation, and listening)
- British Council Learn English – https://learnenglish.britishcouncil.org
- TED Talks – https://www.ted.com/talks (Listening & speaking practice)
- Coursera English Communication Skills Specialisation – https://www.coursera.org
- edX English for Professional and Academic Purposes – https://www.edx.org
- Grammarly Blog – https://www.grammarly.com/blog (Writing tips)
- ELSA Speak (App) – https://elsaspeak.com (AI pronunciation coach)

7. YouTube Channels

- English with Lucy – @EnglishwithLucy (Vocabulary, speaking, British accent)
- Learn English with TV Series – @LearnEnglishWithTVSeries
- Rachel's English – @rachelsenglish (American accent and pronunciation)
- TED-Ed – @TEDEd (Critical thinking and communication ideas)
- Spoken English Hub – @SpokenEnglishHub (Indian context, interview prep)
- JenniferESL – @JenniferESL (Grammar and business English)

Lab Software & AI Tools Required:

Software / Tool	Type	Purpose
ELSA Speak	AI Pronunciation Coach App	Real-time speech accuracy & fluency feedback
Grammarly	AI Writing Assistant	Grammar, punctuation, style correction
ChatGPT / Claude.ai	Generative AI Chatbot	Conversation practice, writing assistance, debate prep
Otter.ai	AI Transcription Tool	Transcribe and analyse spoken content
Yoodli	AI Public Speaking Coach	Presentation and interview delivery analysis
Hemingway Editor	Writing Clarity Tool	Improve readability and sentence structure
Mentimeter	Interactive Presentation	Live polls, word clouds during GD sessions
Audacity	Audio Recording Software	Record and review pronunciation exercises
Google Meet / Zoom	Video Conferencing	Mock interviews and virtual presentations
Canva / Beautiful.ai	AI Presentation Design	Create professional visual presentations

Correlation of COs with the POs & PSOs for B.Tech
AK-26 Regulations
***3: Highly Correlated, 2: Moderately Correlated, 1: Weakly Correlated**

Course Title	Course Outcomes COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COMMUNICATIVE	CO1									2		

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MECHANICAL ENGINEERING (ME)

ENGLISH LAB	CO2									2		
	CO3								3	3		
	CO4									3		
	CO5									3		

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	corr	Verb	BTL			
1				Apply	L3	PO9	Thumb Rule	2
2				Apply	L3	PO9	Thumb Rule	2
3				Analyze	L4	PO8, PO9	Thumb Rule	3,3
4				Create	L6	PO9	Thumb Rule	3
5				Evaluate	L5	PO9	Thumb Rule	3

CO-PO mapping justification:

CO1: Apply standard phonemic symbols and AI-assisted pronunciation tools to enhance English pronunciation, fluency, and confidence in spoken communication.

Action Verb: Apply (L3)
CO1 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2).

CO2: Apply AI-assisted language learning tools to enhance listening comprehension and communicate effectively in formal and informal contexts.

Action Verb: Apply (L3)
CO2 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2)

CO3: Analyze information using AI-supported research tools and communicate evidence-based arguments effectively in presentations, discussions, and debates.

Action Verb: Analyze (L4)
CO3 Action Verb analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 to PO11 as high (3).

CO4: Create professional documents using AI-powered writing and formatting tools while ensuring grammatical accuracy, coherence, and contextual appropriateness.

Action Verb: Create (L6)
CO4 Action Verb Create is of BTL 6. Using Thumb rule, L6 correlates PO6 to PO11 as high (3)

CO5: Evaluate and utilize AI-powered language technologies to enhance English communication while ensuring accuracy, originality, and ethical use of AI-generated content

Action Verb: Evaluate (L5)
CO5 Action Verb Evaluate is of BTL 5 Using Thumb rule, L5 correlates PO6 to PO11 as high (3).

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MECHANICAL ENGINEERING (ME)

Common to I SEM CSE/CIC/SCD/EEE & II SEM ECE/AI&DS/AI&ML/CE/ME

Course Code: 26AHM9903	HEALTH AND WELLNESS, YOGA AND SPORTS	L	T	Pr	P	C
		0	0	0	1	0.5

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.p

Course Outcomes: After completion of the course the student will be able toCO1

CO1:Understand the fundamental concepts of health, wellness, fitness and the dimensions of holistic well-being.
CO2: Apply correct yogic practices – asanas, pranayama and meditation – for physical and mental health.
CO3:Apply a personal fitness plan integrating nutrition, exercise, stress management and lifestyle modification.
CO4: Understand rules, skills and safety norms for a chosen sport and participate actively with sportsmanship.
CO5: Evaluate personal health indicators and reflect on lifestyle choices using technology and evidence-based practices.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	the fundamental concepts of health, wellness, fitness and the dimensions of holistic well-being.			**L2**
2	**Apply**	correct yogic practices – asanas, pranayama and meditation – for physical and mental health.			**L3**
3	**Apply**	a personal fitness plan integrating nutrition, exercise, stress management and lifestyle modification.			**L3**
4	**Understand**	rules, skills and safety norms for a chosen sport and participate actively with sportsmanship.			**L2**
5	**Evaluate**	personal health indicators and reflect on lifestyle choices using technology and evidence-based practices.			**L5**

Unit-wise Syllabus with Learning Outcomes

UNIT 1	Health, Wellness and Preventive Healthcare	5 Hrs
Topics	• Concept of health, wellness and fitness – definitions and seven dimensions • WHO definition of health; holistic health model (Physical, Mental, Social, Spiritual) • Nutrition basics – macronutrients, micronutrients, balanced diet, BMI calculation	

	• Lifestyle diseases – diabetes, hypertension, obesity – causes and prevention • Mental health & stress management – causes, symptoms, COPE model • Sleep hygiene and circadian rhythm regulation • Substance abuse – awareness, prevention and rehabilitation • Personal hygiene, sanitation and communicable disease prevention • Ergonomics and occupational health for students
Unit-wise Learning Outcomes (ULOs)	**On completion of this unit, students will be able to:** • ULO1.1: Define health, wellness and fitness and describe the seven dimensions of holistic well-being. [Remember] • ULO1.2: Explain the role of balanced nutrition, BMI and sleep hygiene in maintaining good health. [Understand] • ULO1.3: Identify risk factors, early signs and preventive strategies for major lifestyle diseases. [Understand] • ULO1.4: Apply stress-management techniques and healthy daily routines to personal lifestyle. [Apply] • ULO1.5: Evaluate personal health habits and propose evidence-based improvements. [Evaluate]

UNIT 2	**Yoga, Pranayama, Meditation and Mind-Body Practice**	**5 Hrs**
Topics	• Introduction to Yoga – history, philosophy, Patanjali's Ashtanga Yoga • Surya Namaskar – 12-step sequence with correct breathing • Asanas for flexibility: Tadasana, Trikonasana, Paschimottanasana, Sarvangasana • Asanas for strength & balance: Virabhadrasana I & II, Vrikshasana, Naukasana • Pranayama techniques: Anulom-Vilom, Bhastrika, Kapalbhati, Bhramari • Meditation and mindfulness – Dharana, Dhyana, body-scan, guided relaxation • Yoga Nidra for sleep and stress relief • Yoga for specific conditions – stress, back pain, PCOD/PCOS, anxiety • Shatkarmas (cleansing processes) – an overview; International Day of Yoga	
Unit-wise Learning Outcomes (ULOs)	**On completion of this unit, students will be able to:** • ULO2.1: Describe the history, philosophy and eight limbs of Patanjali's Yoga Sutras. [Remember/Understand] • ULO2.2: Perform Surya Namaskar and a set of 8 asanas with correct posture and breath coordination. [Apply] • ULO2.3: Practise at least four pranayama techniques with proper technique and safety awareness. [Apply] • ULO2.4: Apply mindfulness meditation and Yoga Nidra for stress reduction and improved concentration. [Apply] • ULO2.5: Adapt appropriate asanas and pranayama for managing specific health conditions. [Analyse]	

UNIT 3	**Physical Fitness, Sports Skills and Sports Technology**	**5 Hrs**
Topics	• Physical fitness components – strength, endurance, flexibility, agility, speed, coordination • Principles of training • – overload, progression, specificity, reversibility, individuality • Warm-up, cool-down and dynamic stretching routines	

	• Indoor sports: Badminton, Table Tennis, Chess, Carrom – rules and basic skills • Outdoor sports: Cricket, Football, Volleyball, Kabaddi, Athletics – rules and skills • Sports injuries – types, RICE method, prevention and return-to-play protocol • Sports psychology – motivation, goal setting, concentration and visualisation • Gender equity and inclusivity in sports; Para-sports awareness • Sports technology – wearables, fitness trackers, GPS analytics, performance dashboards
Unit-wise Learning Outcomes (ULOs)	**On completion of this unit, students will be able to:** • ULO3.1: Identify the components of physical fitness and explain training principles for improving each. [Understand] • ULO3.2: Demonstrate correct warm-up, cool-down and stretching routines before and after physical activity. [Apply] • ULO3.3: Apply rules, techniques and safety norms of at least one indoor and one outdoor sport. [Apply] • ULO3.4: Design a personalised 4-week physical fitness training plan with progressive overload. [Create] • ULO3.5: Use wearable/fitness-tracking technology to monitor personal performance and evaluate progress. [Evaluate]

Text Books

S.No	Title	Author(s)	Publisher	Year
1	Health and Physical Education	Dr. S. K. Mangal & Shubhra Mangal	PHI Learning Pvt. Ltd.	2021
2	The Science of Yoga	William J. Broad	Simon & Schuster	2012

Reference Books

S.No	Title	Author(s)	Publisher	Year
1	Yoga: The Iyengar Way	Silva, Mira & Shyam Mehta	Dorling Kindersley	2019
2	Sports Medicine Essentials	Jim Clover	Cengage Learning	2020
3	Foundations of Physical Education & Sport	Charles A. Bucher	McGraw-Hill Education	2018
4	Mindfulness: An Eight-Week Plan for Finding Peace	Mark Williams & Danny Penman	Rodale Books	2011

Web Resources

- Ministry of AYUSH – https://main.ayush.gov.in
- Yoga for Youth (International Day of Yoga) – https://yoga.ayush.gov.in
- National Health Portal – https://nhp.gov.in
- ICMR Dietary Guidelines – https://www.icmr.nic.in
- Sports Authority of India – https://www.sportsauthorityofindia.nic.in
- WHO Physical Activity Guidelines – https://www.who.int/news-room/fact-sheets/detail/physical-activity
- Khelo India Programme – https://kheloindia.gov.in
- NIMHANS (Mental Health Resources) – https://nimhans.ac.in

YouTube Resources

- Surya Namaskar – Complete 12-Step Tutorial – https://youtu.be/surya_tut_01
- Pranayama for Beginners (Swami Ramdev) – https://youtu.be/pranayama_sr_02
- Mindfulness Meditation (10 Min) – https://youtu.be/mindful_med_03

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- Balanced Nutrition Explained (ICMR) – https://youtu.be/nutrition_icmr_04
- Sports Injury Prevention Tips – https://youtu.be/injury_prev_05
- Mental Health Awareness for Students – https://youtu.be/mh_students_06
- Yoga for Stress Relief – Isha Foundation – https://youtu.be/yoga_isha_07
- Fit India Movement – PM Modi Launch – https://youtu.be/fitindia_pmo_08

AI-Integrated Activities

S.No	AI Activity	Description / Tool
1	AI Fitness Assessment Dashboard	Log BMI, steps and sleep for 2 weeks using Google Fit / Apple Health; generate AI health-insight reports and compare with WHO benchmarks.
2	Personalised Diet Planner with AI	Use NutriAI / Eat Right Now app to design a 7-day balanced meal plan; compare output with ICMR dietary guidelines.
3	Yoga Pose Correction using ML Camera	Use YogaNotch / KAIA Health app for real-time AI posture feedback; record before/after improvement videos.
4	Mental Health Chatbot Interaction & Reflection	Engage with Woebot / Wysa AI mental-health chatbot for one week; write a critical reflection on AI vs human counsellor effectiveness.
5	Sports Performance Analytics with Python	Analyse a cricket/football dataset on Google Colab using Pandas; visualise player performance KPIs with Matplotlib / Seaborn.

CO – PO / PSO Mapping

Correlation: 3 = Strong | 2 = Moderate | 1 = Slight | – = No correlation

- Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1						2	2						
2						2	2						
3						2	2						
4						2	2						
5						3	3						

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High) **CO-PO mapping justification:**

CO	Percentage of contact hours over the total planned contact hours				CO		Program Outcome (PO)	Level of Correlation (0-3)
	Register (Hrs)	Lesson Plan (Hrs)	%	corr	Verb	BTL		
1					Understand	L2	P06,P07	2
2					Apply	L3	P06,P07	2
3					Apply	L3	P06, P07	2
4					Understand	L2	P06, P07	2
5					Evaluate	L5	P06,P07 PO11	3

CO1: Understand the fundamental concepts of health, wellness, fitness and the dimensions of holistic well-being

Action Verb: Understand (L2)

CO1 Action Verb is **Understand** of BTL 2.Using Thumb rule; L2 correlates PO6 and PO7 as a moderate (2)

CO2: Apply correct yogic practices – asanas, pranayama and meditation – for physical and mental health.

Action Verb: Apply(L3)

CO2 Action Verb is **Apply** of BTL 3.Using Thumb rule; L2 correlates PO6 and PO7 as a moderate (2)

CO3: Apply a personal fitness plan integrating nutrition, exercise, stress management and lifestyle modification.

Action Verb: APPLY (L3)

CO3 Action Verb is APPLY of BTL 3 Using Thumb rule; L3 correlates PO6 and PO7 as a moderate (2)

CO4: Understand rules, skills and safety norms for a chosen sport and participate actively with sportsmanship.

Action Verb: Understand (L2)

CO1 Action Verb is **Understand** of BTL 2.Using Thumb rule; L2 correlates PO6 and PO7 as a moderate (2)

CO5: Evaluate personal health indicators and reflect on lifestyle choices using technology and evidence-based practices.

CO5 Action Verb is **Evaluate** of BTL 5 .Using Thumb rule; L5 correlates PO6 and PO7 as a high (3)

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Course Code	Year & Sem	Cybersecurity Awareness for Engineers	L	T / CLC	P	C
26AMC3601	I-II		2	0	0	0

Course Outcomes: Student will be able to

CO1 **Understand** the fundamentals of cybersecurity.
CO2 **Analyze** the cyber threats and cyberattacks.
CO3 **Apply** the personal cybersecurity practices and security technologies.
CO4 **Apply** the cyber ethics, privacy principles and cyber laws.
CO5 **Apply** the secure digital practices and cyber hygiene.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	the fundamentals of cybersecurity.			L2
CO2	**Analyze**	the cyber threats and cyberattacks.			L4
CO3	**Apply**	the personal cybersecurity practices and security technologies.			L3
CO4	**Apply**	the cyber ethics, privacy principles, and cyber laws.			L3
CO5	**Apply**	the secure digital practices and cyber hygiene.			L3

UNIT – I	**Introduction to Cyberspace and Cybersecurity**	**6 Hrs**
Content	• Introduction to cyberspace and cybersecurity; Evolution of information systems and Internet; Importance of cybersecurity in engineering and society. • Information security concepts; CIA Triad (Confidentiality, Integrity, Availability); Digital footprint and digital identity; Security governance basics. • Cyber threat actors; Engineering ethics and responsible digital behavior; Cyber hygiene practices.	
AI Integration	Use of cybersecurity awareness platforms and threat-intelligence dashboards to map real-world CIA triad violations. Free/Open-Source Tools: National Cyber Security Awareness Portal (India); CERT-In resources.	
UNIT - II	**Cyber Threats, Cybercrime and Social Engineering**	**6 Hrs**
Content	• Cyber threats and vulnerabilities; Cybercrime and cyber offenders; Malware: Virus, Worm, Trojan, Spyware, Ransomware; Cyberattack lifecycle and common attack methods. • Phishing, Spear Phishing, Smishing and Vishing; Social engineering attacks; Password attacks and credential theft; Identity theft and financial fraud. • Insider threats; AI-enabled cyber threats and deepfakes; Case studies of major cyber incidents.	
AI Integration	Analysis of deepfake detection demos and AI-generated phishing email recognition exercises. Free/Open-Source Tools: OWASP Foundation resources; National Cyber Crime Reporting Portal case studies.	
UNIT – III	**Personal Cyber Safety and Cybersecurity Technologies**	**6 Hrs**
Content	• Password management and Multi-Factor Authentication; Authentication and access control concepts; Safe browsing practices; Email and communication security. • Mobile device security; Cloud security basics; Secure use of Wi-Fi and public networks; Data backup and recovery. • Cryptography and digital signatures (awareness level only); Safe use of AI tools and digital platforms.	
AI Integration	Practical exercises using free password managers and MFA setup; NIST Cybersecurity Framework self-assessment activity. Free/Open-Source Tools: NIST Cybersecurity Framework Resources.	
UNIT – IV	**Privacy, Cyber Ethics and Cyber Laws**	**6 Hrs**
Content	• Data protection and privacy concepts; Personal data and sensitive information; Cyber ethics and responsible digital behavior. • Overview of cyber laws in India; Information Technology (IT) Act and related provisions (awareness level); Common cybercrimes and legal implications. • Cybercrime reporting mechanisms and grievance redressal; Digital evidence basics; Social media responsibility and legal considerations.	

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AI Integration	Case discussion using CERT-In advisories and IT Act provisions applied to AI-generated content disputes. Free/Open-Source Tools: National Cyber Crime Reporting Portal; CERT-In.	
UNIT – V	**Cyber Hygiene and Secure Digital Practices**	**6 Hrs**
Content	• Cybersecurity risk awareness; Password management and Multi-Factor Authentication; Secure use of email, web, cloud and public networks. • Safe digital transactions and digital payment awareness; Secure use of social media and AI tools; Cybersecurity awareness in IoT and emerging technologies. • Incident awareness and cyber hygiene best practices.	
AI Integration	Cisco Networking Academy module on Introduction to Cybersecurity as a self-paced AI-assisted learning supplement. Free/Open-Source Tools: Cisco Networking Academy – Introduction to Cybersecurity.	

Textbooks:

1. Ajay Singh, *Introduction to Cyber Security: Concepts, Principles, Technologies and Practices*, Universities Press / Orient BlackSwan, Latest Edition.
2. Nina Godbole & Sunit Belapure, *Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives*, Wiley India.

Reference Books:

1. Charles J. Brooks, Christopher Grow, Philip Craig & Donald Short, *Cybersecurity Essentials*, Wiley.
2. William Stallings & Lawrie Brown, *Computer Security: Principles and Practice*, Pearson.
3. Michael E. Whitman & Herbert J. Mattord, *Principles of Information Security*, Cengage Learning.
4. Joseph Migga Kizza, *Guide to Computer Network Security*, Springer.
5. Eric Cole, *Cybersecurity for Beginners*, Wiley.

Web references:

- National Cyber Security Awareness Portal (India)
- CERT-In – Indian Computer Emergency Response Team – cert-in.org.in
- National Cyber Crime Reporting Portal – cybercrime.gov.in
- NIST Cybersecurity Framework Resources – nist.gov
- OWASP Foundation – owasp.org
- Cisco Networking Academy – Introduction to Cybersecurity – netacad.com

Recommended Cybersecurity Awareness Resources & Tools

Reporting & Response: CERT-In, National Cyber Crime Reporting Portal (cybercrime.gov.in) – incident reporting and alerts.
Frameworks: NIST Cybersecurity Framework, OWASP – security best practices and awareness.
Authentication & Hygiene: Bitwarden, KeePass, Google Authenticator – password management and Multi-Factor Authentication.
Learning: Cisco Networking Academy (Introduction to Cybersecurity), National Cyber Security Awareness Portal – self-paced awareness training.

Correlation of COs with the POs & PSOs for B.Tech

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

***3: Highly Correlated, 2: Moderately Correlated, 1: Weakly Correlated**

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CO-PO mapping justification:

UnitNo.	CO					Program Outcome (PO)	PO(s):Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	6	20%	CO1	Understand	L2	PO1 PO2 PO7	PO1: Apply (L3) PO2: Analyze (L4) PO7: Thumb rule	2 1 2
2	6	20%	CO2	Analyze	L4	PO1 PO2 PO5 PO7	PO1: Apply(L3) PO2: Analyze(L4) PO5: Apply(L3) PO7: Thumb rule	3 3 3 3
3	6	20%	CO3	Apply	L3	PO1 PO2 PO5 PO7	PO1: Apply(L3) PO2: Analyze(L4) PO5: Apply(L3) PO7: Thumb rule	3 2 3 2
4	6	20%	CO4	Apply	L3	PO1 PO2 PO6 PO7 PO10	PO1: Apply(L3) PO2: Analyze(L4) PO6: Thumb rule PO7: Thumb rule PO10: Thumb rule	3 2 2 2 2
5	6	20%	CO5	**Apply**	L3	PO1 PO2 PO5 PO6 PO7	PO1: Apply(L3) PO2: Analyze(L4) PO5: Apply(L3) PO6: Thumb rule PO7: Thumb rule	3 2 3 2 2
	30	100 %						

Justification Statements:

CO1: Understand the fundamentals of cybersecurity.
Action Verb: Understand (L2)

PO1 verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2)
PO2: Analyze (L4)
CO1 Action verb is less than PO2 verb by two level. Therefore, the correlation is low(1)
PO7: Thumb rule
CO1 provides a fundamental understanding of cybersecurity and awareness of ethical practices. Therefore, the correlation is **Moderate (2)**.

CO2: Analyze the cyber threats and cyberattacks.
Action Verb: Analyze (L4)

PO1 Verb: Apply(L3)
CO1 Action verb is greater than PO1 verb by one level. Therefore, the correlation is high (3)
PO2: Analyze(L4)
CO1 Action verb is same as PO2 verb. Therefore, the correlation is high (3)
PO5: Apply(L3)
CO1 Action verb is greater than PO5 verb by one level. Therefore, the correlation is high (3)
PO7: Thumb rule
CO2 develops the ability to analyze cyber threats and cyberattacks while considering their ethical implications. Therefore, the correlation is **High (3)**.

CO3: Apply the personal cybersecurity practices and security technologies.
Action Verb: Apply (L3)
PO1: Apply(L3)

CO1 Action verb is same as PO1 verb. Therefore, the correlation is **high (3)**
PO2: Analyze(L4)
CO1 Action verb is less than PO2 verb by one level. Therefore, the correlation is **moderate (2)**
PO5: Apply(L3)
CO1 Action verb is same as PO5 verb. Therefore, the correlation is **high (3)**
PO7: Thumb rule
CO3 applies personal cybersecurity practices and security technologies to promote responsible and ethical use of digital technologies. Therefore, the correlation is **Moderate (2)**.

CO4: Apply the cyber ethics, privacy principles, and cyber laws.
Action Verb: Apply (L3)

PO1: Apply(L3)
CO1 Action verb is same as PO1 verb. Therefore, the correlation is **high (3)**
PO2: Analyze(L4)
CO1 Action verb is less than PO2 verb by one level. Therefore, the correlation is **moderate (2)**
PO6: Thumb rule
CO4 applies cyber ethics, privacy principles, and cyber laws to promote responsible and lawful use of digital technologies. Therefore, the correlation is **moderate (2)**
PO7: Thumb rule
CO4 applies cyber ethics, privacy principles, and cyber laws to promote ethical and responsible use of digital technologies. Therefore, the correlation is **moderate (2)**
PO10: Thumb rule
CO4 supports clear communication of ethical, privacy, and legal responsibilities. Therefore, the correlation is **Moderate (2)**.

CO5: Apply the secure digital practices and cyber hygiene.
Action Verb: Apply (L3)

PO1: Apply(L3)
CO1 Action verb is same as PO1 verb. Therefore, the correlation is **high (3)**
PO2: Analyze(L4)
CO1 Action verb is less than PO2 verb by one level. Therefore, the correlation is **moderate (2)**
PO5: Apply(L3)
CO1 Action verb is same as PO5 verb. Therefore, the correlation is **high (3)**
PO6: Thumb rule
CO5 applies secure digital practices and cyber hygiene for responsible use of digital technologies. Therefore, the correlation is **Moderate (2)**.
PO7: Thumb rule
CO5 promotes secure and responsible digital practices through cyber hygiene. Therefore, the correlation is **Moderate (2).**