G.PULLA REDDY ENGINEERING COLLEGE

(Autonomous)

KURNOOL – 518 007

Scheme-2026

Part-B :: Scheme & Syllabus for I B Tech

(Effective from the A.Y. 2026-2027)

INDEX

Scheme-2026 of all branches

FOUR YEAR B.Tech DEGREE PROGRAMME
Scheme of Instruction and Examination
CIVIL ENGINEERING

B.Tech. – First Semester **Scheme-2026**

S.No.	Course code	Title	L/D	T	Pr	P	Credits
I		**Theory**					
1	BS103	Physics for Civil Engineering	3	0	0	0	3
2	BS101	Linear Algebra & Calculus	3	0	2	0	4
3	ME101	Engineering Graphics	1	0	4	0	3
4	CS102	Computational Thinking and Problem Solving with Python	3	0	0	0	3
II		**Practical**					
5	CS101	AI Tools and Applications	1	0	4	0	3
6	ME102	Engineering Workshop	0	0	0	3	1.5
7	BS104	Physics Lab for Civil Engineering	0	0	0	3	1.5
8	CS103	Computational Thinking and Problem Solving lab with Python	0	0	0	3	1.5
9	BS123	NSS/NCC/Scouts and Guides / Community Service	0	0	0	1	0.5
Total			**11**	**0**	**10**	**10**	**21**

B.Tech. – Second Semester **Scheme-2026**

S.No.	Course code	Title	L	T	Pr	P	Credits
I		**Theory**					
1	BS119	Chemistry for Civil Engineering	3	0	0	0	3
2	BS102	Differential Equations & Vector Calculus	3	0	2	0	4
3	HU101	Communicative English	2	0	0	0	2
4	ES101	Design Thinking	1	0	4	0	3
5	CE101	Engineering Mechanics	2	0	2	0	3
II		**Practical**					
6	CE102	Civil Engineering Workshop	0	0	0	2	1
7	BS120	Chemistry Lab for Civil Engineering	0	0	0	3	1.5
8	HU102	Communicative English Lab	0	0	0	2	1
9	BS124	Health and Wellness, Yoga and Sports	0	0	0	1	0.5
10	CS106	Cyber Security Awareness	2	0	0	0	0
Total			**13**	**0**	**8**	**8**	**19**

FOUR YEAR B.Tech DEGREE PROGRAMME
Scheme of Instruction and Examination
Common to CSE & CSE (AI &ML)

B.Tech. – First Semester **Scheme-2026**

S.No.	Course code	Title	L	T	Pr	P	Credits
I		**Theory**					
1	BS113	Chemistry for Computer Science	3	0	0	0	3
2	BS101	Linear Algebra & Calculus	3	0	2	0	4
3	HU101	Communicative English	2	0	0	0	2
4	CS102	Computational Thinking and Problem Solving with Python	3	0	0	0	3
II		**Practical**					
5	CS101	AI Tools and Applications	1	0	4	0	3
6	BS114	Chemistry Lab for Computer Science	0	0	0	3	1.5
7	HU102	Communicative English Lab	0	0	0	2	1
8	CS103	Computational Thinking and Problem Solving lab with Python	0	0	0	3	1.5
9	BS124	Health and wellness, Yoga and Sports	0	0	0	1	0.5
10	CS106	Cyber Security Awareness	2	0	0	0	0
		Total	**14**	**0**	**6**	**9**	**19.5**

B.Tech. – Second Semester **Scheme-2026**

S.No.	Course code	Title	L	T	Pr	P	Credits
I		**Theory**					
1	BS111	Physics for Advanced Computing	3	0	0	0	3
2	BS102	Differential Equations &Vector Calculus	3	0	2	0	4
3	ME101	Engineering Graphics	1	0	4	0	3
4	ES101	Design Thinking	1	0	4	0	3
5	CS107	Data Structures & Efficient Problem Solving	3	0	0	0	3
II		**Practical**					
6	CS108	Data Structures & Efficient Problem Solving Lab	0	0	0	2	1
7	ME102	Engineering Workshop	0	0	0	3	1.5
8	BS112	Physics Lab for Advanced Computing	0	0	0	3	1.5
9	BS123	NSS/NCC/Scouts & Guides/Community Service	0	0	0	1	0.5
		Total	**11**	**0**	**10**	**9**	**20.5**

FOUR YEAR B.Tech DEGREE PROGRAMME
Scheme of Instruction and Examination
ELECTRONICS AND COMMUNICATION ENGINEERING

B.Tech. – First Semester **Scheme-2026**

S.No.	Course code	Title	L/D	T	Pr	P	Credits
I		**Theory**					
1	BS109	Physics for Electronics & Communication Engineering	3	0	0	0	3
2	BS101	Linear Algebra & Calculus	3	0	2	0	4
3	ME101	Engineering Graphics	1	0	4	0	3
4	CS102	Computational Thinking and Problem Solving with Python	3	0	0	0	3
II		**Practical**					
5	CS101	AI Tools and Applications	1	0	4	0	3
6	ME102	Engineering Workshop	0	0	0	3	1.5
7	BS110	Physics Lab for Electronics & Communication Engineering	0	0	0	3	1.5
8	CS103	Computational Thinking and Problem Solving Lab with Python	0	0	0	3	1.5
9	BS123	NSS/NCC/Scouts and Guides / Community Service	0	0	0	1	0.5
Total			**11**	**0**	**10**	**10**	**21**

B.Tech. – Second Semester **Scheme-2026**

S.No.	Course code	Title	L	T	Pr	P	Credits
I		**Theory**					
1	BS115	Chemistry for Electronics & Communication Engineering	3	0	0	0	3
2	BS102	Differential Equations & Vector Calculus	3	0	2	0	4
3	HU101	Communicative English	2	0	0	0	2
4	ES101	Design Thinking	1	0	4	0	3
5	EE102	Network Analysis	3	0	0	0	3
II		**Practical**					
6	EE101	Electronics and Electrical Engineering Workshop	0	0	0	2	1
7	BS116	Chemistry Lab for Electronics & Communication Engineering	0	0	0	3	1.5
8	HU102	Communicative English Lab	0	0	0	2	1
9	BS124	Health and wellness, Yoga and Sports	0	0	0	1	0.5
10	CS106	Cyber Security Awareness	2	0	0	0	0
Total			**14**	**0**	**6**	**8**	**19**

FOUR YEAR B.Tech DEGREE PROGRAMME
Scheme of Instruction and Examination
ELECTRICAL AND ELECTRONICS ENGINEERING

B.Tech. – First Semester **Scheme-2026**

S.No.	Course code	Title	L/D	T	Pr	P	Credits
I		**Theory**					
1	BS107	Physics for Electrical Engineering	3	0	0	0	3
2	BS101	Linear Algebra & Calculus	3	0	2	0	4
3	ME101	Engineering Graphics	1	0	4	0	3
4	CS102	Computational Thinking and Problem Solving with Python	3	0	0	0	3
II		**Practical**					
5	CS101	AI Tools and Applications	1	0	4	0	3
6	ME102	Engineering Workshop	0	0	0	3	1.5
7	BS108	Physics Lab for Electrical Engineering	0	0	0	3	1.5
8	CS103	Computational Thinking and Problem Solving lab with Python	0	0	0	3	1.5
9	BS123	NSS/NCC/Scouts and Guides / Community Service	0	0	0	1	0.5
Total			**11**	**0**	**10**	**10**	**21**

B.Tech. – Second Semester **Scheme-2026**

S.No.	Course code	Title	L	T	Pr	P	Credits
I		**Theory**					
1	BS117	Chemistry For Electrical Engineering	3	0	0	0	3
2	BS102	Differential Equations & Vector Calculus	3	0	2	0	4
3	HU101	Communicative English	2	0	0	0	2
4	ES101	Design Thinking	1	0	4	0	3
5	EE104	Electromagnetic Fields	3	0	0	0	3
II		**Practical**					
6	EE103	Electrical Engineering Workshop	0	0	0	2	1
7	BS118	Chemistry Lab for Electrical Engineering	0	0	0	3	1.5
8	HU102	Communicative English Lab	0	0	0	2	1
9	BS124	Health and wellness, Yoga and Sports	0	0	0	1	0.5
10	CS106	Cyber Security Awareness	2	0	0	0	0
Total			**14**	**0**	**6**	**8**	**19**

FOUR YEAR B.Tech DEGREE PROGRAMME
Scheme of Instruction and Examination
MECHANICAL ENGINEERING

B.Tech. – First Semester **Scheme-2026**

S.No.	Course code	Title	L/D	T	Pr	P	Credits
I		**Theory**					
1	BS105	Physics for Mechanical Engineering	3	0	0	0	3
2	BS101	Linear Algebra & Calculus	3	0	2	0	4
3	ME101	Engineering Graphics	1	0	4	0	3
4	CS102	Computational Thinking and Problem Solving with Python	3	0	0	0	3
II		**Practical**					
5	CS101	AI Tools and Applications	1	0	4	0	3
6	ME102	Engineering Workshop	0	0	0	3	1.5
7	BS106	Physics Lab for Mechanical Engineering	0	0	0	3	1.5
8	CS103	Computational Thinking and Problem Solving lab with Python	0	0	0	3	1.5
9	BS123	NSS/NCC/Scouts and Guides / Community Service	0	0	0	1	0.5
Total			**11**	**0**	**10**	**10**	**21**

B.Tech. – Second Semester **Scheme-2026**

S.No.	Course code	Title	L	T	Pr	P	Credits
I		**Theory**					
1	BS121	Chemistry for Mechanical Engineering	3	0	0	0	3
2	BS102	Differential Equations & Vector Calculus	3	0	2	0	4
3	HU101	Communicative English	2	0	0	0	2
4	ES101	Design Thinking	1	0	4	0	3
5	CE101	Engineering Mechanics	2	0	2	0	3
II		**Practical**					
6	ME103	Basic Simulation Lab	0	0	0	2	1
7	BS122	Chemistry Lab for Mechanical Engineering	0	0	0	3	1.5
8	HU102	Communicative English Lab	0	0	0	2	1
9	BS124	Health and wellness, Yoga and Sports	0	0	0	1	0.5
10	CS106	Cyber Security Awareness	2	0	0	0	0
Total			**13**	**0**	**8**	**8**	**19**

Syllabus of all courses

LINEAR ALGEBRA & CALCULUS (LAC)

I Semester : Common to all Branches							**Scheme : 2026**		
Course Code	**Category**	**Hours/Week**				**Credits**	**Maximum Marks**		
		L	**T**	**Pr**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
BS101	BS	**3**	**-**	**2**	**-**	**4**	**30**	**70**	**100**
Sessional Exam Duration : 2 Hrs							**End Exam Duration: 3 Hrs**		

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

CO1: Apply matrix algebra techniques to solve systems of linear equations and analyze matrix properties relevant to engineering models.

CO2: Analyze Eigen value problems, diagonalization, and quadratic forms to interpret linear transformations for engineering systems.

CO3: Apply mean value theorems, Taylor and Maclaurin series, and curvature concepts to approximate and interpret engineering functions

CO4: Analyze multivariable functions using partial derivatives, Jacobians and optimization techniques.

CO5: Familiarize with double and triple integrals of functions of several variables in two dimensions using cartesian and polar coordinates and in three dimensions using cylindrical and spherical coordinates.

UNIT – I

Matrix Algebra and Linear Systems

Matrices, types of matrices, operations, transpose, inverse, symmetric and skew-symmetric matrices; determinant properties; rank of a matrix; echelon and normal forms, inverse of the matrix by Gauss-Jordan method. System of linear equations; consistency conditions; Gauss elimination method; iterative methods: Jacobi and Gauss-Seidel; 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 – II

Eigen values, Eigen vectors, Diagonalization and Quadratic forms

Eigen values and Eigen vectors; characteristic equation; Cayley-Hamilton theorem (without proof); 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 Eigen value computation and verification; Python/SciPy visualization of Eigen modes 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 – III

Single Variable Calculus and Series of Expansions

Rolle's theorem; Lagrange's mean value theorem; Cauchy's mean value theorem; Taylor's and Maclaurin's series with remainder(without proof); Curvature of plane curves; radius and centre of

curvature;
AI Integration: SymPy-based Taylor and Maclaurin expansion generation; 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; Wolfram Alpha free tier.

UNIT – IV

Multivariable Differentiation and Optimization
Functions of several variables; limits and continuity; partial derivatives; higher order partial derivatives; total derivative; chain rule; Jacobians; functional dependence; Taylor expansion of two-variable functions; maxima and minima; second derivative test; Lagrange multipliers and constrained optimization
AI Integration: AI-assisted Jacobian computation and verification; constrained optimization using SciPy; use of AI tools to interpret saddle points, extreme, and optimization constraints.
Free/Open-Source AI Tools: Python (NumPy, SciPy, SymPy, Matplotlib); Google Colab; Jupyter Notebook; SciPy optimize module

UNIT – V

Multiple Integral and Coordinate Transformations
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 computations.
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.

Text Books

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

Reference Books

1. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas' Calculus, Pearson Publishers, Delhi
2. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Alpha Science International Ltd.,New Delhi
3. Glyn James, Advanced Modern Engineering Mathematics ,Pearson publishers, Delhi
4. Michael Greenberg, Advanced Engineering Mathematics, Pearson publishers, Delhi
5. H. K Das, Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand Publications, New Delhi

Question Paper Pattern:

Sessional Exam :
The question paper for Sessional Examination shall be for 50 marks. The question paper shall consist of Four questions. Question No.1 contains Ten short answer questions (2 marks each) for a total of Twenty marks. Remaining Three questions shall be EIHER/OR Type descriptive questions for Ten marks each. Each of these descriptive questions may contain sub-questions.

End Examination:

The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions. Question No.1 shall contain Ten short answer questions (2 marks each) for a total of Twenty marks, with Two short answer questions from each unit. Remaining Five Questions (Each question covering one unit of syllabus) carrying 10 marks each shall be EITHER/OR Type descriptive questions and may contain sub-questions.

DIFFERENTIAL EQUATIONS & VECTOR CALCULUS (DEVC)

II Semester : Common to all Branches						**Scheme : 2026**			
Course Code	**Category**	**Hours/Week**				**Credits**	**Maximum Marks**		
		L	**T**	**Pr**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
BS102	BS	**3**	**-**	**2**	**-**	**4**	**30**	**70**	**100**
Sessional Exam Duration : 2 Hrs						**End Exam Duration: 3 Hrs**			

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

CO1: Solve first-order order differential equations related to various engineering fields.

CO2: Solve the higher order ordinary differential equations and its applications.

CO3: Formulate and solve first-order and selected higher-order partial differential equations relevant to engineering models including wave, heat, and Laplace equations.

CO4: Interpret and compute gradient of scalar, divergence and curl of vector fields and explain their physical significance in engineering contexts.

CO5: Apply Green's, Stoke's and Divergence theorems to compute work done ,circulation, flux and evaluate engineering fields.

UNIT – I

First Order Ordinary Differential Equations

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; Engineering applications of first-order ODEs: Newton's law of cooling and natural growth/decay models; electrical circuit models (RC and RL circuits);

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

Higher Order Linear Differential Equations

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 SymPy dsolve for symbolic ODE solution and verification, AI-assisted Wronskian computation using SymPy;

Free/Open-Source AI Tools: Python (NumPy, SciPy, SymPy, Matplotlib); GNU Octave; Wolfram Alpha free tier.

UNIT – III

Partial Differential Equations

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). Second-order PDE applications - wave equation, heat equation, and Laplace's equation

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;

Free/Open-Source AI Tools: Python (SymPy, NumPy, SciPy, Matplotlib); Wolfram Alpha free tier; Scilab.

UNIT – IV

Vector Differentiation

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;

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;

Free/Open-Source AI Tools: Python (NumPy, SymPy, Matplotlib, mpl_toolkits); SciPy for numerical computation.

UNIT – V

Vector Integration and Integral Theorems

Line integrals over scalar and vector fields; work done and path independence; surface integrals and flux; Green's theorem in the plane (without proof) and its applications. Stokes' theorem(without proof); 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; Wolfram Alpha free tier.

Text Books

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

Reference Books

1. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas' Calculus, Pearson Publishers, Delhi
2. N.P.Bali and others [2009], A Text book of Engineering Mathematics, Laxmi Publishers, New Delhi.
3. Dennis G. Zill and Warren S. Wright, Jones and Bartlett Learning, Advanced Engineering Mathematics, Massachusetts
4. Gl yn James, Advanced Modern Engineering Mathematics, Pearson publishers, Delhi
5. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Alpha Science International Ltd.,New Delhi
6. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill Education, New Delhi

Question Paper Pattern:

Sessional Exam :

The question paper for Sessional Examination shall be for 50 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 contains Ten short answer questions (2 marks each) for a total of Twenty marks. Remaining Three questions shall be EIHER/OR Type descriptive questions for Ten marks each. Each of these descriptive questions may contain sub-questions.

End Examination:

The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten short answer questions (2 marks each) for a total of Twenty marks, with Two short answer questions from each unit. Remaining Five Questions (Each question covering one unit of syllabus) carrying 10 marks each shall be EITHER/OR Type descriptive questions and may contain sub-questions.

PHYSICS FOR CIVIL ENGINEERING (PCE)									
I Semester: CIV							**Scheme: 2026**		
Course Code	**Category**	**Hours/Week**				**Credits**	**Maximum Marks**		
BS103	**BS**	**L/D**	**T**	**Pr**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
		3	**0**	**0**	**0**	**3**	**30**	**70**	**100**
Sessional Exam Duration: 2 Hrs							**End Exam Duration: 3 Hrs**		

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

CO1: Analyse the principles of interference, diffraction, and polarization and apply optical techniques for civil engineering applications.

CO2: Examine crystal structures and interpret X-ray diffraction patterns for material characterization for civil engineering materials.

CO3: Apply the concepts of quantum mechanics and quantum computing to explain quantum-based communication systems.

CO4: Analyse oscillatory systems, vibration control mechanisms, and architectural acoustics for civil engineering structures.

CO5: Evaluate ultrasonic and non-destructive testing techniques for identifying defects and assessing the quality of structural materials.

UNIT – I

Applied Wave Optics

***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: Introduction to diffraction; Fresnel and Fraunhofer diffraction; Fraunhofer diffraction due to single, double and N-slits (Diffraction Grating) (Qualitative); Dispersive power and Resolving power of grating. Applications: Diffraction applications in civil engineering.

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

***AI Integration*:** AI-Assisted Flatness Detection Using Interference Fringes, AI-Based Mineral Analysis and Degradation Detection in Masonry and Concrete Using Diffraction.

Free/Open-Source AI Tools: Python (NumPy, SciPy, Matplotlib and scikit-learn).

UNIT – II

Crystallography and AI-Driven Material Characterization

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.

***AI Integration*:** AI-driven XRD for Real-time corrosion assessment in reinforced concrete and identifying micro-cracks in ageing infrastructure.

***Free/Open-Source AI Tools*:** Google Colab, Python, NumPy, SciPy and Scikit-learn/ Tensor Flow.

UNIT – III

Introduction to Quantum Mechanics and Quantum Computing

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.

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 (qualitative only).

AI Integration: AI-Assisted Analysis of Tunnel Diode Characteristics using Quantum Tunnelling Concepts. AI-Assisted Quantum Key Distribution for Secure Communication. ***Free/Open-Source AI Tools***: Google Colab, Python and Scikit-learn.

UNIT – IV

Oscillations and Acoustics of Buildings

***Oscillations*:** Introduction to oscillations, Oscillations of springs, Series and parallel combinations of springs (quantitative), Stiffness factor and its physical significance. Damping and Resonance: Theory of damped oscillations (Over, Under and Critical damping- allqualitative); Forced oscillations (qualitative) and Resonance. Sharpness of resonance and Quality factor (Q). Applications: Tuned Mass Dampers (TMDs) for seismic resilience.

Acoustics of Buildings: Introduction to architectural acoustics; Reverberation and reverberation time, Sabine's formula (qualitative). Factors affecting architectural acoustics and requirements for acoustically optimized halls. Applications- Active Noise Cancellation (ANC) systems for smart urban facades (Qualitative).

***AI Integration*:** AI-Assisted Strategies for noise mitigation in Green Buildings. Use of Acoustic Simulation AI for auditorium design.

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

UNIT – V

Ultrasonics and Non-Destructive Testing

Ultrasonics: Introduction to ultrasonics: Production of ultrasonics: Piezoelectric method and Magnetostriction method. Detection of ultrasonics: Kundt's tube and Quartz crystal methods. Role of Ultrasonic Pulse Velocity (UPV**)** testing in assessing concrete quality, uniformity and depth of cracks in structural elements.

***Non-Destructive Testing (NDT)*:** Introduction, need and advantages in civil engineering structures. Basic inspection methods: Visual inspection, Liquid penetrant testing, basic principle for detecting surface defects in steel. Application: Electromagnetic inspection: eddy current testing (to detect surface cracks, corrosion and defects in conductive materials). (basic idea)

***AI Integration*:** AI-Powered Defect Detection in Structural Steel, Weld Joints and Corrosion in Reinforced Concrete (RCC)

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

Text Books:

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

Reference Books:

1. Engineering Physics, B. K. Pandey & S. Chaturvedi, Cengage Learning, 2021.
2. Engineering Physics, Shatendra Sharma & Jyotsna Sharma, Pearson, 2018.
3. Engineering Physics, Sanjay D. Jain, D. Sahasrabudhe & Girish, Universities Press, 2010.
4. Engineering Physics, M. R. Srinivasan, New Age International, 2009

5. Solid State Physics, S. O. Pillai, New Age International
6. Modern Physics, R. Murugeshan & Kiruthiga Sivaprasath, S. Chand.
7. NPTEL – nptel.ac.in
8. MIT Open Course Ware – ocw.mit.edu
9. Hyper Physics – hyperphysics.phy- astr.gsu.edu
10. Feynman Lectures – feynmanlectures.caltech.edu
11. PhET Simulations – phet.colorado.edu
Recommended Free & Open-Source AI/Computational Tools
1. Python (NumPy, SciPy, OpenCV, Matplotlib) – FREE on Google Colab for optics and EM simulations
2. IBM Qiskit (free, open-source) – For quantum computing and quantum cryptography simulations
3. scikit-learn (free, open-source) – For semiconductor data analysis and signal classification
4. PhET Interactive Simulations (free) – For wave optics, semiconductors and quantum phenomena
Question Paper Pattern:
Sessional Exam : The question paper for Sessional Examination shall be for 50 marks. The question paper shall consist of Four questions. Question No.1 contains Ten short answer questions (2 marks each) for a total of Twenty marks. Remaining Three questions shall be EIHER/OR Type descriptive questions for Ten marks each. Each of these descriptive questions may contain sub-questions. **End Examination:** The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions. Question No.1 shall contain Ten short answer questions (2 marks each) for a total of Twenty marks, with Two short answer questions from each unit. Remaining Five Questions (Each question covering one unit of syllabus) carrying 10 marks each shall be EITHER/OR Type descriptive questions and may contain sub-questions.

PHYSICS FOR ADVANCED COMPUTING (PAC)									
I Semester: Common to CSE & CSM							**Scheme: 2026**		
Course Code	**Category**	**Hours/Week**				**Credits**	**Maximum Marks**		
BS111	**BS**	**L/D**	**T**	**Pr**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
		3	**0**	**0**	**0**	**3**	**30**	**70**	**100**
Sessional Exam Duration: 2 Hrs							**End Exam Duration: 3 Hrs**		

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

CO1: Apply the principles of interference, diffraction, polarization to analyse optical systems and engineering applications.

CO2: Analyze the working principles of lasers, fibres and applications in optical communication, sensing systems.

CO3: Apply the concepts of quantum mechanics and quantum computing to secure communication systems.

CO4: Analyse semiconductor characteristics and magnetic material behaviour for engineering and electronic applications.

CO5: Apply the concepts of Low temperature physics and superconductivity in modern technological applications.

UNIT – I

Wave Optics and Quantum Information Processing

***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: Introduction to diffraction; Fresnel and Fraunhofer diffraction; Fraunhofer diffraction due to single, double and N-slits (Diffraction Grating) (Qualitative); Dispersive power and Resolving power of grating. Applications: CD/DVD data storage, Barcode scanners.

***Polarisation*:** Types of polarization; Nicol's prism; Half-wave and Quarter-wave plates.

AI Integration: AI-assisted polarization management for quantum key distribution. AI-integrated holographic interferometry for surface flatness analysis.

Free/Open-Source AI Tools: Python (NumPy, SciPy, Matplotlib and scikit-learn).

UNIT – II

Quantum Photonics and Advanced Sensing

Lasers: Interaction of radiation with matter; Characteristics of Lasers; Requisites and conditions for laser action; Ruby Laser; He-Ne laser; Nd-YAG laser; LiDAR basics; Applications of lasers

Fiber Optics: Propagation mechanism; Numerical aperture; Acceptance angle; Types of optical fibers; Classifications and Modes of optical fibers; Attenuation and Losses in optical fibers; V-Number; Optical fiber communication system; Basic idea about Fiber optic sensors.

AI Integration: AI-powered signal analysis for distributed fiber optic sensing. Python simulation of laser propagation and fiber optic signal attenuation.

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

UNIT – III

Introduction to Quantum Mechanics and Quantum Computing

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.

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 (qualitative only)

AI Integration: AI-Assisted Analysis of Tunnel Diode Characteristics using Quantum Tunnelling Concepts. AI-Assisted Quantum Key Distribution for Secure Communication.

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

UNIT – IV

Semiconductors and Magnetic Materials

Semiconductors: Introduction; Fermi energy and Fermi level in intrinsic and extrinsic semiconductors; Expression for concentration of electrons in conduction band and holes in valence band(Qualitative); Electrical conductivity; Expressions for drift and diffusion currents; Hall effect; Expression for Hall coefficient and its applications.

Magnetism: Origin of magnetism; Dia, Para, Ferro, Ferri and Anti-ferro magnetic materials; Hysteresis; Soft and Hard magnetic materials. Applications (qualitative only): Magnetic data storage (MRAM), Hard Disk Drive and Magnetic shielding.

AI Integration: AI-Assisted Hall Effect Analysis for Semiconductor Characterization. AI-Assisted Magnetic Data Storage and MRAM Optimization.

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

UNIT – V

Low Temperature Physics and Superconductivity

Low Temperature Physics: Low temperature and its importance; Properties of materials at low temperatures; Liquefaction of gases (basic concept only); Liquid nitrogen and liquid helium (basic properties and uses). Applications (basic ideas): MRI, Rocket fuels, Cryogenic Cooling of High-Performance Computing System.

Superconductors: Definitions; Meissner effect; Type I and Type II superconductors; BCS theory: Cooper pairs and energy gap (qualitative); DC and AC Josephson effect. Applications (qualitative only): SQUIDs, magnetic levitation and lossless power transmission. Superconducting qubits: Charge, Flux, Phase.

AI Integration: AI-Assisted Cryogenic Cooling Optimization for High-Performance Computing Systems. AI-Assisted Stability Control in Superconducting Magnetic Levitation Systems. Free/Open-Source AI Tools: Google Colab, Python and Scikit-learn.

Text books

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

Reference Books

1. Engineering Physics, B.K. Pandey, &S. Chaturvedi, Cengage Learning, 2021.
2. Solid State Physics, S. O. Pillai, New Age International, 2005
3. Quantum Computation & Quantum Information, M.A. Nielsen & I.L. Chuang, Cambridge University Press, 2000
4. Fundamentals of Photonics. B. E. A. Saleh, & M. C. Teich, Wiley, Second Edition
5. Optical Fibre Communications,G. Keiser, McGraw Hill. Second Edition
6. Introduction to Superconductivity, Tinkham, M., Second Edition, Dover Publications.
7. NPTEL – nptel.ac.in
8. MIT Open Course Ware – ocw.mit.edu
9. Hyper Physics – hyperphysics.phy-astr.gsu.edu
10. PhET Simulations – phet.colorado.edu

11. IBM Qiskit (free, open-source) – For quantum computing and superconducting qubit simulations on Google Colab

Question Paper Pattern:

Sessional Exam :

The question paper for Sessional Examination shall be for 50 marks. The question paper shall consist of Four questions. Question No.1 contains Ten short answer questions (2 marks each) for a total of Twenty marks. Remaining Three questions shall be EIHER/OR Type descriptive questions for Ten marks each. Each of these descriptive questions may contain sub-questions.

End Examination:

The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions. Question No.1 shall contain Ten short answer questions (2 marks each) for a total of Twenty marks, with Two short answer questions from each unit. Remaining Five Questions (Each question covering one unit of syllabus) carrying 10 marks each shall be EITHER/OR Type descriptive questions and may contain sub-questions.

PHYSICS FOR ELECTRONICS & COMMUNICATION ENGINEERING (PECE)									
I Semester: ECE							**Scheme: 2026**		
Course Code	**Category**	**Hours/Week**				**Credits**	**Maximum Marks**		
BS109	**BS**	**L/D**	**T**	**Pr**	**p**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
		3	**0**	**0**	**0**	**3**	**30**	**70**	**100**
Sessional Exam Duration: 2 Hrs							**End Exam Duration: 3 Hrs**		

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

CO1: Apply the principles of interference, diffraction, polarization to analyse optical systems and engineering applications.

CO2: Analyze the working principles of lasers, fibers and applications in optical communication sensing systems.

CO3: Apply the concepts of quantum mechanics and quantum computing to secure communication systems.

CO4: Analyse the electrical properties of metals and semiconductors for conductivity analysis methods

CO5: Apply Maxwell's equations and electromagnetic field concepts for energy transportation.

UNIT – I

Wave Optics and Quantum Information Processing

***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: Introduction to diffraction; Fresnel and Fraunhofer diffraction; Fraunhofer diffraction due to single, double and N-slits (Diffraction Grating) (Qualitative); Dispersive power and Resolving power of grating. Applications: CD/DVD data storage, Barcode scanners.

***Polarisation*:** Types of polarization; Nicol's prism; Half-wave and Quarter-wave plates.

AI Integration : AI-assisted polarization management for quantum key distribution. AI-integrated holographic interferometry for surface flatness analysis.

Free/Open-Source AI Tools: Python (NumPy, SciPy, Matplotlib and scikit-learn).

UNIT – II

Quantum Photonics and Advanced Sensing

Lasers: Interaction of radiation with matter; Characteristics of Lasers; Requisites and conditions for laser action; Ruby Laser; He-Ne laser; Nd-YAG laser; LiDAR basics; Applications of lasers.

Fiber Optics: Propagation mechanism; Numerical aperture; Acceptance angle; Types of optical fibers; Classifications and Modes of optical fibers; Attenuation and Losses in optical fibers; V-Number; Optical fiber communication system; Basic idea about Fiber optic sensors.

***AI Integration*:** AI-powered signal analysis for distributed fiber optic sensing. Python simulation of laser propagation and fiber optic signal attenuation.

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

UNIT – III

Introduction to Quantum Mechanics and Quantum Computing

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.

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 (qualitative only)

AI Integration: AI-Assisted Analysis of Tunnel Diode Characteristics using Quantum Tunnelling Concepts.

AI-Assisted Quantum Key Distribution for Secure Communication.

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

UNIT – IV

Electrical Properties of Metals and Semiconductors

Electron Theory of Metals: Classical free electron theory – merits and demerits; Quantum free electron theory – equation for electrical conductivity, Fermi-Dirac statistics, Fermi level and variation with temperature, Classification of solids – metals, insulators and semiconductors.

Semiconductors: Introduction, Fermi energy and Fermi level in intrinsic and extrinsic semiconductors, Expression for concentration of electrons in conduction band and holes in valence band(Qualitative), Electrical conductivity, Expressions for drift and diffusion currents, Hall effect, Expression for Hall coefficient and its applications.

AI Integration: AI-Assisted Prediction of Electrical Conductivity in Metals and Semiconductors, AI-Assisted Carrier Concentration and Conductivity Analysis in Semiconductors.

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

UNIT – V

Introduction to EM Theory

Introduction, Basic Laws of Electricity and Magnetism; Displacement current; Derivation of Maxwell's equation in Differential form; Maxwell's equation in Conducting media and vacuum; Poynting Vector; Applications (Qualitative only).

AI Integration: AI-Assisted RFID-Based Smart Tracking and Identification Systems, AI-Assisted Fault Detection in Antenna Systems,

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

Text books

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

Reference Books

1. Engineering Physics, B. K. Pandey & S. Chaturvedi, Cengage Learning, 2021.
2. Engineering Physics, Shatendra Sharma & Jyotsna Sharma, Pearson, 2018.
3. Introduction to Quantum Mechanics, D. J. Griffiths, Cambridge Press.
4. Fundamentals of Photonics, Saleh & Teich, Wiley.
5. Solid State Electronic Devices, Streetman & Banerjee, Pearson.
6. Introduction to Solid State Physics, C. Kittel, Wiley.
7. NPTEL – nptel.ac.in
8. MIT Open Course Ware – ocw.mit.edu
9. Hyper Physics – hyperphysics.phy-astr.gsu.edu
10. Feynman Lectures – feynmanlectures.caltech.edu
11. PhET Simulations – phet.colorado.edu

Recommended Free & Open-Source AI/Computational Tools

1. Python (NumPy, SciPy, OpenCV, Matplotlib) – FREE on Google Colab for optics and EM simulations
2. IBM Qiskit (free, open-source) – For quantum computing and quantum cryptography simulations
3. Scikit-learn (free, open-source) – For semiconductor data analysis and signal classification
4. OpenEMS (free, open-source) – For electromagnetic field simulation and antenna design
5. PhET Interactive Simulations (free) – For wave optics, semiconductors and quantum phenomena

Question Paper Pattern:

Sessional Exam :

The question paper for Sessional Examination shall be for 50 marks. The question paper shall consist of Four questions. Question No.1 contains Ten short answer questions (2 marks each) for a total of Twenty marks. Remaining Three questions shall be EIHER/OR Type descriptive questions for Ten marks each. Each of these descriptive questions may contain sub-questions.

End Examination:

The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions. Question No.1 shall contain Ten short answer questions (2 marks each) for a total of Twenty marks, with Two short answer questions from each unit. Remaining Five Questions (Each question covering one unit of syllabus) carrying 10 marks each shall be EITHER/OR Type descriptive questions and may contain sub-questions.

PHYSICS FOR ELECTRICAL ENGINEERING (PEE)									
I Semester: EEE								**Scheme: 2026**	
Course Code	**Category**	**Hours/Week**				**Credits**	**Maximum Marks**		
BS107	**BS**	**L/D**	**T**	**Pr**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
		3	**0**	**0**	**0**	**3**	**30**	**70**	**100**
Sessional Exam Duration: 2 Hrs							**End Exam Duration: 3 Hrs**		

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

CO1: Apply the principles of interference, diffraction, and polarization and apply optical techniques for engineering applications.

CO2: Analyze the electrical properties of metals and semiconductors using conductivity analysis techniques.

CO3: Apply the concepts of quantum mechanics and quantum computing to secure communication systems.

CO4: Analyse dielectric and magnetic materials behaviour in power systems.

CO5: Apply and analyse Maxwell's equations and electromagnetic field concepts for energy transport.

UNIT – I

Applied Wave Optics

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*:** Introduction to diffraction; Fresnel and Fraunhofer diffraction; Fraunhofer diffraction due to single, double and N-slits (Diffraction Grating) (Qualitative); Dispersive power and Resolving power of grating. Applications: LiDAR for autonomous sensing in electric vehicles (EV)

***Polarisation*:** Types of polarization; Nicol's prism; Half-wave and Quarter-wave plates.

***AI Integration*:** AI-powered LiDAR integration for autonomous EV sensing and navigation; Python-based fringe pattern analysis for semiconductor wafer surface profiling.

***Free/Open-Source AI Tools*:** Google Colab, Python and scikit-learn / basic DL model

UNIT – II

Electrical Properties of Metals and Semiconductors

***Electron Theory of Metals*:** Classical free electron theory – merits and demerits; Quantum free electron theory – equation for electrical conductivity, Fermi-Dirac statistics, Fermi level and variation with temperature, Classification of solids – metals, insulators and semiconductors.

***Semiconductors*:** Introduction, Fermi energy and Fermi level in intrinsic and extrinsic semiconductors, Expression for concentration of electrons in conduction band and holes in valence band (Qualitative), Electrical conductivity, Expressions for drift and diffusion currents, Hall effect, Expression for Hall coefficient and its applications.

***AI Integration*:** AI-Assisted Prediction of Electrical Conductivity in Metals and Semiconductors, AI-Assisted Carrier Concentration and Conductivity Analysis in Semiconductors.

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

UNIT – III

Introduction to Quantum Mechanics and Quantum Computing

***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.

***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 (qualitative only)

AI Integration: AI-Assisted Analysis of Tunnel Diode Characteristics using Quantum Tunnelling Concepts. AI-Assisted Quantum Key Distribution for Secure Communication.

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

UNIT – IV

Dielectrics and Magnetic Materials for Power Systems

***Dielectric materials*:** introduction, basic definitions, types of polarizations, internal fields in solids and the Clausius-Mossotti relation, frequency dependence of the polarisation, dielectric loss; application (qualitative only)

***Magnetic materials and energy conversion*:** introduction and classification (dia, para, ferro, ferri, and anti-ferro); hysteresis; soft & hard magnetic materials; applications (basic idea) — transformer cores, armatures, high-frequency inductors and permanent magnets for EV motors and wind generators.

***AI Integration*:** AI-based hysteresis loop analysis and eddy current loss estimation; AI-driven design of permanent magnets for EV motors.

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

UNIT – V

Electromagnetic Fields in Power Systems

Introduction, Basic Laws of Electricity and Magnetism; Displacement current; Derivation of Maxwell's equation in Differential form; Maxwell's equation in Conducting media and vacuum; Poynting Vector; Applications (Qualitative only)

Textbooks:

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

Reference Books:

1. Engineering Physics, Shatendra Sharma & Jyotsna Sharma, Pearson, 2018.
2. Solid State Physics, S. O. Pillai, New Age International.
3. Quantum Computation & Quantum Information, Nielsen & Chuang, Cambridge.
4. Solid State Electronic Devices, Streetman & Banerjee, Pearson.
5. Introduction to Solid State Physics, C. Kittel, Wiley.
6. Dielectrics and Waves, A. Von Hippel, Wiley.
7. Introduction to Electrodynamics, D. J. Griffiths, Cambridge.
8. Engineering Electromagnetics, W. H. Hayt & J. A. Buck, McGraw Hill
9. NPTEL – nptel.ac.in
10. MIT Open Course Ware – ocw.mit.edu
11. Hyper Physics – hyperphysics.phy-astr.gsu.edu
12. Feynman Lectures – feynmanlectures.caltech.edu

13. PhET Simulations – phet.colorado.edu
Recommended Free & Open-Source AI/Computational Tools :
1. Python (NumPy, SciPy, OpenCV, Matplotlib) – FREE on Google Colab for optics and EM simulations
2. IBM Qiskit (free, open-source) – For quantum computing and quantum cryptography simulations
3. Scikit-learn (free, open-source) – For semiconductor data analysis and signal classification
4. PhET Interactive Simulations (free) – For wave optics, semiconductors and quantum phenomena
Question Paper Pattern:
Sessional Exam : The question paper for Sessional Examination shall be for 50 marks. The question paper shall consist of Four questions. Question No.1 contains Ten short answer questions (2 marks each) for a total of Twenty marks. Remaining Three questions shall be EIHER/OR Type descriptive questions for Ten marks each. Each of these descriptive questions may contain sub-questions. **End Examination:** The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions. Question No.1 shall contain Ten short answer questions (2 marks each) for a total of Twenty marks, with Two short answer questions from each unit. Remaining Five Questions (Each question covering one unit of syllabus) carrying 10 marks each shall be EITHER/OR Type descriptive questions and may contain sub-questions.

PHYSICS FOR MECHANICAL ENGINEERING (PME)									
I Semester: MEC							**Scheme: 2026**		
Course Code	**Category**	**Hours/Week**				**Credits**	**Maximum Marks**		
		L/D	**T**	**Pr**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
BS105	**BS**	**3**	**0**	**0**	**0**	**3**	**30**	**70**	**100**
Sessional Exam Duration: 2 Hrs							**End Exam Duration: 3 Hrs**		

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

CO1: Examine the principles of interference, diffraction, and polarization and apply optical techniques for engineering applications.

CO2: Analyze crystal structures, diffraction patterns and material properties using X-ray diffraction methods.

CO3: Interpret the concepts of quantum mechanics and quantum computing for secure communication systems.

CO4: Analyse oscillatory systems, vibration control mechanisms, and laser based metrology techniques for predictive approaches.

CO5: Evaluate ultrasonic and non-destructive testing techniques for defect identification and quality assessment.

UNIT – I

Applied Wave Optics

***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: Introduction to diffraction; Fresnel and Fraunhofer diffraction; Fraunhofer diffraction due to single, double and N-slits (Diffraction Grating) (Qualitative); Dispersive power and Resolving power of grating. Applications: Diffraction applications in Mechanical engineering.

***Polarisation*:** 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 AI-Driven Material Engineering

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.

***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 and Quantum Computing

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.

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 (qualitative only)

AI Integration: AI-Assisted Analysis of Tunnel Diode Characteristics using Quantum Tunnelling Concepts. AI-Assisted Quantum Key Distribution for Secure Communication.

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

UNIT – IV

Oscillations, Vibration Control and Laser-Based Metrology

Oscillations: 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). Forced oscillations (qualitative) and Resonance; Sharpness of resonance and Quality factor (Q). 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

Ultrasonics: Introduction; 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, 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.

LEARNING RESOURCES

Text Books:

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

Reference Books:

1. Engineering Physics, B. K. Pandey & S. Chaturvedi, Cengage Learning, 2021.
2. Engineering Physics, Shatendra Sharma & Jyotsna Sharma, Pearson, 2018.
3. Engineering Physics, Sanjay D. Jain, D. Sahasrabudhe & Girish, Universities Press, 2010.
4. Engineering Physics, M. R. Srinivasan, New Age International, 2009.
5. Solid State Physics, S. O. Pillai, New Age International.
6. Modern Physics, R. Murugeshan & Kiruthiga Sivaprasath, S. Chand.

7. NPTEL – nptel.ac.in
8. MIT OpenCourseWare – ocw.mit.edu
9. HyperPhysics – hyperphysics.phy-astr.gsu.edu
10. Feynman Lectures – feynmanlectures.caltech.edu
11. PhET Simulations – phet.colorado.edu
Recommended Free & Open-Source AI/Computational Tools :
1. Python (NumPy, SciPy, OpenCV, Matplotlib) – FREE on Google Colab for wave optics and signal analysis
2. TensorFlow / Keras (free, open-source) – For crack and defect detection CNNs on Google Colab
3. scikit-learn (free, open-source) – For anomaly detection in vibration and NDT data
4. IBM Qiskit (free, open-source) – For quantum computing simulations on Google Colab
5. OpenCV (free, open-source) – For image processing in visual inspection and interferometry
6. PhET Interactive Simulations (free) – For wave optics, quantum mechanics and oscillations
Question Paper Pattern:
Sessional Exam : The question paper for Sessional Examination shall be for 50 marks. The question paper shall consist of Four questions. Question No.1 contains Ten short answer questions (2 marks each) for a total of Twenty marks. Remaining Three questions shall be EIHER/OR Type descriptive questions for Ten marks each. Each of these descriptive questions may contain sub-questions. **End Examination:** The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions. Question No.1 shall contain Ten short answer questions (2 marks each) for a total of Twenty marks, with Two short answer questions from each unit. Remaining Five Questions (Each question covering one unit of syllabus) carrying 10 marks each shall be EITHER/OR Type descriptive questions and may contain sub-questions.

CHEMISTRY FOR CIVIL ENGINEERING (CCE)

II Semester : CE							Scheme:2026		
Course Code	Category	Hours/Week				Credits	Maximum Marks		
		L/D	T	Pr	P	C	Continuous Internal Assessment	End Exam	TOTAL
BS119	BS	3	0	0		3	30	70	100
Sessional Exam Duration: 2Hrs						End Exam Duration: 3Hrs			

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

CO1: Recall and explain water chemistry, analyze water quality and apply appropriate treatment methods for boiler feed water and potable water supply.

CO2: Identify types of corrosion and their mechanisms in reinforced concrete, steel structures and evaluate cathodic protection, protective coating and corrosion inhibitor strategies.

CO3: Analyze the chemistry of concrete including admixtures, lime-gypsum materials and select appropriate special cement types, steel based on construction requirements.

CO4: Evaluate the properties and civil engineering applications of engineering polymers elastomers, and fiber-reinforced polymer composites used in modern construction.

CO5: Apply the twelve principles of green chemistry, evaluate sustainable alternatives and design strategies to minimize pollution and manage solid waste in civil engineering projects.

UNIT – I

Water Chemistry and Treatment:

Water chemistry: hardness of water, temporary and permanent hardness of water, hardness units, problems, estimation of hardness of water by EDTA method. Boiler troubles: scale and sludge formation, boiler corrosion, caustic embrittlement, Internal treatment of boiler feed water. a. phosphate conditioning b. Calgon conditioning c. complexometric method, External treatment of boiler feed water- ion exchange, reverse osmosis.

Analysis of water: alkalinity, pH, dissolved oxygen, BOD, COD.

Water treatment processes: screening, sedimentation, coagulation-flocculation, filtration, disinfection, Chemistry of coagulation: alum, ferric chloride, polyelectrolytes, Disinfection: chlorination chemistry, breakpoint chlorination, ozonation, UV treatment, Wastewater treatment: Sludge treatment and disposal.

AI Integration: Prediction of water quality trends using Python (Pandas, Matplotlib). Regression models for forecasting BOD/COD. Visualization of water treatment efficiency using datasets.

Free/Open-Source AI Tools: Python (NumPy, Pandas, Matplotlib), Google Colab

UNIT – II

Electrochemistry and Corrosion:

Electrochemical principles: Electrode potential, Nernst equation, Galvanic series.

Conductance - Conductometric titrations - a. Strong Acid *vs* Strong Base, b. Weak Acid *vs* Strong Base.

Types of corrosion: Chemical Corrosion, pilling bed worth rule and Electro Chemical Corrosion, Concentration cell Corrosion, pitting, galvanic, stress corrosion. Factors effecting the corrosion. Corrosion prevention methods: cathodic protection-Sacrificial anodes and impressed current systems. Protective coatings-Galvanizing and electroplating for steel protection, electroless plating, corrosion inhibitors.

AI Integration: Machine learning models for corrosion rate prediction using open datasets. Data-driven analysis of environmental corrosion factors.

Free/Open-Source AI Tools: Python (scikit-learn), Google Colab, Kaggle datasets

UNIT – III

Chemistry of Construction Materials:

Chemistry of cement: Portland cement composition (C_3S, C_2S, C_3A, C_4AF), hydration reactions, heat of hydration. Setting and hardening mechanisms, calcium silicate hydrates (C-S-H gel). Special Types of cement and their applications. A. High alumina cements B. High early strength

cements (HES) C. Sorel cements.
Chemistry of concrete: role of aggregates, water-cement ratio, workability. Chemical admixtures: plasticizers, retarders, accelerators, air-entraining agents. Chemistry of lime, gypsum, and clay materials.Steel chemistry: composition and applications of steel, alloying elements. Heat treatment: annealing, normalizing, hardening, tempering, age hardening.

AI Integration: Prediction of concrete compressive strength using machine learning models. Data analysis of mix design parameters.
Free/Open-Source AI Tools: TensorFlow, Orange Data Mining, Python

UNIT – IV

Engineering Polymers and Composite Materials:
Polymer chemistry: polymerization mechanisms (addition, condensation), classification (thermoplastics, thermosets). Engineering polymers: polyethylene, PVC, polypropylene, epoxy resins, polyurethane. Elastomers: Natural rubber, vulcanisation, synthetic rubbers (BUNA-S and BUNA-N). Applications in civil engineering.
Composite materials: matrix and reinforcement, types (polymer matrix, metal matrix, ceramic matrix). Fiber-reinforced polymers (FRP): glass fiber, carbon fiber and applications.

AI Integration: Computer vision for polymer structure identification and degradation analysis. Image-based classification of materials.
Free/Open-Source AI Tools: KNIME, Teachable Machine, OpenCV

UNIT – V

Green Chemistry and Environmental Chemistry:
Principles of green chemistry and their applications, Sustainable construction materials: geopolymer concrete, industrial by-products (Ground Granulated Blast-furnace Slag (GGBS).
Air pollution: types, sources, effects; air quality index, Water pollution: sources, effects and remedial methods, Chemistry of greenhouse gases and climate change
Soil chemistry: pH, organic matter, contamination, remediation.
Solid waste management: classification, treatment, recycling in construction.

AI Integration: Life Cycle Analysis (LCA) using AI tools. Air quality prediction models using machine learning. Sustainability assessment of materials.
Free/Open-Source AI Tools: OpenLCA, Google Colab, Python

Text Books:

1. Engineering Chemistry, P. C. Jain and M. Jain, Dhanpat Rai Publishing Company, 2020. 17th Edition.
2. Engineering Chemistry, Shikha Agarwal,Cambridge University Press, 2026. 5th Edition.

Reference Books& Web Resources Links:

1. Water and wastewater engineering: Design principles and practice, M. L. Davis, McGraw-Hill Education, 2020. 2nd Edition.
2. Engineering Chemistry, S. S. Dara and S. S. Umare, S. Chand Publishing, 2018. 15th Edition.
3. American Concrete Institute. (2021). ACI 222R-01: Protection of metals in concrete against corrosion. https://www.concrete.org
4. Bureau of Indian Standards. (2012). IS 456:2000 – Plain and reinforced concrete – Code of practice. https://www.services.bis.gov.in
5. U.S. Environmental Protection Agency. (2023). Green chemistry. https://www.epa.gov/greenchemistry
6. World Health Organization. (2022). Guidelines for drinking-water quality (4th Edition.). https://www.who.int/publications/i/item/9789241549950
7. Indian Green Building Council. (2023). LEED India rating systems. https://igbc.in/igbc/

Question Paper Pattern:

Sessional Exam :

The question paper for Sessional Examination shall be for 50 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 contains Ten short answer questions (2 marks each) for a total of Twenty marks. Remaining Three questions shall be EIHER/OR Type descriptive questions for Ten marks each. Each of these descriptive questions may contain sub-questions.

End Examination:

The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten short answer questions (2 marks each) for a total of Twenty marks, with Two short answer questions from each unit. Remaining Five Questions (Each question covering one unit of syllabus) carrying 10 marks each shall be EITHER/OR Type descriptive questions and may contain sub-questions.

CHEMISTRY FOR COMPUTER SCIENCE (CCS)

I Semester : Common for CSE & CSM							Scheme : 2026		
Course Code	Category	Hours / Week				Credits	Maximum Marks		
		L/D	T	Pr	P	C	Continuous Internal Assessment	End Exam	Total
BS113	BS	3	0	0	0	3	30	70	100
Sessional Exam Duration: 2Hrs							End Exam Duration : 3 Hrs		

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

CO1: Utilise quantum chemistry concepts to examine molecular systems and elucidate molecular orbital theory for material computation.

CO2: Investigate semiconductor materials, doping chemistry, and production procedures utilised in present-day electronic gadgets.

CO3: Analyze energy storage technologies, including batteries, supercapacitors, and fuel cells, for applications in computing and data centers.

CO4: Investigate the mechanisms of corrosion in electronic equipment and provide effective protective strategies for PCBs and interconnects.

CO5: Create cutting-edge material solutions utilising nanotechnology methodologies and AI-supported technologies for nanoelectronics and quantum computing.

UNIT - I

Quantum Chemistry:

Fundamentals of quantum chemistry: black body radiation, photoelectric effect, wave-particle duality, de Broglie wave equation, Heisenberg uncertainty principle. Fundamentals of Quantum Mechanics: Schrödinger wave equation; significance of Ψ and Ψ^2; quantum numbers. Particle in a one-dimensional box.

Molecular orbital theory: bonding in homonuclear and heteronuclear diatomic molecules; energy level diagrams of O_2 and CO. π-molecular orbitals of butadiene and benzene; calculation of bond order.

AI Integration: Simulation of quantum systems using Python (NumPy, SciPy); visualization of molecular orbitals and energy levels using computational chemistry tools (Google MColab); introduction to quantum computing simulations using Qiskit (introductory level).

***Free/Open-Source AI Tools*:** Python (NumPy, SciPy), Google Colab, Qiskit.

UNIT - II

Semiconductor Chemistry:

Atomic structure and chemical bonding relevant to semiconductors. Band theory: valence band, conduction band, band gap energy. Intrinsic and extrinsic semiconductors: silicon, germanium, gallium arsenide. Doping chemistry: *n*-type (phosphorus, arsenic) and *p*-type (boron, aluminum) dopants. Chemical vapour deposition (CVD) for thin film formation; silicon dioxide (SiO_2) formation and properties. Chemistry of compound semiconductors: GaAs, SiC.

***AI Integration*:** AI-based prediction of semiconductor properties using ML models; process parameter optimization in semiconductor fabrication using machine learning; Python-based bandgap prediction using regression models.

***Free/Open-Source AI Tools*:** Python, TensorFlow, Scilab.

UNIT - III

Electrochemistry and Energy Storage:

Electrochemical cells: galvanic cells, electrode potential, Nernst equation and problems; potentiometry (redox reactions); conductometry (strong acid vs. strong base, weak acid vs. strong base). Primary batteries: Zinc-air battery, Secondary batteries: chemistry of charging and discharging of lead-acid. Lithium-ion batteries: construction, working, and applications of $LiCoO_2$. Supercapacitors: definition, classification, and applications. Fuel cells: construction,

working, and applications of hydrogen fuel cells and direct methanol fuel cells (DMFC). Battery management systems: overcharge protection and thermal management.

AI Integration: AI models for battery health prediction and state-of-charge optimization using scikit- learn; data analysis for energy efficiency in data centres using Python (Pandas); ML-based prediction of electrochemical impedance spectra.
Free/Open-Source AI Tools: Python (Pandas, scikit-learn), Google Colab.

UNIT - IV

Chemistry of Corrosion and Protective Techniques:
Corrosion: definition, examples, types - chemical corrosion and electrochemical corrosion; Pilling-Bedworth rule. Galvanic corrosion; concentration cell corrosion; factors affecting corrosion. Passivation layers — silicon dioxide and aluminum oxide. Corrosion of printed circuit boards (PCBs): copper oxidation, tin whiskers; corrosion in solder joints and interconnects. Protective techniques: proper design, inhibitors; cathodic protection — sacrificial anodic protection, impressed current cathodic protection. Electroplating (nickel) and electroless plating (copper).

AI Integration: Computer vision (OpenCV) for automated defect detection in PCBs; AI-based prediction of corrosion failure in electronic components using TensorFlow; image classification models for identifying corrosion types from microscope images.
Free/Open-Source AI Tools: OpenCV, TensorFlow, Python.

UNIT - V

Chemistry of Nanomaterials:
Introduction to nanochemistry: size-dependent properties, quantum confinement.
Carbon nanomaterials: fullerenes, carbon nanotubes (CNTs), graphene. Synthesis methods: chemical vapour deposition (CVD), sol-gel process.
Quantum dots: synthesis, properties, applications in displays and quantum computing.
Metallic nanoparticles: preparation and applications of silver and copper nanoparticles.
Applications: nanoelectronics, sensors (optical and biosensors), memory devices.
Spintronics materials: magnetic nanoparticles. Chemistry of quantum computing materials: superconducting materials (NbTi, Nb_3Sn).

AI Integration: AI-based nanomaterial property prediction using machine learning (Python, TensorFlow); simulation of nano-devices and quantum materials using open-source tools; generative AI for exploring nanomaterial design spaces.
Free/Open-Source AI Tools: Python, TensorFlow, open-source materials simulation platforms.

Text Books:

1. Engineering Chemistry, P. C. Jain and M. Jain, Dhanpat Rai Publishing Company, 2020. 17th Edition.
2. Engineering Chemistry, Shikha Agarwal, Cambridge University Press, 2026. 5th Edition.

Reference Books & Web Resources Links:

1. Handbook of Batteries, D. Linden and T. B. Reddy, McGraw-Hill, 2001. 3rd Edition.
2. The Chemistry of Nanomaterials: Synthesis, Properties and Applications, C. N. R. Rao, A. Muller and A. K. Cheetham, Wiley-VCH, 2007. Vols. (1–2).
3. Introduction to Nanotechnology, C. P. Poole and F. J Owens, John Wiley & Sons, 2003.
4. Engineering Chemistry, B. K. Sharma and H. Gaur, Krishna Prakashan Media, 2019.
5. Engineering Chemistry, S. S. Dara and S. S. Umare, S. Chand Publishing, 2018. 15th Edition.
6. NPTEL Engineering Chemistry: https://nptel.ac.in/
7. IBM Qiskit Learning: https://learning.quantum.ibm.com/
8. Google Colab: https://colab.research.google.com/
9. OpenCV Python Documentation: https://docs.opencv.org/
10. Materials Project (open nanomaterials database): https://materialsproject.org/

Question Paper Pattern:

Sessional Exam :

The question paper for Sessional Examination shall be for 50 marks. The question paper shall consist of Four questions. Question No.1 contains Ten short answer questions (2 marks each) for a total of Twenty marks. Remaining Three questions shall be EIHER/OR Type descriptive questions for Ten marks each. Each of these descriptive questions may contain sub-questions.

End Examination:

The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions. Question No.1 shall contain Ten short answer questions (2 marks each) for a total of Twenty marks, with Two short answer questions from each unit. Remaining Five Questions (Each question covering one unit of syllabus) carrying 10 marks each shall be EITHER/OR Type descriptive questions and may contain sub-questions.

CHEMISTRY FOR ELECTRONICS & COMMUNICATION ENGINEERING (CECE)

II Semester: ECE								**Scheme:2026**	
Course Code	**Category**	**Hours/Week**				**Credits**	**Maximum Marks**		
BS115	**BS**	**L/D**	**T**	**Pr**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
		3	**0**	**0**	**0**	**3**	**30**	**70**	**100**
Sessional Exam Duration: 2 Hrs								**End Exam Duration: 3 Hrs**	

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

CO1: Apply quantum chemistry principles to analyse electronic systems and predict molecular orbital properties.

CO2: Analyse spectroscopic techniques for material characterization and interpret spectral data for molecular identification.

CO3: Evaluate semiconductor materials and chemical fabrication processes relevant to electronic device manufacturing.

CO4: Analyse energy storage systems and electrochemical principles for communication device power management.

CO5: Design corrosion prevention and reliability strategies for electronic components using AI-assisted analysis.

UNIT – I

***Quantum Chemistry*:**

Fundamentals of quantum chemistry — black body radiation, photoelectric effect, wave-particle duality, de-Broglie wave equation, Heisenberg's uncertainty principle. Fundamentals of quantum mechanics, Schrödinger wave equation, significance of Ψ and Ψ^2. Quantum numbers. Particle in a one-dimensional box. Molecular orbital theory - bonding in homo and hetero nuclear diatomic molecules - energy level diagrams of O_2 and CO. π-molecular orbitals of butadiene and benzene, calculation of bond order.

AI Integration: Simulation of quantum systems using Python. Visualization of molecular orbitals and energy levels. Introduction to quantum computing models.
Free/Open-Source AI Tools: Python (NumPy, SciPy), Google Colab

UNIT – II

***Spectroscopy*:**

Introduction, types of energy in molecules, types of spectra, representation and general features of absorption spectra. Microwave spectroscopy — introduction, principle, instrumentation and applications. UV-Visible spectroscopy — chromophore, auxochrome, bathochromic shift, hypsochromic shift, Beer-Lambert law, principle, instrumentation and applications. Infrared (IR) spectroscopy - introduction, principle, instrumentation and applications.

AI Integration: AI-based spectral analysis and pattern recognition. Automated identification of compounds using machine learning models.
Free/Open-Source AI Tools: Python (Pandas, scikit-learn), spectroscopy datasets, Google Colab

UNIT – III

***Chemistry of electronic materials*:**

Atomic structure and chemical bonding relevant to semiconductors. Band theory: valence band, conduction band, band gap energy. Intrinsic and extrinsic semiconductors: silicon, germanium, gallium arsenide. Doping chemistry: *n*-type (phosphorus, arsenic) and *p*-type (boron, aluminum) dopants. Chemical vapor deposition (CVD) for thin film formation. Silicon dioxide (SiO_2) formation and properties. Chemistry of compound semiconductors: GaAs, SiC.

AI Integration: AI-based prediction of semiconductor properties and fabrication optimization. Data-driven defect analysis in semiconductor wafers.
Free/Open-Source AI Tools : Tensor Flow, Python, Scilab

UNIT – IV

***Electrochemistry and Energy Storage*:**

Fundamentals of electrochemistry: redox reactions, electrode potential, Nernst equation. Galvanic cells and electrolytic cells. Energy storage: batteries — primary batteries: zinc-air battery, secondary batteries: lead-acid, lithium-ion batteries ($LiFePO_4$). Supercapacitors: EDLC, pseudo capacitors for energy harvesting. Fuel cells: DMFC for backup power. Energy harvesting: solar cells (dye-sensitized, perovskite), thermoelectric generators. Battery management: charging algorithms, state of charge, thermal management.

***AI Integration* :** AI models for battery health monitoring and energy optimization in IoT devices. Predictive analytics for battery life and performance.
***Free/Open-Source AI Tools* :** Python (Pandas, scikit-learn), Google Colab

UNIT – V

Corrosion Chemistry and Protection:

Corrosion: definition, types — chemical corrosion and electrochemical corrosion, Pilling-Bedworth rule. Galvanic corrosion, concentration cell corrosion. Factors affecting corrosion. Passivation layers (SiO_2, Al_2O_3). Corrosion of printed circuit boards: copper oxidation, tin whiskers. Corrosion in solder joints and interconnects. Protective techniques: proper design, inhibitors. Cathodic protection. Electroplating (nickel) and electroless plating (copper).

AI Integration : Computer vision for PCB defect detection. AI-based prediction of corrosion failure in electronic components.
Free/Open-Source AI Tools : OpenCV, TensorFlow, Python

Text Books:

1. Engineering Chemistry, P. C. Jain and M. Jain, DhanpatRai Publishing Company, 2020. 17th Edition.
2. Engineering Chemistry,ShikhaAgarwal,CambridgeUniversity Press, 2026. 5thEdition.

Reference Books & Web Resources Links:

1. Solid State Electronic Devices, B.G. Streetman and S.K.Banerjee, Pearson Education, 2015. 7th Edition.
2. Physics of Semiconductor Devices, S.M. Sze and K.K.Ng, John Wiley & Sons, 2006.3rd Edition.
3. Engineering Chemistry, S. S.Dara and S. S. Umare, S. Chand Publishing, 2018. 15th Edition.
4. IEEE Electron Devices Society – https://eds.ieee.org
5. SEMI – Semiconductor Manufacturing Standards – https://www.semi.org
6. NPTEL Engineering Chemistry – https://nptel.ac.in

Question Paper Pattern:

Sessional Exam :

The question paper for Sessional Examination shall be for 50 marks. The question paper shall consist of Four questions. Question No.1 contains Ten short answer questions (2 marks each) for a total of Twenty marks. Remaining Three questions shall be EIHER/OR Type descriptive questions for Ten marks each. Each of these descriptive questions may contain sub-questions.

End Examination:

The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions. Question No.1 shall contain Ten short answer questions (2 marks each) for a total of Twenty marks, with Two short answer questions from each unit. Remaining Five Questions (Each question covering one unit of syllabus) carrying 10 marks each shall be EITHER/OR Type descriptive questions and may contain sub-questions.

CHEMISTRY FOR ELECTRICAL ENGINEERING (CEE)

II Semester : EEE						Scheme : 2026			
Course Code	Category	Hours/Week				Credits	Maximum Marks		
		L/D	T	Pr	P	C	Continuous Internal Assessment	End Exam	TOTAL
BS117	BS	3	0	0	0	3	30	70	100
Sessional Exam Duration:2 Hrs						End Exam Duration:3 Hrs			

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

CO1: Analyze electrochemical storage systems and select suitable technologies.

CO2: Evaluate corrosion in electrical infrastructure and design protection strategies.

CO3: Analyze and select electrical materials based on properties and applications.

CO4: Design thermal management solutions for electrical equipment.

CO5: Apply quantum chemistry concepts and AI tools for materials/energy analysis.

UNIT – I

***Electrochemical Energy Storage and Conversion*:**
Fundamentals of electrochemistry: electrode potential, Nernst equation and problems, potentiometry (redox reactions), conductometry (strong acid*vs* strong base and weak acid *vs* strong base); electrochemical cells (Galvanic and electrolytic cells); primary batteries: construction, working and electrical applications of zinc-air batteries; secondary batteries: construction, charging-discharging reactions and applications of lead-acid, lithium-ion batteries; supercapacitors: definition, classification and applications; electric fuel cells: construction, working and electrical applications of methanol-oxygen fuel cells; battery management systems: state of charge, thermal management, safety.

***AI Integration*:** Battery health prediction (SoH/SoC) using regression/ML; anomaly detection for thermal runaway; optimization of charge–discharge profiles using data analytics.
Free/Open-Source AI Tools: Python (NumPy, Pandas, scikit-learn); Google Colab

UNIT – II

***Corrosion Chemistry and Protective Techniques*:**
Corrosion: definition, examples, types of corrosion — chemical corrosion and electrochemical corrosion, Pilling-Bedworth rule; galvanic corrosion, concentration cell corrosion, pitting, galvanic, stress and corrosion; factors affecting corrosion; protective techniques (corrosion control): proper design, inhibitors; cathodic protection — sacrificial anodic protection, impressed current cathodic protection; electroplating; electroplating and electroless plating (nickel and copper); underground cable corrosion: stray current corrosion; corrosion in electrical substations: steel structures, conductors; battery terminal corrosion; corrosion in cooling systems of electrical machines.

AI Integration:Predictive corrosion modeling using environmental/operational data; computer vision for coating/defect inspection; maintenance scheduling via ML.
Free/Open-Source AI Tools: Python (scikit-learn); OpenCV; Google Colab

UNIT– III

***Electrical Materials*:**
Introduction, classification and applications of conductors: copper, aluminium, silver, alloys (brass, bronze) — resistivity, conductivity, temperature coefficient; semiconductors: band theory, intrinsic and extrinsic semiconductors (Si, Ge, GaAs), doping –*n*-type (P, As) and *p*-type (B, Al); superconductors: Type I and Type II, BCS theory; insulators: definition, classification and dielectric properties–solid insulators (ceramics, alumina, polymers), liquid insulators (transformer oil, silicone fluids), gaseous insulators (SF6, nitrogen); electrical polymers: types of polymerisation, thermoplastics and thermosetting plastics — preparation, properties and uses of

Bakelite, nylon-6, butyl rubber, conducting polymers; magnetic materials: ferromagnetic, paramagnetic.

AI Integration: Material selection using ML (property prediction, multi-objective optimization); defect classification in insulation using image analytics.
Free/Open-Source AI Tools:TensorFlow; Python; Orange Data Mining

UNIT – IV

***Coolants and Thermal Management in Electrical Systems*:**
Transformer oils: mineral oil, synthetic esters, silicone fluids; properties of oils; oil testing: breakdown voltage, acidity, moisture content; coolants for electrical machines: air, hydrogen, water, oil; water cooling: deionized water, corrosion inhibitors; hydrogen cooling in large generators: properties, purity requirements, safety; cooling fluids for power electronics: water-glycol; nanofluids for enhanced heat transfer; fire-resistant fluids: less-flammable oils, synthetic fluids.

AI Integration: Predictive analytics for hot-spot temperature and insulation life; anomaly detection from DGA data; optimization of cooling systems using data-driven models.
Free/Open-Source AI Tools: Python (Pandas, SciPy); scikit-learn; Google Colab

UNIT – V

***Quantum Chemistry*:**
Fundamentals of quantum chemistry — black body radiation, photoelectric effect, wave-particle duality, De-Broglie wave equation, and Heisenberg's uncertainty principle; fundamentals of quantum mechanics, Schrodinger wave equation, significance of Ψ and Ψ^2; quantum numbers; particle in one-dimensional box; molecular orbital theory — bonding in homo- and hetero-nuclear diatomic molecules, energy level diagrams of O_2 and CO; π-molecular orbitals of butadiene and benzene, calculation of bond order.

AI Integration: Quantum system visualization and simple simulations; introduction to quantum-inspired models for materials.
Free/Open-Source AI Tools: Python (NumPy, SciPy); Google Colab

Text Books:

1. Engineering Chemistry, P. C. Jain and M. Jain, DhanpatRai Publishing Company, 2020. 17th Edition.
2. Engineering Chemistry,ShikhaAgarwal,CambridgeUniversity Press,2026. 5thEdition.

Reference Books& Web Resources Links:

1. Handbook of Batteries,D. Linden and T. B. Reddy, McGraw-Hill, 2001.3rdEdition.
2. Engineering: Principles and Practice,P. R.Roberge,Corrosion, McGraw-Hill, 2008.
3. Engineering Chemistry, A. Shikha and R. K.Sharma, Krishna Prakashan Media, 2019.
4. Engineering Chemistry, S. S.Dara and S. S. Umare, S. Chand Publishing, 2018. 15th Edition.
5.IEEE Standards – https://standards.ieee.org/
6. IEC Standards for Electrical Equipment – https://www.iec.ch/
7. IRENA – Renewable Energy Technologies – https://www.irena.org/
8. U.S. Department of Energy – Energy Storage Database – https://www.energy.gov/eere/buildings/grid-interactive-efficient-buildings
9. Bureau of Indian Standards (BIS) – https://www.services.bis.gov.in/
10. Python (NumPy, Pandas, Matplotlib) – FREE on Google Colab
11. TensorFlow / scikit-learn – free, open-source
12. OpenCV – free, open-source

13. Orange Data Mining – free, open-source

Question Paper Pattern:

Sessional Exam :

The question paper for Sessional Examination shall be for 50 marks. The question paper shall consist of Four questions. Question No.1 contains Ten short answer questions (2 marks each) for a total of Twenty marks. Remaining Three questions shall be EIHER/OR Type descriptive questions for Ten marks each. Each of these descriptive questions may contain sub-questions.

End Examination:

The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions. Question No.1 shall contain Ten short answer questions (2 marks each) for a total of Twenty marks, with Two short answer questions from each unit. Remaining Five Questions (Each question covering one unit of syllabus) carrying 10 marks each shall be EITHER/OR Type descriptive questions and may contain sub-questions.

CHEMISTRY FOR MECHANICAL ENGINEERING (CME)

II Semester : ME						Scheme : 2026			
Course Code	Category	Hours / Week				Credits	Maximum Marks		
BS121	BS	L/D	T	Pr	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	0	3	30	70	100
Sessional Exam Duration: 2Hrs						End Exam Duration : 3 Hrs			

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

CO1: Analyze corrosion and recommend protection methods

CO2: Evaluate fuels and combustion processes

CO3: Apply lubrication principles in mechanical systems

CO4: Analyze engineering materials and composites

CO5: Design sustainable solutions using green chemistry and AI tools

UNIT - I

Corrosion chemistry and protective methods

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, stress corrosion. Corrosion prevention: cathodic protection, protective coatings – Galvanizing: hot-dip galvanizing, Electroplating: principles, process parameters (current density, temperature, pH) Ex: Copper plating, Nickel plating.
Anodizing: aluminium anodizing. Surface hardening: carbonitriding, flame hardening.
Corrosion 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.

Free/Open-Source AI Tools: Python (scikit-learn, OpenCV), Google Colab

UNIT - II

Energy Chemistry(Fuels and Combustion)

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), Liquid fuels (Petroleum oil): composition, refining processes (fractional distillation and cracking – catalytic), Synthetic fuels: Fischer-Tropsch synthesis.
Green fuels – Green hydrogen, Hythane, ethanol. Knocking in IC engines (petrol engines): octane number, anti-knock additives: Methyl Tertiary Butyl Ether (MTBE).
Knocking in diesel engines: cetane number, ignition quality, anti-knock additives.

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

Free/Open-Source AI Tools: Python (NumPy, Pandas), TensorFlow, Google Colab

UNIT - III

Chemistry of Lubricants

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. Lubricants: classification, Solid lubricants: graphite, molybdenum disulfide (MoS_2). Semi-solid lubricants: Greases – composition (base oil + thickener + additives), National Lubricating Grease Institute (NLGI) grades and applications.
Liquid 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.
Free/Open-Source AI Tools: Python, Excel AI tools, scikit-learn.

UNIT – IV

Engineering Materials and Composites
Ferrous alloys: composition and applications of carbon steels, stainless steels. Heat treatment: annealing, normalizing, hardening, tempering, age hardening.
Polymer chemistry: types of polymerizations, examples, thermoplastics, thermosets.
Engineering polymers: Preparation and engineering applications of Nylon, Acrylonitrile Butadiene styrene (ABS), Polytetrafluoroethylene (PTFE). Polymer processing: Compression moulding. Elastomers – Natural rubber, vulcanization, synthetic rubbers (BUNA-S and BUNA-N).
Ceramics: alumina, silicon carbide, zirconia and applications.
Refractories: characteristics, classification and properties (refractoriness, RUL, porosity and thermal spalling) of refractories.
Composite materials: Fiber-reinforced polymer composites and applications.

AI Integration: AI-based material property prediction and selection. Machine learning for composite optimization and performance analysis.
Free/Open-Source AI Tools: TensorFlow, Orange Data Mining, Python

UNIT – V

Chemistry of Green Engineering
Principles of green chemistry and their applications. Sustainable construction materials: geopolymer concrete, industrial by-products (Ground Granulated Blast-furnace Slag (GGBS).
Air pollution: types, sources, effects; air quality index. Water pollution: sources, effects and remedial methods. Chemistry of greenhouse gases and climate change.
Soil chemistry: pH, organic matter, contamination, remediation.
Solid waste management: classification, treatment, recycling in construction.

AI Integration: AI-based environmental impact assessment and life-cycle analysis. Air quality prediction models.
Free/Open-Source AI Tools: OpenLCA, Python, Google Colab

Text Books

1. Engineering chemistry, P. C. Jain and , M. Jain, Dhanpat Rai Publishing Company, 2020. 17th Edition,
2. Engineering Chemistry, Shikha Agarwal, Cambridge University Press, 2026. 5th edition.
3. A Textbook of Engineering Mechanics, S.S. Bhavikatti, New Age International Publications, 2018. 4th Edition.

Reference Books and Web Resource Links:

1. Water and wastewater engineering: Design principles and practice, M. L.Davis, 2020. McGraw-Hill Education. 2nd Edition.
2. Engineering Chemistry, A. Shikha and R. K. Sharma, Krishna Prakashan Media. 2019.
3. Engineering Chemistry, S. S. Dara and S. S. Umare, S. Chand Publishing, 2018. 15th Edition.
4. Society of Tribologists and Lubrication Engineers (STLE). (2023). Tribology and lubrication resources. https://www.stle.org/
5. ASM International, 2023. Materials information and education. https://www.asminternationa l.org/
6. Society of Automotive Engineers (SAE), 2023. Automotive engineering standards. https://www.sae.org/www.asminternational.org/
7. American Society of Mechanical Engineers (ASME), 2023. Mechanical engineering

resources. https://www.asme.org/

8. National Association of Corrosion Engineers (NACE), 2023. Corrosion prevention and control. https://www.nace.org/

Question Paper Pattern:

Sessional Exam :

The question paper for Sessional Examination shall be for 50 marks. The question paper shall consist of Four questions. Question No.1 contains Ten short answer questions (2 marks each) for a total of Twenty marks. Remaining Three questions shall be EIHER/OR Type descriptive questions for Ten marks each. Each of these descriptive questions may contain sub-questions.

End Examination:

The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions. Question No.1 shall contain Ten short answer questions (2 marks each) for a total of Twenty marks, with Two short answer questions from each unit. Remaining Five Questions (Each question covering one unit of syllabus) carrying 10 marks each shall be EITHER/OR Type descriptive questions and may contain sub-questions.

PHYSICS LAB FOR CIVIL ENGINEERING (PCEL)

I Semester: CIV							Scheme:2026		
Course Code	Category	Hours/Week				Credits	Maximum Marks		
		L/D	T	Pr	P	C	Continuous Internal Assessment	End Exam	TOTAL
BS104	BS	0	0	0	3	1.5	30	70	100

End Exam Duration: 2 Hrs.

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

CO1: Determine dispersive power of a prism, thickness by wedge method, radius of curvature by Newton's rings, and wavelengths of mercury spectrum and LASER using diffraction grating determine the refractive indices of O-ray & E-ray using Double Refraction; record, tabulate, and interpret optical measurement data.

CO2: Estimate Planck's constant from photoelectric effect data; Study the Characteristics of Solar cell, Identify the type of semiconductor using Hall effect; relate results to quantum and solid-state physics concepts

CO3: Trace B–H curves of magnetic materials; Determine Frequency of AC supply using Sonometer, measure velocity of Ultrasonic waves using Acoustical Grating method; Determine the Rigidity modulus of the given material by using Torsional Pendulum set up; analyze and compare experimental values with theoretical/standard values.

CO4: Study the Resonance phenomenon in LCR circuits; Behavior of Loaded springs in Series and Parallel combinations; evaluate results against theoretical predictions.

CO5: Automate optical fringe analysis using Open CV; extract Planck's constant by regression on photoelectric data; perform dispersive power curve fitting with Matplotlib /NumPy; evaluate computational model accuracy using percentage error and R^2.

Part A – Regular Experiments

Note: At least 12 of the following experiments shall be conducted.

1. Determination of the dispersive power of the prism.
2. Determination of the thickness of a thin object by the wedge method.
3. Determination of the radius of curvature of the lens by Newton's rings.
4. Determination of wavelengths of various colors of mercury spectrum using diffraction grating in the normal incidence method.
5. Study the variation of B versus H by magnetizing the magnetic material (B–H curve)
6. Estimation of Planck's constant using the photoelectric effect.
7. Determination of Frequency of AC supply using Sonometer.
8. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall effect
9. Double Refraction – Determination of refractive index of O-ray and E-ray.
10. Characteristics of Solar cell.
11. Determination of ultrasonic velocity in liquid (Acoustic grating).
12. Determination of wavelength using a diffraction grating.
13. LCR Resonance – Series and Parallel
14. Determination of Rigidity modulus of material of a wire-dynamic method (Torsional pendulum)
15. Study of oscillations of a mass under different combinations of springs (Loaded Springs)

Part B – AI Integration Lab Exercises

1. Any **three** of the following AI exercises must be completed using Python / Google Colab or appropriate AI/LLM tools.
2. Optics Data Automation (Python / Matplotlib): input raw angle-of-deviation data from the prism experiment; fit a polynomial to the deviation vs. angle curve; extract the angle of minimum deviation and compute dispersive power; overlay the fitted curve on experimental data points.
3. Fringe Analysis using OpenCV (Python / Google Colab): import Newton's ring or wedge-fringe images; apply Gaussian blur and Canny edge detection to locate fringe centres; compute fringe diameters automatically; calculate radius of curvature or thickness and compare with manual measurements.
4. Planck's Constant Estimation (Python / NumPy): input stopping potential vs. frequency data from the photoelectric experiment; apply linear regression (V_s vs. ν); extract slope to compute h and y-intercept to find work function; plot the regression line and quantify percentage error against the accepted value 6.626×10^{-34} J·s.

AI Integration:

AI integration adds three exercises after the regular experiments: (i) Python automation of prism deviation curve fitting and dispersive power extraction using Matplotlib/NumPy; (ii) OpenCV-based fringe image analysis for Newton's rings and wedge method — automating diameter measurement and radius of curvature computation; (iii) linear regression on photoelectric effect data to extract Planck's constant and work function — reinforcing the connection between the physical experiment and quantum theory.

Free / Open-Source AI Tools:

Python (NumPy, SciPy, OpenCV, Matplotlib) – Google Colab (free); scikit-learn (free) – semiconductor data analysis; PhET Interactive Simulations (free) – wave optics and quantum phenomena; VLabs IIT (free) – online physics experiments.

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IIT Bombay Virtual Labs (Physical Sciences) – https://iitb.vlabs.co.in/discipline.html?discipline=Physical_Sciences

Recommended Free & Open-Source AI/Computational Tools

Python (NumPy, SciPy, OpenCV, Matplotlib) – FREE on Google Colab for wave optics and EM field analysis

scikit-learn (free, open-source) – for semiconductor property prediction and EMI data analysis

OpenEMS (free, open-source) – for 3D electromagnetic field simulation and power system analysis

PHYSICS LAB FOR ADVANCED COMPUTING (PACL)

II Semester: Common to CSE& CSM							Scheme:2026		
Course Code	Category	Hours/Week				Credits	Maximum Marks		
BS112	BS	L/D	T	Pr	P	C	Continuous Internal Assessment	End Exam	TOTAL
		0	0	0	3	1.5	30	70	100

End Exam Duration: 2 Hrs.

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

CO1: Determine dispersive power of a prism, thickness by wedge method, radius of curvature by Newton's rings, and wavelengths of mercury spectrum and LASER using diffraction grating determine the refractive indices of O-ray & E-ray using Double Refraction; record, tabulate, and interpret optical measurement data.

CO2: Estimate Planck's constant from photoelectric effect data; Study the Characteristics of Solar cell, Identify the type of semiconductor using Hall effect; relate results to quantum and solid-state physics concepts

CO3: Trace B–H curves of magnetic materials; Determine Frequency of AC supply using Sonometer, measure velocity of Ultrasonic waves using Acoustical Grating method; Determine the Rigidity modulus of the given material by using Torsional Pendulum set up; analyze and compare experimental values with theoretical/standard values.

CO4: Study the Resonance phenomenon in LCR circuits; Behavior of Loaded springs in Series and Parallel combinations; evaluate results against theoretical predictions.

CO5: Automate optical fringe analysis using Open CV; extract Planck's constant by regression on photoelectric data; perform dispersive power curve fitting with Matplotlib /NumPy; evaluate computational model accuracy using percentage error and R^2.

Part A – Regular Experiments

Note: At least 12 of the following experiments shall be conducted.

1. Determination of the dispersive power of the prism.
2. Determination of the thickness of a thin object by the wedge method.
3. Determination of the radius of curvature of the lens by Newton's rings.
4. Determination of wavelengths of various colors of mercury spectrum using diffraction grating in the normal incidence method.
5. Study the variation of B versus H by magnetizing the magnetic material (B–H curve)
6. Estimation of Planck's constant using the photoelectric effect.
7. Determination of Frequency of AC supply using Sonometer.
8. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall effect
9. Double Refraction – Determination of refractive index of O-ray and E-ray.
10. Characteristics of Solar cell.
11. Determination of ultrasonic velocity in liquid (Acoustic grating).
12. Determination of wavelength using a diffraction grating.
13. LCR Resonance – Series and Parallel
14. Determination of Rigidity modulus of material of a wire-dynamic method (Torsional pendulum)
15. Study of oscillations of a mass under different combinations of springs (Loaded Springs)

Part B – AI Integration Lab Exercises

1. Any **three** of the following AI exercises must be completed using Python / Google Colab

or appropriate AI/LLM tools.

2. Optics Data Automation (Python / Matplotlib): input raw angle-of-deviation data from the prism experiment; fit a polynomial to the deviation vs. angle curve; extract the angle of minimum deviation and compute dispersive power; overlay the fitted curve on experimental data points.
3. Fringe Analysis using OpenCV (Python / Google Colab): import Newton's ring or wedge-fringe images; apply Gaussian blur and Canny edge detection to locate fringe centres; compute fringe diameters automatically; calculate radius of curvature or thickness and compare with manual measurements.
4. Planck's Constant Estimation (Python / NumPy): input stopping potential vs. frequency data from the photoelectric experiment; apply linear regression (V_s vs. ν); extract slope to compute h and y-intercept to find work function; plot the regression line and quantify percentage error against the accepted value 6.626×10^{-34} J·s.

AI Integration:

AI integration adds three exercises after the regular experiments: (i) Python automation of prism deviation curve fitting and dispersive power extraction using Matplotlib/NumPy; (ii) OpenCV-based fringe image analysis for Newton's rings and wedge method — automating diameter measurement and radius of curvature computation; (iii) linear regression on photoelectric effect data to extract Planck's constant and work function — reinforcing the connection between the physical experiment and quantum theory.

Free / Open-Source AI Tools:

Python (NumPy, SciPy, OpenCV, Matplotlib) – Google Colab (free); scikit-learn (free) – semiconductor data analysis; PhET Interactive Simulations (free) – wave optics and quantum phenomena; VLabs IIT (free) – online physics experiments.

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Recommended Free & Open-Source AI/Computational Tools

Python (NumPy, SciPy, OpenCV, Matplotlib) – FREE on Google Colab for wave optics and EM field analysis

Scikit-learn (free, open-source) – for semiconductor property prediction and EMI data analysis

OpenEMS (free, open-source) – for 3D electromagnetic field simulation and power system analysis

PHYSICS LAB FOR ELECTRONICS & COMMUNICATION ENGINEERING (PECEL)

I Semester: ECE							Scheme:2026		
Course Code	Category	Hours/Week				Credits	Maximum Marks		
BS110	BS	L/D	T	Pr	P	C	Continuous Internal Assessment	End Exam	TOTAL
		0	0	0	3	1.5	30	70	100
End Exam Duration: 2 Hrs.									
Course Out comes : At the end of the course students will be able to									
CO1: Determine dispersive power of a prism, thickness by wedge method, radius of curvature by Newton's rings, and wavelengths of mercury spectrum and LASER using diffraction grating determine the refractive indices of O-ray & E-ray using Double Refraction; record, tabulate, and interpret optical measurement data.									
CO2: Estimate Planck's constant from photoelectric effect data; determine e/m by J.J.Thomson Method; Study the Characteristics of Solar cell, Identify the type of semiconductor using Hall effect; relate results to quantum and solid-state physics concepts									
CO3: Trace B–H curves of magnetic materials; Determine Frequency of AC supply using Sonometer, measure velocity of Ultrasonic waves using Acoustical Grating method; analyze and compare experimental values with theoretical/standard values.									
CO4: Determine magnetic field along a coil axis by Stewart & Gee's method; Measure Resistivity by Four-Probe method; evaluate results against theoretical predictions.									
CO5: Automate optical fringe analysis using Open CV; extract Planck's constant by regression on photoelectric data; perform dispersive power curve fitting with Matplotlib/NumPy; evaluate computational model accuracy using percentage error and R^2.									
Part A – Regular Experiments									
Note: At least 12 of the following experiments shall be conducted.									
1. Determination of the dispersive power of the prism.									
2. Determination of the thickness of a thin object by the wedge method.									
3. Determination of the radius of curvature of the lens by Newton's rings.									
4. Determination of wavelengths of various colors of mercury spectrum using diffraction grating in the normal incidence method.									
5. Study the variation of B versus H by magnetizing the magnetic material (B–H curve)									
6. Estimation of Planck's constant using the photoelectric effect.									
7.Determination of Frequency of AC supply using Sonometer.									
8.Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall effect									
9. Double Refraction – Determination of refractive index of O-ray and E-ray.									
10. Characteristics of Solar cell.									
11.Determination of ultrasonic velocity in liquid (Acoustic grating).									
12. Determination of wavelength using a diffraction grating.									
13.Determination of the resistivity of a semiconductor by the four-probe method									
14.Determination of magnetic field along the axis of a current-carrying circular coil by Stewart & Gee's Method									
15.Determination of e/m of an electron by J.J. Thomson method									

Part B – AI Integration Lab Exercises

1. Any **three** of the following AI exercises must be completed using Python / Google Colab or appropriate AI/LLM tools.

2. Optics Data Automation (Python / Matplotlib): input raw angle-of-deviation data from the prism experiment; fit a polynomial to the deviation vs. angle curve; extract the angle of minimum deviation and compute dispersive power; overlay the fitted curve on experimental data points.

3. Fringe Analysis using OpenCV (Python / Google Colab): import Newton's ring or wedge-fringe images; apply Gaussian blur and Canny edge detection to locate fringe centres; compute fringe diameters automatically; calculate radius of curvature or thickness and compare with manual measurements.

4. Planck's Constant Estimation (Python / NumPy): input stopping potential vs. frequency data from the photoelectric experiment; apply linear regression (V_s vs. ν); extract slope to compute h and y-intercept to find work function; plot the regression line and quantify percentage error against the accepted value 6.626×10^{-34} J·s.

AI Integration:

AI integration adds three exercises after the regular experiments: (i) Python automation of prism deviation curve fitting and dispersive power extraction using Matplotlib/NumPy; (ii) OpenCV-based fringe image analysis for Newton's rings and wedge method — automating diameter measurement and radius of curvature computation; (iii) linear regression on photoelectric effect data to extract Planck's constant and work function — reinforcing the connection between the physical experiment and quantum theory.

Free / Open-Source AI Tools:

Python (NumPy, SciPy, OpenCV, Matplotlib) – Google Colab (free); scikit-learn (free) – semiconductor data analysis; PhET Interactive Simulations (free) – wave optics and quantum phenomena; VLabs IIT (free) – online physics experiments.

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Recommended Free & Open-Source AI/Computational Tools

Python (NumPy, SciPy, OpenCV, Matplotlib) – FREE on Google Colab for wave optics and EM field analysis

Scikit-learn (free, open-source) – for semiconductor property prediction and EMI data analysis

OpenEMS (free, open-source) – for 3D electromagnetic field simulation and power system analysis

PHYSICS LAB FOR ELECTRICAL ENGINEERING (PEEL)

I Semester: EEE									Scheme:2026
Course Code	Category	Hours/Week				Credits	Maximum Marks		
BS108	BS	L/D	T	Pr	P	C	Continuous Internal Assessment	End Exam	TOTAL
		0	0	0	3	1.5	30	70	100

End Exam Duration: 2 Hrs.

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

CO1: Determine dispersive power of a prism, thickness by wedge method, radius of curvature by Newton's rings, and wavelengths of mercury spectrum and LASER using diffraction grating determine the refractive indices of O-ray & E-ray using Double Refraction; record, tabulate, and interpret optical measurement data.

CO2: Estimate Planck's constant from photoelectric effect data; determine e/m by J.J.Thomson Method; Study the Characteristics of Solar cell, Identify the type of semiconductor using Hall effect; relate results to quantum and solid-state physics concepts

CO3: Trace B–H curves of magnetic materials; Determine Frequency of AC supply using Sonometer, measure velocity of Ultrasonic waves using Acoustical Grating method; analyze and compare experimental values with theoretical/standard values.

CO4: Determine magnetic field along a coil axis by Stewart & Gee's method; Measure Resistivity by Four- Probe method; evaluate results against theoretical predictions

CO5: Automate optical fringe analysis using Open CV; extract Planck's constant by regression on photoelectric data; perform dispersive power curve fitting with Matplotlib/NumPy; evaluate computational model accuracy using percentage error and R^2.

Part A – Regular Experiments

Note: At least 12 of the following experiments shall be conducted.

1. Determination of the dispersive power of the prism.
2. Determination of the thickness of a thin object by the wedge method.
3. Determination of the radius of curvature of the lens by Newton's rings.
4. Determination of wavelengths of various colors of mercury spectrum using diffraction grating in the normal incidence method.
5. Study the variation of B versus H by magnetizing the magnetic material (B–H curve)
6. Estimation of Planck's constant using the photoelectric effect.
7. Determination of Frequency of AC supply using Sonometer.
8. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall effect
9. Double Refraction – Determination of refractive index of O-ray and E-ray.
10. Characteristics of Solar cell.
11. Determination of ultrasonic velocity in liquid (Acoustic grating).
12. Determination of wavelength using a diffraction grating.
13. Determination of the resistivity of a semiconductor by the four-probe method
14. Determination of magnetic field along the axis of a current-carrying circular coil by Stewart & Gee's Method
15. Determination of e/m of an electron by J.J. Thomson method

Part B – AI Integration Lab Exercises

1. Any **three** of the following AI exercises must be completed using Python / Google Colab or appropriate AI/LLM tools.
2. Optics Data Automation (Python / Matplotlib): input raw angle-of-deviation data from the prism experiment; fit a polynomial to the deviation vs. angle curve; extract the angle of minimum deviation and compute dispersive power; overlay the fitted curve on experimental data points.
3. Fringe Analysis using OpenCV (Python / Google Colab): import Newton's ring or wedge-fringe images; apply Gaussian blur and Canny edge detection to locate fringe centres; compute fringe diameters automatically; calculate radius of curvature or thickness and compare with manual measurements.
4. Planck's Constant Estimation (Python / NumPy): input stopping potential vs. frequency data from the photoelectric experiment; apply linear regression (V_s vs. ν); extract slope to compute h and y-intercept to find work function; plot the regression line and quantify percentage error against the accepted value 6.626×10^{-34} J·s.

AI Integration:

AI integration adds three exercises after the regular experiments: (i) Python automation of prism deviation curve fitting and dispersive power extraction using Matplotlib/NumPy; (ii) OpenCV-based fringe image analysis for Newton's rings and wedge method — automating diameter measurement and radius of curvature computation; (iii) linear regression on photoelectric effect data to extract Planck's constant and work function — reinforcing the connection between the physical experiment and quantum theory

Free / Open-Source AI Tools:

Python (NumPy, SciPy, OpenCV, Matplotlib) – Google Colab (free); scikit-learn (free) – semiconductor data analysis; PhET Interactive Simulations (free) – wave optics and quantum phenomena; VLabs IIT (free) – online physics experiments.

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Recommended Free & Open-Source AI/Computational Tools

Python (NumPy, SciPy, OpenCV, Matplotlib) – FREE on Google Colab for wave optics and EM field analysis

Scikit-learn (free, open-source) – for semiconductor property prediction and EMI data analysis

Open EMS (free, open-source) – for 3D electromagnetic field simulation and power system analysis

PHYSICS LAB FOR MECHANICAL ENGINEERING (PMEL)

I Semester: MEC							Scheme:2026		
Course Code	Category	Hours/Week				Credits	Maximum Marks		
		L/D	T	Pr	P	C	Continuous Internal Assessment	End Exam	TOTAL
BS106	BS	0	0	0	3	1.5	30	70	100

End Exam Duration: 2 Hrs.

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

CO1: Determine dispersive power of a prism, thickness by wedge method, radius of curvature by Newton's rings, and wavelengths of mercury spectrum and LASER using diffraction grating determine the refractive indices of O-ray & E-ray using Double Refraction; record, tabulate, and interpret optical measurement data.

CO2: Estimate Planck's constant from photoelectric effect data; Study the Characteristics of Solar cell, Identify the type of semiconductor using Hall effect; relate results to quantum and solid-state physics concepts

CO3: Trace B–H curves of magnetic materials; Determine Frequency of AC supply using Sonometer, measure velocity of Ultrasonic waves using Acoustical Grating method; Determine the Rigidity modulus of the given material by using Torsional Pendulum set up; analyze and compare experimental values with theoretical/standard values.

CO4: Study the Resonance phenomenon in LCR circuits; Behavior of Loaded springs in Series and Parallel combinations; evaluate results against theoretical predictions.

CO5: Automate optical fringe analysis using Open CV; extract Planck's constant by regression on photoelectric data; perform dispersive power curve fitting with Matplotlib /NumPy; evaluate computational model accuracy using percentage error and R^2.

Part A – Regular Experiments

Note: At least 12 of the following experiments shall be conducted.

1. Determination of the dispersive power of the prism.
2. Determination of the thickness of a thin object by the wedge method.
3. Determination of the radius of curvature of the lens by Newton's rings.
4. Determination of wavelengths of various colors of mercury spectrum using diffraction grating in the normal incidence method.
5. Study the variation of B versus H by magnetizing the magnetic material (B–H curve)
6. Estimation of Planck's constant using the photoelectric effect.
7. Determination of Frequency of AC supply using Sonometer.
8. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall effect
9. Double Refraction – Determination of refractive index of O-ray and E-ray.
10. Characteristics of Solar cell.
11. Determination of ultrasonic velocity in liquid (Acoustic grating).
12. Determination of wavelength using a diffraction grating.
13. LCR Resonance – Series and Parallel
14. Determination of Rigidity modulus of material of a wire-dynamic method (Torsional pendulum)
15. Study of oscillations of a mass under different combinations of springs (Loaded Springs)

Part B – AI Integration Lab Exercises

1. Any **three** of the following AI exercises must be completed using Python / Google Colab or appropriate AI/LLM tools.
2. Optics Data Automation (Python / Matplotlib): input raw angle-of-deviation data from the prism experiment; fit a polynomial to the deviation vs. angle curve; extract the angle of minimum deviation and compute dispersive power; overlay the fitted curve on experimental data points.
3. Fringe Analysis using Open CV (Python / Google Colab): import Newton's ring or wedge-fringe images; apply Gaussian blur and Canny edge detection to locate fringe centres; compute fringe diameters automatically; calculate radius of curvature or thickness and compare with manual measurements.
4. Planck's Constant Estimation (Python / NumPy): input stopping potential vs. frequency data from the photoelectric experiment; apply linear regression (V_s vs. ν); extract slope to compute h and y-intercept to find work function; plot the regression line and quantify percentage error against the accepted value 6.626×10^{-34} J·s.

AI Integration:

AI integration adds three exercises after the regular experiments: (i) Python automation of prism deviation curve fitting and dispersive power extraction using Matplotlib/NumPy; (ii) Open CV-based fringe image analysis for Newton's rings and wedge method — automating diameter measurement and radius of curvature computation; (iii) linear regression on photoelectric effect data to extract Planck's constant and work function — reinforcing the connection between the physical experiment and quantum theory.

Free / Open-Source AI Tools:

Python (NumPy, SciPy, Open CV, Matplotlib) – Google Colab (free); scikit-learn (free) – semiconductor data analysis; PhET Interactive Simulations (free) – wave optics and quantum phenomena; VLabs IIT (free) – online physics experiments.

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Recommended Free & Open-Source AI/Computational Tools

Python (NumPy, SciPy, Open CV, Matplotlib) – FREE on Google Colab for wave optics and EM field analysis

Scikit-learn (free, open-source) – for semiconductor property prediction and EMI data analysis

OpenEMS (free, open-source) – for 3D electromagnetic field simulation and power system analysis

CHEMISTRY LAB FOR CIVIL ENGINEERING (CCEL)

II Semester : CE									Scheme:2026
Course Code	Category	Hours/Week				Credits	Maximum Marks		
		L/D	T	Pr	P	C	Continuous Internal Assessment	End Exam	Total
BS120	BS	0	0	0	3	1.5	30	70	100
								End Exam Duration:	2 Hrs

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

CO1 : Estimate the concentration of acid and ferrous iron using acid-base and redox titrations

CO2 : Determine the amount of hardness and dissolved oxygen present in given water sample

CO3 : Apply conductometric and colorimetric techniques for quantitative chemical analysis.

CO4: Synthesize a polymer, relate its properties to electronics applications and determine the viscosity of lubricating oils using Viscometer.

List of Experiments

Note: At least 10 of the following experiments shall be conducted

1. Determination of strength of an acid in Pb-Acid battery (acid-base titration)
2. Determination of Copper (II) using Ethylenediamine tetra acetic acid (EDTA) (complexometric titrations)
3. Estimation of Total hardness, permanent and temporary hardness of water by using Ethylene Diamine Tetra Acetic acid (EDTA) (complexometric titrations)
4. Estimation of Ferrous Iron (Fe^{+2}) using potassium dichromate ($K_2Cr_2O_7$) (Redox titrations)
5. Estimation of Dissolved Oxygen in water sample (Iodometry)
6. Preparation of a polymer (Bakelite)
7. Conductometric titrations of strong acid Vs strong base (Ex: HCl *vs* NaOH)
8. Determination of viscosity of lubricating oil using Red-Wood Viscometer – I
9. Determination of viscosity of lubricating oil by Engler's Viscometer
10. Verification of Beer-Lamberts law using Colorimeter
11. Determination of corrosion by environment
12. Determination of corrosion
13. pH metry – Estimation of Hydrochloric acid (HCl) using Sodium Hydroxide (NaOH)
14. Determination of Iron (Fe) in cement by colorimetry

AI Integration: Data collection, visualization, and analysis using Python/Excel. Correlation analysis (e.g., hardness *vs* alkalinity).

Reference Books & Web Resources Links:

1. Vogel's Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and B. Sivasankar, Pearson Publications, 2009, 6th Edition.

2. WHO, EPA, BIS, Concrete.org, IGBC
3. Python (NumPy, Pandas, Matplotlib), TensorFlow / scikit-learn, OpenLCA, Orange Data Mining, KNIME / Teachable Machine

CHEMISTRY LAB FOR COMPUTER SCIENCE (CCSL)

II Semester: Common for CSE&CSM							**Scheme:2026**		
Course Code	**Category**	**Hours/Week**				**Credits**	**Maximum Marks**		
BS114	**BS**	**L/D**	**T**	**Pr**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		0	**0**	**0**	**3**	**1.5**	**30**	**70**	**100**
								End Exam Duration:2 Hrs	

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

CO1 : Estimate the concentration of acid and ferrous iron using acid-base and redox titrations

CO2 : Determine the amount of Cu (II) by EDTA and estimate the oxygen present in water sample

CO3 : Apply instrumental methods –conductometry, potentiometry, colorimetry for chemical Analysis

CO4 : Synthesize a polymer, relate its properties to electronics applications and determine the viscosity of lubricating oils using Viscometer.

List of Experiments

Note: At least 10 of the following experiments shall be conducted

1. Determination of strength of an acid in Pb-Acid battery
2. Estimation of Cu (II) by using Ethylene diamine tetra acetic acid (EDTA)
3. Estimation of ferrous iron (Fe^{2+}) using potassium dichromate ($K_2Cr_2O_7$) (redox titrations).
4. Estimation of Dissolved Oxygen by Winkler's method
5. Preparation of a polymer (Bakelite)
6. Conductometric titration of strong acid *vs* strong base
7. Conductometric titration of weak acid *vs* strong base
8. Determination of viscosity of lubricating oil using Red-Wood Viscometer – I
9. Potentiometry (redox titrations) – estimation of iron (Fe^{2+}) using potassium dichromate ($K_2Cr_2O_7$).
10. Verification of Beer-Lamberts law using Colorimeter
11. Determination of corrosion
12. Determination of corrosion by environment
13. Spectrophotometry – Determination of Wavelength (λ) and Verification of Beer–Lambert Law
14. Identification of Functional Groups in Organic Compounds by IR Spectrophotometer

AI Integration : Data analysis using Python (NumPy, Pandas, Matplotlib) for titration curve plotting and equivalence point detection. Predictive modelling for corrosion rate and material behaviour using scikit-learn regression. TensorFlow for optional IR spectrum pattern classification. OpenCV for colorimetric image-based concentration estimation. Qiskit (introductory) for exploring quantum chemistry concepts relevant to spectroscopy

ReferenceBooks & Web Resources Links:

1. Vogel's Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and B. Sivasankar, Pearson Publications,2009, 6th Edition.

2. IEEE Xplore Digital Library, Semiconductor Industry Association resources, NPTEL Engineering Chemistry, ASME technical resources
3. Python (NumPy, Matplotlib, scikit-learn) – Google Colab (free); LibreOfficeCalc (free) – data recording; Virtual Chemistry Lab – VLabs IIT (free).

CHEMISTRY LAB FOR ELECTRONICS & COMMUNICATION ENGINEERING (CECEL)

II Semester: ECE							**Scheme:2026**		
Course Code	**Category**	**Hours/Week**				**Credits**	**Maximum Marks**		
BS116	**BS**	**L/D**	**T**	**Pr**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		0	**0**	**0**	**3**	**1.5**	**30**	**70**	**100**
								End Exam Duration:2 Hrs	

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

CO1 : Estimate the concentration of acid and ferrous iron using acid-base and redox titrations

CO2 : Determine the amount of Cu (II) by EDTA and estimate the oxygen present in water sample

CO3 : Apply instrumental methods –conductometry, potentiometry, colorimetry for chemical analysis

CO4 : Synthesize a polymer, relate its properties to electronics applications and determine the viscosity of lubricating oils using Viscometer.

List of Experiments

Note: At least 10 of the following experiments shall be conducted

1. Determination of strength of an acid in Pb-Acid battery
2. Estimation of Cu (II) by using Ethylene diamine tetra acetic acid (EDTA)
3. Estimation of ferrous iron (Fe^{2+}) using potassium dichromate ($K_2Cr_2O_7$) (redox titrations).
4. Estimation of Dissolved Oxygen by Winkler's method
5. Preparation of a polymer (Bakelite)
6. Conductometric titration of strong acid *vs* strong base
7. Conductometric titration of weak acid *vs* strong base
8. Determination of viscosity of lubricating oil using Red-Wood Viscometer – I
9. Potentiometry (redox titrations) – estimation of iron (Fe^{2+}) using potassium dichromate ($K_2Cr_2O_7$).
10. Verification of Beer-Lamberts law using Colorimeter
11. Determination of corrosion
12. Determination of corrosion by environment
13. Spectrophotometry – Determination of Wavelength (λ) and Verification of Beer–Lambert Law
14. Identification of Functional Groups in Organic Compounds by IR Spectrophotometer

AI Integration: Data logging and analysis using Python/Excel; predictive models for corrosion rates, battery parameters, and lubricant properties.

ReferenceBooks & Web Resources Links:

1. Vogel's Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and B. Sivasankar, Pearson Publications,2009, 6th Edition.

2. IEEE Standards, IEC, IRENA, U.S. DOE (Energy Storage), BIS.
3. Python (NumPy, Pandas, Matplotlib), TensorFlow / scikit-learn, OpenCV, Orange Data Mining

CHEMISTRY LAB FOR ELECTRICAL ENGINEERING (CEEL)

II Semester: EEE							**Scheme:2026**		
Course Code	**Category**	**Hours/Week**				**Credits**	**Maximum Marks**		
BS118	**BS**	**L/D**	**T**	**Pr**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		0	**0**	**0**	**3**	**1.5**	**30**	**70**	**100**
								End Exam Duration:2 Hrs	

Course Out comes : At the end of the course students will be able to

CO1: Estimate the concentration of acid and ferrous iron using acid-base and redox titrations

CO2: Determine the amount of Cu (II) by EDTA and estimate the oxygen present in water sample

CO3: Apply instrumental methods –conductometry, potentiometry, colorimetry for chemical analysis

CO4 : Synthesize a polymer, relate its properties to electronics applications and determine the viscosity of lubricating oils using Viscometer.

List of Experiments

Note: At least 10 of the following experiments shall be conducted

1. Determination of strength of an acid in Pb-Acid battery
2. Estimation of Cu (II) by using Ethylene diamine tetra acetic acid (EDTA)
3. Estimation of ferrous iron (Fe^{2+}) using potassium dichromate ($K_2Cr_2O_7$) (redox titrations).
4. Estimation of Dissolved Oxygen by Winkler's method
5. Preparation of a polymer (Bakelite)
6. Conductometric titration of strong acid *vs* strong base
7. Conductometric titration of weak acid *vs* strong base
8. Determination of viscosity of lubricating oil using Red-Wood Viscometer – I
9. Potentiometry (redox titrations) – estimation of iron (Fe^{2+}) using potassium dichromate ($K_2Cr_2O_7$).
10. Verification of Beer-Lamberts law using Colorimeter
11. Determination of corrosion
12. Determination of corrosion by environment
13. Determination of viscosity of lubricating oil using Red-Wood Viscometer – II

AI Integration: Data logging and analysis using Python/Excel; predictive models for corrosion rates, battery parameters, and lubricant properties.

ReferenceBooks & Web Resources Links:

1. Vogel's Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and B. Sivasankar, Pearson Publications,2009, 6th Edition.
2. IEEE Standards, IEC, IRENA, U.S. DOE (Energy Storage), BIS.
3. Python (NumPy, Pandas, Matplotlib), TensorFlow / scikit-learn, OpenCV, Orange Data Mining

CHEMISTRY LAB FOR MECHANICAL ENGINEERING (CMEL)

II Semester : ME								Scheme:2026	
Course Code	Category	Hours/Week				Credits	Maximum Marks		
		L/D	T	Pr	P	C	Continuous Internal Assessment	End Exam	Total
BS122	BS	0	0	0	3	1.5	30	70	100
								End Exam Duration:	2 Hrs

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

CO1: Estimate the concentration of alkalinity and ferrous iron using acid-base and redox titrations

CO2: Determine the amount of hardness and dissolved oxygen present in given water sample

CO3: Apply conductometric and colorimetric techniques for quantitative chemical analysis.

CO4: Synthesize a polymer, relate its properties to electronics applications and determine the viscosity of lubricating oils using Viscometer.

List of Experiments

Note: At least 10 of the following experiments shall be conducted

1. Determination of strength of acid (H_2SO_4) using Sodium Hydroxide
2. Determination of Copper (II) using Ethylenediamine tetra acetic acid (EDTA) (complexometric titrations)
3. Estimation of Total hardness, permanent and temporary hardness of water by using Ethylene diaminetetra acetic acid (EDTA) (complexometric titrations)
4. Estimation of Ferrous Iron (Fe^{+2}) using potassium dichromate ($K_2Cr_2O_7$) (Redox titrations)
5. Estimation of Dissolved Oxygen in water sample (Iodometry)
6. Preparation of a polymer (Bakelite)
7. Conductometric titrations of strong acid Vs strong base (Ex: HCl*vs*NaOH)
8. Determination of viscosity of lubricating oil using Red-Wood Viscometer – I
9. Determination of viscosity of lubricating oil by Engler's Viscometer
10. Verification of Beer-Lamberts law using Colorimeter
11. Determination of corrosion by environment
12. Determination of corrosion
13. Determination of moisture content in coal sample (Proximate analysis)
14. Verification of Freundlich Adsorption isotherm (Adsorption of acetic acid by charcoal)
15. pH metry - Estimation of Hydrochloric acid (HCl) using Sodium Hydroxide (NaOH)

AI Integration:Data collection, visualization, and analysis using Python/Excel. Correlation analysis(e.g., hardness *vs* alkalinity).

Reference Books & Web Resources Links:

1. Vogel's Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and B. Sivasankar, Pearson Publications,2009, 6th Edition.
2. WHO, EPA, BIS, Concrete.org, IGBC
3. Python (NumPy, Pandas, Matplotlib), TensorFlow / scikit-learn, OpenLCA, Orange Data Mining, KNIME / Teachable Machine

Engineering Graphics (EG)									
I/ II Semester: Common to all branches						**Scheme:2026**			
Course Code	**Category**	**Hours/Week**				**Credits**	**Maximum Marks**		
ME101	**ES**	**L/D**	**T**	**Pr**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
		1	**0**	**4**	**0**	**3**	**30**	**70**	**100**
Sessional Exam Duration:2Hrs						**End Exam Duration: 3Hrs**			

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

CO1: Understand the principles of engineering drawing, including engineering curves, scales, Orthographic and Isometric projections.

CO2: Interpret and draw orthographic projections of points, lines and planes in front, top and side views

CO3: Apply the principles of projection to draw projections of solids in various positions in the first quadrant

CO4: Explain the principles behind the development of surfaces.

CO5: Apply isometric principles to construct isometric views of simple and compound solids and convert between isometric and orthographic views.

UNIT– I

Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions and Constructing regular Polygons by general methods.

Curves: Construction of ellipse, parabola and hyperbola by eccentric method, Cycloids, Involutes, Normal and tangent to Curves.

Scales: Plain scales, diagonal scales and Vernier scales.

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: Reference planes, importance of reference Plane, reference line. Projections of a point situated in any one of the four quadrants.

Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane. Projections of Straight Line Inclined to both the reference planes

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.

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

Projections of Solids: Types of solids: Polyhedron 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.

AI Integration Module: Object recognition models trained to identify standard solid geometries; automated multiview projection generation from 3D CAD meshes using programmatic render layers.

UNIT– IV

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 toolpath generation using physics-guided heuristic networks.

UNIT– V

Conversion of Views: Isometric scale, Isometric views of simple solids, Isometric view of compound solids, Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views. (limited to simple problems)

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

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.N.D.Bhatt,V.M.Panchal,"Elementary Engineering Drawing", Charotar Publishing house, Pvt. Ltd.

2.K.L.Narayana and P.Kannaiah "Text book on Engineering Drawing," Scitech Publications.

3. Dhananjay A Jolhe, "Engineering Drawing with an introduction to AutoCAD", Tata McGraw-Hill Publishing Company Ltd., New Delhi.

Reference Books

1. A.P. Gautam,Pradeep Jain,Ankita Maheshwari,"Engineering Graphics and Design", Khanna Publishers.

2. M.B.Shaw, B.C.Rana" Engineering Drawing" Pearson Education, New Delhi.

3. K.Venugopal,V.Prabhu Raja "Engineering Drawing with Auto CAD", New Age International Private Limited.

Question Paper Pattern:

Sessional Exam :

The question paper for sessional examination shall be for 30 marks. The question paper shall consist of three sections with Two Questions (EITHER/ OR Type) in each section. The student shall answer one question from each section.

End Examination:

The question paper for End examination shall be for 70 marks. The Question paper shall contain Five Units with Two Questions (Either or Type) from each unit. Each of these questions may contain sub-questions and the student should answer any one question from each unit. Each Question carries 14 marks.

ENGINEERING WORKSHOP (EWP)									
I/II Semester : Common to All Branches						**Scheme : 2026**			
Course Code	**Category**	**Hours/Week**				**Credits**	**Maximum Marks**		
ME102	**ES**	**L/D**	**T**	**Pr**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
		0	**0**	**0**	**3**	**1.5**	**30**	**70**	**100**
End Exam Duration: 3 Hrs									

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

CO1: Understand the usage of tools and equipments in work shop trades.

CO2: Fabricate simple models in carpentry and fitting.

CO3: Prepare electrical connections in house wiring and perform soldering on circuit boards.

CO4: Prepare sand moulds using foundry tools and fabricate simple components in the smithy.

CO5: Perform the Arc and Gas welding processes.

CO6: Perform the sheet metal processes and plumbing.

LIST OF EXPERIMENTS

Introduction : Introduction to tools and equipment used in each trade

Cycle – I (Carpentry)

1. Dovetail joint 2. Mitre-faced Bridle joint 3.Mortise and Tenon joint

Cycle – II (Fitting)

1. V – fitting 2.Stepped fitting 3.Half round fitting

Cycle – III (House wiring)

1. One bulb controlled by one-way switch and two-way switches.
2. Two bulbs in series and parallel

Cycle – IV (Soldering)

1. Soldering Practice 2. Soldering Resistances in Series 3.Soldering Resistances in parallel.

Cycle – V (Black smithy and Foundry)

1. Making Round to square cross section 2. Making eye bolt
3. Preparation of mould with split piece pattern.

Cycle – VI (Welding)

Demonstration and practice on Arc Welding and Gas welding.

Cycle – VII(Sheet Metal and Plumbing)

Sheet Metal: Familiarity with different types of tools used in sheet metal working, Development of simple sheet metal jobs from GI sheets.

Plumbing: Demonstration and practice of Plumbing tools, Preparation of Pipe joints with coupling for same diameter and with reducer for different diameters.

Cycle – VIII(Disassembly and assembly of Desktop computer)

Disassembly and **assembly** of Desktop computer to understand the role of each component (CPU, motherboard, RAM, HDD/SSD, GPU, etc.).

Cycle – IX(Hardware Troubleshooting & Peripheral Installation)

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

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

Cycle –X(Network Setup and Configuration)

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

Cycle –XI (Disassembly and assembly of Equipment)
Disassembly and assembly of Bicycle, Gear Box and Braking system.

Note: Student has to perform at least Ten jobs.

AI Integration Module: Use AI-assisted image recognition and digital visualization for identification of workshop tools, equipment, materials, components, and manufacturing processes across carpentry, fitting, electrical wiring, soldering, blacksmithy, foundry, welding, sheet metal, plumbing, computer hardware, networking, and mechanical equipment .

Text Books

1. S.K. Hajra Choudhury, A. K. Hajra Choudhury and Nirjhar Roy," Elements of Workshop Technology" Vol.1, Media Promoters & Publishers, New Delhi
2. B.S. Raghuwanshi, "A Course in Workshop Technology" Vol I., Dhanpath Rai & Co, New Delhi.
3. Giacomo Veneri, Antonio Capasso,"Hands-On Industrial Internet of Things", Packt Publishing.
4. Felix W., "Basic Workshop Technology Manufacturing Process", Independenty Published.
5. Bruce J. Black, "Workshop Processes, Practices and Materials", Routledge Publisher.
6. P.M. Soni, P.A.Upadhyay,"Wiring, Estimating, & Contracting", Atul Prakashan Publishers.

Reference Books

1. P. N. Rao, Manufacturing Technology Vol-1, MCGrawhill Publisher.
2. R. Keith Mobley,"An Introduction to Predictive Maintenance (Plant Engineering)", Butterworth-
3. P. Kannaiah and K.L.Narayana,"Workshop Manual", Scitech Publications (India) Pvt Ltd.
4. S.Gowri and T.Jeyapoovan, "Engineering Practices Lab Manual",Vikas Publishing House.
5. H.S.Bawa, "Workshop Practice", McGraw Hill Education.

BASIC SIMULATION LAB (BSL)

II Semester : ME							Scheme : 2026		
Course Code	Category	Hours / Week				Credits	Maximum Marks		
		L/D	T	Pr	P	C	Continuous Internal Assessment	End Exam	Total
ME103	PC	0	0	0	2	1	30	70	100
							End Exam Duration : 3 Hrs		

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

CO1: Develop customized computational scripts to automate data processing and data analysis.

CO2: Plot clear 2D and 3D graphs to analyze and present experimental engineering data.

CO3: Solve basic algebraic and simple differential equations

CO4: Understand practical way to use MATLAB for solving mechanical engineering problems

List of Experiments

1. Introduction to MATLAB Environment

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

2. Basic MATLAB operations

AI Integration Module: Use AI-assisted code generation, explanation, debugging, and optimization for basic MATLAB commands, variables, operators, and mathematical expressions.

3. Basic matrix operations

AI Integration Module: Use AI-assisted tools to generate, explain, and verify MATLAB programs for matrix creation, manipulation, arithmetic operations, and solutions of basic matrix problems.

4. Two-dimensional and Three-dimensional plotting of engineering data

AI Integration Module: Use AI-assisted tools to generate MATLAB plotting code, select suitable 2D/3D visualizations, customize plots, and interpret engineering data patterns and trends.

5. Curve fitting – Straight line fit

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

6. Curve fitting – Polynomial fit

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

7. Numerical integration using Trapezoidal method

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

8. Numerical integration using Simpson's method.

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

9. Solution of linear systems of equations

AI Integration: Use the interactive Optimization Tool wizard to find the minimum weight of a box without manually calculating derivatives.
10. Solution of nonlinear equations **AI Integration:** Use the interactive Optimization Tool wizard to find the minimum weight of a box without manually calculating derivatives.
11. Solution of ordinary differential equations **AI Integration:** Use the Live Editor Task for Solving ODEs to define and solve the cooling rate visually without deep programming.
12. Engineering applications analysis – Mechanical systems **AI Integration:** Use the System Identification App to upload data from a basic pendulum swing and let the tool guess its length and drag.
13. Introduction to MATLAB Simulink and Graphical modelling **AI Integration:** Use Simulink Onramp interactive widgets to discover how pre-trained machine learning blocks can predict the output of a system.
Note: Student has to perform at least 10 experiments from the above list
Text Books
1. MATLAB for Engineers, Holly Moore, Pearson Education Inc, 2022, 6th Edition
2. MATLAB for ME Engineers, Rao V Dukkipati, New age Science, 2008, 1st Edition
3. MATLAB And Simulink For Engineers, Agam Kumar Tyagi, Oxford University Press, 2011
4. Modeling and Simulation using MATLAB, Shailendra Jain, Wiley, 2016
Reference Books
1. Numerical Methods for Engineers, Steven C. Chapra & Raymond P. Canale, McGraw Hill Education India, 2021
2. Numerical Methods Using MATLAB, John H. Mathews & Kurtis D. Fink, Prentice Hall, 2004
3. Applied Numerical Methods Using MATLAB, Won Y. Yang, Wenwu Cao, Tae-Sang Chung & John Morris, Wiley-Interscience, 2005
Online resources
1. https://in.mathworks.com/products/matlab.html
2. https://nptel.ac.in/courses/103106118

II Semester : Common for CE & ME							Scheme:2026		
Course Code	Category	Hours/Week				Credits	Maximum Marks		
CE101	PC	L/D	T	Pr	P	C	Continuous Internal Assessment	End Exam	Total
		2	0	2	0	3	30	70	100
Sessional Exam Duration: 2 Hrs							End Exam Duration: 3 Hrs		

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

CO1: Apply the principles of statics to the force systems and the concept of friction to the engineering applications.

CO2: Apply the equilibrium conditions and the principle of virtual work in structures and trusses.

CO3: Apply the concept of centroid, centre of gravity and moment of inertia for simple and composite bodies.

CO4: Analyze the particle dynamics using principles of kinematics and kinetics.

CO5: Analyze stresses and strains of bars subjected to uniaxial loading and temperature.

UNIT – I

Introduction, Force Systems & Friction

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.

Friction:Limiting friction– Coulomb's laws of dry friction–Coefficient of friction, angle of friction, cone of static friction–Impending motion problems, and wedge friction.

AI Integration: Introduction to AI in Engineering: Concept of data, Machine learning (ML), and simulation. Using Python (NumPy) to solve force equilibrium problems computationally.

UNIT – II

Equilibrium of Force Systems & Virtual Work

Equilibrium conditions for coplanar systems: Free body diagrams–Equations of equilibrium ($\Sigma F_x=0$, $\Sigma F_y=0$, $\Sigma M=0$).

Analysis of plane trusses: Method of joints– Method of sections.

Principle of virtual work: statement, applications to simple mechanisms.

AI Integration: Using Python/Open Sees (open source) for automated truss analysis. Visual debugging of FBDs using interactive tools.

UNIT – III

Centroid, Centre of Gravity & Moment of Inertia

Centroid of areas from first principles. Centroid of standard shapes: rectangle, triangle, circle, semicircle, quarter circle. Centroid of composite figures. 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.

UNIT – IV

Kinematics & Kinetics of Particles

Kinematics: Rectilinear motion – Displacement, velocity, acceleration relations–Curvilinear

motion–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: Python simulation of projectile motion with drag (real-world). ML-based trajectory prediction: introduction to LSTM for motion prediction. Using Python (matplotlib.animation) for interactive motion visualization.

UNIT – V

Simple Stresses, Strains & Elastic Constants

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

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.

Text Books

1. Engineering Mechanics, Timoshenko S., Young D.H., Rao J.V. and Pati S., McGraw Hill Education, 2017, 5th Edition.
2. A Textbook of Engineering Mechanics,Bhavikatti S.S., New Age International Publications, 2018, 4th Edition.
3. Mechanics of Materials,Timoshenko S. and Gere J., CBS Publishers, 2006.
4. Strength of materials, R.K.Rajput, S.Chand&Co, NewDelhi.
5. Strength of Materials, Basavarajaiah B.S. and Mahadevappa P., Universities Press,2010, 3rd Edition.

Reference Books

1. Engineering Mechanics: Statics and Dynamics,Hibbeler R.C., Pearson Education, 14th Edition, 2022.
2. Engineering Mechanics (Statics & Dynamics),Meriam J.L. and Kraige L.G., John Wiley,2008, 6th Edition.
3. Engineering Mechanics: Statics and Dynamics,Shames I.H., PHI, 2002, 4th Edition.
4. Vector Mechanics for Engineers (Statics & Dynamics), Beer F.P. and Johnston E.R., McGraw Hill, 2019, 12th Edition.
5. Introduction to Statics and Dynamics, Bhattacharya B., Oxford University Press,2014, 2nd Edition.

Question Paper Pattern:

Sessional Exam :

The question paper for Sessional Examination shall be for 50 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 contains Ten short answer questions (2 marks each) for a total of Twenty marks. Remaining Three questions shall be EIHER/OR Type descriptive questions for Ten marks each. Each of these descriptive questions may contain sub-questions.

End Examination:

The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten short answer questions (2 marks each) for a total of Twenty marks, with Two short answer questions from each unit. Remaining Five Questions (Each question covering one unit of syllabus) carrying 10 marks each shall be EITHER/OR Type descriptive questions

and may contain sub-questions.

CIVIL ENGINEERING WORKSHOP (CEW)

II Semester: CE							**Scheme: 2026**		
Course Code	**Category**	**Hours / Week**				**Credits**	**Maximum Marks**		
CE102	**PC**	**L/D**	**T**	**Pr**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		0	**0**	**0**	**2**	**1**	**30**	**70**	**100**
							End Exam Duration: 3 Hrs		

Course Outcomes: The student shall be able to

CO1: Perform setting-out of single room building.

CO2: Construct brick walls using English and Flemish bond.

CO3: Carry out plastering and finishing of wall with putty and paint.

CO4: Install plumbing fixtures.

CO5: Prepare soil cement and fly ash blocks and perform test.

List of Experiments

Part A – Regular Experiments:

1. Setting out of a building: The student should set out a building (single room only) as per the given building plan using tape and cross staff
2. Construct a wall of height 50 cm and wall thickness 1½ bricks using English bond (Nomortar required) – corner portion – length of side walls 60 cm
3. Construct a wall of height 50 cm and wall thickness 2 bricks using English bond (No mortar required) – corner portion – length of side walls 60 cm
4. Construct a wall of height 50 cm and wall thickness 2 bricks using Flemish bond (No mortar required) – corner portion – length of side walls 60 cm
5. Computation of Centre of gravity and Moment of inertia of a given rolled steel section by actual measurements
6. Installation of plumbing and fixtures like Tap, T-Joint, Elbow, Bend, Threading etc.
7. Plastering and finishing of wall
8. Application of wall putty and painting a wall
9. Application of base coat and laying of Tile flooring of one square meter
10. Preparation of soil cement blocks for masonry and testing for compressive strength
11. Casting and testing of Fly ash Blocks
12. Preparation of cover blocks for providing cover to reinforcement

Part B – AI Integration Lab Exercises:

1. CG and MOI Computation (Python / Google Colab): Input the measured dimensions of the rolled steel section from Experiment 5 (flange width, flange thickness, web depth, web thickness); Compute centroidal distances, area moments I_{xx} and I_{yy} and radius of gyration using NumPy; Compare computed values with ISMB / ISMC standard section property tables and compute percentage error.
2. Digital Floor Plan Drawing (AutoCAD Student Version / LibreCAD – free): using the building plan dimensions from Experiment 1 (setting out), draw the floor plan of the single room to scale (1:20) in AutoCAD student version or LibreCAD; add dimensions, door / window symbols, north arrow and title block; Export as PDF.

AI Integration:

AI integration adds three exercises following the workshop exercises: (i) Python computation of CG and MOI for the rolled steel section (Experiment 5) – automating the calculations using NumPy and comparing with standard IS section tables; (ii) floor plan drawing in AutoCAD student version or LibreCAD (free) using the building dimensions from Experiment 1 – introducing the industry-standard CAD environment at the firstyear level.

COMPUTATIONAL THINKING AND PROBLEM SOLVING WITH PYTHON (CTPSP)

I Semester : Common for All Branches						Scheme : 2026			
Course Code	Category	Hours / Week				Credits	Maximum Marks		
CS102	ES	L/D	T	Pr	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	0	3	30	70	100
Sessional Exam Duration: 2Hrs						End Exam Duration : 3 Hrs			

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

CO1: Apply computational thinking concepts to design algorithms, flowcharts, and basic Python programs.

CO2: Develop programs using decision-making and looping constructs to solve logical problems.

CO3: Analyze and manipulate data using strings, lists, tuples, and sets for problem solving.

CO4: Design modular programs using functions, recursion, and dictionaries to improve code reusability.

CO5: Implement file handling, exception handling, and basic object-oriented programming concepts in Python applications.

UNIT – I

Computational Thinking And Programming Basics

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.

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

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.

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

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.

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

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.

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

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.

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.

Text Books

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, 2nd Edition, O'Reilly Media.
2. Eric Matthes, Python Crash Course, 2nd Edition, No Starch Press.

Web References

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

Question Paper Pattern:

Sessional Exam :

The question paper for Sessional Examination shall be for 50 marks. The question paper shall consist of Four questions. Question No.1 contains Ten short answer questions (2 marks each) for a total of Twenty marks. Remaining Three questions shall be EIHER/OR Type descriptive questions for Ten marks each. Each of these descriptive questions may contain sub-questions.

End Examination:

The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions. Question No.1 shall contain Ten short answer questions (2 marks each) for a total of Twenty marks, with Two short answer questions from each unit. Remaining Five Questions (Each question covering one unit of syllabus) carrying 10 marks each shall be EITHER/OR Type descriptive questions and may contain sub-questions.

DATA STRUCTURES & EFFICIENT PROBLEM SOLVING (DSPS)

II Semester : Common for CSE & CSM							Scheme : 2026		
Course Code	Category	Hours / Week				Credits	Maximum Marks		
CS107	PC	L/D	T	Pr	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	0	3	30	70	100
Sessional Exam Duration: 2Hrs							End Exam Duration : 3 Hrs		

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

CO1: Apply basic data structure concepts and analyse algorithm complexity using Python.

CO2: Implement searching and sorting techniques for efficient data processing.

CO3: Develop programs using linear data structures — stacks, queues, and linked lists — in Python.

CO4: Design and implement non-linear data structures including trees and heaps using Python.

CO5: Apply graph traversal and hashing techniques to solve real-world computational problems.

UNIT – I

Introduction, Algorithm Analysis, and Linear Structures

Introduction to data structures - Abstract Data Types (ADTs); algorithm analysis — time and space complexity; Big-O, Big-Omega, Big-Theta notations.

Lists in Python - operations on lists; static vs. dynamic memory allocation.

Searching techniques - Linear Search, Binary Search, Interpolation Search — analysis and comparison.

Sorting techniques - Bubble Sort, Selection Sort, Insertion Sort — algorithms, trace, and complexity analysis.

AI Integration: Use VisuAlgo and Algorithm Visualizer to animate sorting and searching; use ChatGPT to explain Big-O complexity with concrete examples; use Python Tutor to trace memory representation of data structures.

UNIT – II

Stacks and Queues

Stacks - LIFO principle, push, pop, peek; implementation using Python lists; applications — expression evaluation (infix to postfix, postfix evaluation), parenthesis checking.

Queues - FIFO principle, enqueue, dequeue; types — Circular Queue, Priority Queue, Deque; implementation using Python lists.

Applications of queues - BFS simulation, scheduling, real-world analogies.

AI Integration: Use VisuAlgo to animate stack and queue operations; use ChatGPT to generate edge cases (overflow, underflow, circular behaviour); use GitHub Copilot to implement expression evaluation.

UNIT – III

Linked Lists

Singly Linked List - node structure, insertion at head/tail/position, deletion by value/position, traversal, reversal.

Doubly Linked List - forward and backward traversal, insertion, deletion; Circular Linked List: traversal and operations.

Applications - Implement Stack and Queue using linked structures, polynomial representation and addition, browser history simulation (doubly linked list), symbol table implementation.

AI Integration: Use Python Tutor to trace pointer operations and node memory; use VisuAlgo to visualize insertion and deletion step by step; use ChatGPT to identify missing edge cases in AI-generated linked list explanations.

UNIT – IV
Trees and Heaps ***Trees*** - terminology, properties; Binary Trees — representation, traversals (inorder, preorder, postorder, level order). ***Binary Search Trees (BST)*** - insertion, deletion, search; applications — autocomplete, range queries, dictionary lookup. ***Heaps*** - Min-Heap and Max-Heap, array representation, heapify, Build-Heap; Heap Sort — algorithm and complexity. ***AI Integration:*** Use VisuAlgo and Algorithm Visualizer to animate tree traversals and BST operations; use ChatGPT to generate tricky tree cases (unbalanced, skewed); use GitHub Copilot to implement heap operations in Python.
UNIT – V
Graphs and Hashing ***Graphs*** - terminology, types (directed, undirected, weighted); representation — adjacency matrix and adjacency list. ***Graph traversals*** - BFS (queue-based) and DFS (stack/recursion-based); applications — shortest path, cycle detection, social networks. ***Hashing*** - hash functions, properties of a good hash function; collision resolution — chaining (separate chaining), open addressing (linear probing, quadratic probing, double hashing); load factor. ***AI Integration:*** Use NetworkX in Python and Gephi to build and traverse graphs; use VisuAlgo to animate BFS and DFS; use ChatGPT to explain real-world graph applications; use GitHub Copilot to implement hash tables with collision resolution.
Text Books
1. Shriram K. Vasudevan, Abhishek S. Nagarajan, Karthick Nanmaran, Data Structures Using Python, Wiley India.
2. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures and Algorithms in Python (Indian Adaptation), Wiley India.
Reference Books
1. Brad Miller and David Ranum, Problem Solving with Algorithms and Data Structures using Python, Franklin Beedle.
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Pearson Education.
Online Resources
1. NPTEL – Data Structures and Algorithms – nptel.ac.in
2. VisuAlgo – visualgo.net
3. Python Tutor – pythontutor.com
4. NetworkX – networkx.org
5. GeeksforGeeks – geeksforgeeks.org
6. Algorithm Visualizer – algorithm-visualizer.org
Question Paper Pattern:

Sessional Exam :

The question paper for Sessional Examination shall be for 50 marks. The question paper shall consist of Four questions. Question No.1 contains Ten short answer questions (2 marks each) for a total of Twenty marks. Remaining Three questions shall be EIHER/OR Type descriptive questions for Ten marks each. Each of these descriptive questions may contain sub-questions.

End Examination:

The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions. Question No.1 shall contain Ten short answer questions (2 marks each) for a total of Twenty marks, with Two short answer questions from each unit. Remaining Five Questions (Each question covering one unit of syllabus) carrying 10 marks each shall be EITHER/OR Type descriptive questions and may contain sub-questions.

COMPUTATIONAL THINKING AND PROBLEM SOLVING LAB WITH PYTHON (CTPSPL)

I Semester: Common for All Branches						**Scheme: 2026**			
Course Code	**Category**	**Hours/Week**				**Credits**	**Maximum Marks**		
		L	**T**	**Pr**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
CS103	**ES**	0	0	0	3	1.5	**30**	**70**	**100**
							End Exam Duration: 3 Hours		

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

CO1: Apply computational thinking concepts to design algorithms, flowcharts, and Python programs.

CO2: Develop programs using decision-making and looping constructs to solve logical problems.

CO3: Analyse and manipulate data using strings, lists, tuples, and sets.

CO4: Design modular programs using functions, recursion, and dictionaries.

CO5: Implement file handling, exception handling, and basic object-oriented concepts in Python applications.

List of Experiments

1. **Problem Solving using Computational Thinking -** Select three daily-life problems; apply decomposition and abstraction; write algorithms, draw flowcharts, and convert them into pseudocode.
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
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.
4. **Decision Control Statements -** Develop Python programs for largest among three numbers, grade calculation, leap-year checking, and a menu-driven calculator.
5. **Looping and Iterative Problem Solving -** Implement programs for prime-number generation, Armstrong numbers, factorial computation, and multiplication tables.
6. **Nested Loops and Pattern Generation -** Generate number, pyramid, diamond, and character patterns.
7. **String Processing Applications -** Develop programs for string reversal, palindrome checking, frequency counting, and word-occurrence analysis.
8. **List and Nested List Operations -** Perform sorting, searching, list merging, and matrix operations using nested lists.
9. **Tuple and Set Applications -** Implement tuple packing/unpacking, student-record storage, and set union, intersection, and difference operations.
10. **User-Defined Functions -** Implement positional, keyword, default, and variable-length arguments.
11. **Recursive Problem Solving -** Develop recursive solutions for factorial, Fibonacci, GCD, and Tower of Hanoi.
12. **Dictionary and Lambda Applications -** Implement a student database, dictionary operations, dictionary sorting, and lambda-based computations.
13. **File Processing and Data Storage -** Develop programs to create and read text files, count words, and process CSV data.
14. **Exception Handling and Testing -** Implement try-except, finally, and custom exceptions; apply exception handling to division operations, file access, and input validation.
15. **Object-Oriented Programming Mini Project -** Develop a Python application using classes,

objects, constructors, and methods.

Mini Projects

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

Text Books:

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, 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.

DATA STRUCTURES & EFFICIENT PROBLEM SOLVING LAB (DSPSL)

II Semester : Common for CSE & CSM						Scheme : 2026			
Course Code	Category	Hours / Week				Credits	Maximum Marks		
CS108	PC	L/D	T	Pr	P	C	Continuous Internal Assessment	End Exam	Total
		0	0	0	2	1	30	70	100
						End Exam Duration : 3 Hrs			

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

CO1: Implement and analyze searching, sorting, and list operations; measure empirical complexity against Big-O predictions.

CO2: Implement stacks and queues using Python lists and linked structures; apply to expression evaluation, BFS, and scheduling.

CO3: Implement singly, doubly, and circular linked lists with all standard operations; apply to polynomial addition and cycle detection.

CO4: Implement binary trees, BSTs, and heaps; apply traversals, BST operations, and Heap Sort to practical problems.

CO5: Represent and traverse graphs using BFS and DFS; implement hash tables with collision resolution.

List of Experiments

1. ***List Operations***
   Implement insertion and deletion at head, tail, and a given position in a Python list.

2. ***Searching Techniques — Linear and Binary Search***
   i) Implement Linary Search.
   ii) Implement Binary Search.

3. ***Sorting Algorithms — Bubble, Selection, Insertion, and Merge Sort***
   i) Implement Bubble Sort.
   ii) Implement Selection Sort.
   iii) Implement Insertion Sort.
   iv) Implement Merge Sort.

4. ***Stack Implementation and Applications***
   i) Implement Stack and its Operations
   ii) Infix to Postfix Conversion
   iii) Postfix Evaluation

5. ***Queue, Circular Queue, Priority Queue, Deque and Applications***
   i) Implement Queue and its Operations
   ii) Implement Circular Queue and its Operations
   iii) Implement Priority Queue and its Operations
   iv) Implement Deque and its Operations
   v) Implement Palindrome Checker using Deque.

6. ***Singly Linked List, Doubly Linked List and Circular Linked List and Applications***
   i) Implement Singly Linked List and perform all operations
   ii) Implement Doubly Linked List and perform all operations
   iii) Implement Circular Linked List and perform all operations
   iv) Implement Polynomial Addition

7. ***Binary Tree — Traversals***
   Implement a Binary Tree with insert (level-order) and the four traversals: Inorder, Preorder, Postorder, Level-Order

8. ***Binary Search Tree — Insert, Delete, Search***
   Implement a Binary Search Tree and perform insert, delete, search and traversal operations.

9. Heap — Build, Insert, Delete, and Heap Sort

i) Implement a Min-Heap and Max-Heap

ii) Implement Heap Sort using Max-Heap

10. Graph Representation

Implement a Graph using both Adjacency Matrix and Adjacency List representations.

11. Hashing — Implementation and Collision Resolution

i) Implement a Hash Table class with: hash_function(key) using the division method (h(k) = k%table_size, table_size=11), insert(key, value), search(key), delete(key), display operations.

ii) Implement collision resolution strategies: Chaining — each slot is a linked list of (key, value) pairs

AI Tools Integration (Lab): VisuAlgo (visualgo.net) for animated visualization of all data structures. Python Tutor (pythontutor.com) for step-by-step pointer and memory tracing. Algorithm Visualizer (algorithm-visualizer.org) for sorting and searching animations. NetworkX + Matplotlib for graph construction and traversal visualization. Gephi for large graph visualization. ChatGPT / Claude for test case generation, complexity explanation, and code review. Jupyter Notebook / Thonny IDE for development and debugging.

List of Additional Experiments

1. Measure actual execution time for Linear Search and Binary Search on lists of sizes [100, 1000, 10000, 100000] using the time module. Plot time vs. input size using Matplotlib. Trace manual Big-O derivation for each.
2. Implement Interpolation Search.
3. Implement Balanced Parentheses Checker using a stack.
4. Implement BFS simulation on a small graph (6 nodes) using a queue; print the traversal order.
5. Implement to merge two sorted Linked Lists: implement merge_sorted(l1, l2) without using extra space (in-place merge using pointer manipulation).
6. Implement Autocomplete System: insert 10 words; implement starts_with(prefix) that returns all words with the given prefix using BST traversal.
7. Implement BFS using a queue and DFS using recursion.
8. Implement Shortest Path using BFS
9. Implement Cycle Detection: implement cycle detection for both directed (using DFS with recursion stack) and undirected (using Union-Find) graphs; test on 3 graphs — with cycle, without cycle, and a tree.
10. Implement collision resolution strategies: Open Addressing with Linear Probing

Text Books

1. Shriram K. Vasudevan, Abhishek S. Nagarajan, Karthick Nanmaran, Data Structures Using Python, Cambridge University Press.
2. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures and Algorithms in Python, Wiley.

Reference Books

1. Brad Miller and David Ranum, Problem Solving with Algorithms and Data Structures Using Python. (Free at runestone.academy)
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Pearson Education.

Online Resources

1. NPTEL – Data Structures and Algorithms – nptel.ac.in

2. VisuAlgo – visualgo.net
3. Python Tutor – pythontutor.com
4. NetworkX – networkx.org
5. GeeksforGeeks – geeksforgeeks.org
6. Algorithm Visualizer – algorithm-visualizer.org

I/II Semester : Common for all Branches						Scheme : 2026			
Course Code	Category	Hours / Week				Credits	Maximum Marks		
CS106	ES	L/D	T	Pr	P	C	Continuous Internal Assessment	End Exam	Total
		2	0	0	0	0	--	--	--
Sessional Exam Duration: --						End Exam Duration : --			

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

CO1: Understand the evolution of cyberspace and the growing importance of cyber security in modern engineering systems.

CO2: Classify various cyber threats and malware types based on their characteristics.

CO3: Apply secure password management, authentication, and safe browsing practices to protect data across devices and networks.

CO4: Demonstrate awareness of cyber ethics, privacy protection, and cyber laws.

CO5: Apply cyber hygiene best practices for secure use of email, digital payments, and social media.

UNIT – I

Introduction to Cyberspace and Cyber security

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, Cyber threat actors.

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

Cyber threats and vulnerabilities, Cybercrime and cyber offenders. Malware: Virus, Worm, Trojan, Spyware, Ransom ware. Cyber attack lifecycle and common attack methods. Phishing, Smishing and Vishing. Social engineering attacks, Password attacks and Credential theft, Identity theft and financial fraud, Insider threats.

AI Integration

Analysis of deep fake 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 Cyber security Technologies

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.

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

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. Cybercrime reporting mechanisms and grievance redressal.

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

Cyber security risk awareness. Secure use of email, web, cloud and public networks. Safe digital transactions and digital payment awareness, Secure use of social media and AI tools, 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.

Text Books

1. Singh, A. (n. d.). Introduction to Cyber Security: Concepts, Principles, Technologies and Practices.Universities Press / Orient Black Swan.
2. Godbole, N., & Belapure, S. (n. d.). Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives. Wiley India.

Reference Books

1. Brooks, C. J., Grow, C., Craig, P., & Short, D. (n. d.). Cybersecurity Essentials. Wiley.
2. Stallings, W., & Brown, L. (n. d.). Computer Security: Principles and Practice. Pearson.
3. Whitman, M. E., & Mattord, H. J. (n. d.). Principles of Information Security. Cengage Learning.
4. Kizza, J. M. (n. d.). Guide to Computer Network Security. Springer.
5. Cole, E. (n. d.). Cybersecurity for Beginners. Wiley.

Online Resources

1. National Cyber Security Awareness Portal (India)
2. CERT-In (Indian Computer Emergency Response Team)
3. National Cyber Crime Reporting Portal
4. NIST Cybersecurity Framework Resources
5. OWASP Foundation
6. Cisco Networking Academy – Introduction to Cybersecurity

I Semester : Common to all branches						Scheme : 2026			
Course Code	Category	Hours / Week				Credits	Maximum Marks		
CS101	ES	L/D	T	Pr	P	C	Continuous Internal Assessment	End Exam	Total
		1	0	4	0	3	30	70	100
							End Exam Duration : 2 Hrs		

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

CO1: Describe the fundamentals of AI, ML, and Generative AI, and use AI tools to create documents and presentations.

CO2: Utilize AI-based tools for research, note-taking, and spreadsheet data analysis to solve academic tasks.

CO3: Use AI tools to generate and evaluate visual content such as images, diagrams, and media.

CO4: Examine AI tools in visual design, diagrams, media and verify AI applications relevant to their own engineering discipline.

CO5: Develop an AI-assisted mini-project while demonstrating responsible and ethical AI usage.

UNIT - I

Understanding AI And AI For Documents And Presentations

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.app — full slide deck from a paragraph prompt; Canva AI — Magic Design, text-to-presentation, brand kits.

AI for document writing: Microsoft Copilot in Word — draft, rewrite, summarize; 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 — identifying AI-generated content using GPTZero.

AI Integration: Use Gamma.app to generate a presentation on an engineering topic in under 2 minutes; use Copilot in Word 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 - II

AI For Research, Note-Taking, Data, And Spreadsheets

Notebook LM (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), Elicit (academic paper search with evidence summaries).

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 — uploading CSV files, computing statistics, generating charts, interpreting patterns — no coding required.

AI Integration: Upload your own lecture notes to Notebook LM and generate a study guide and audio overview; use Perplexity AI to research a topic; use Wolfram Alpha to solve and verify equations from your current semester subjects; use Copilot in Excel or ChatGPT ADA to analyse a real dataset.

UNIT - III

AI For Visual Design, Diagrams, And Media

AI for image generation: DALL-E 3 (via ChatGPT), Canva AI (text-to-image, Magic Design, background remover), iterative prompt refinement for posters and diagrams.

AI for diagrams and visual thinking: Napkin.ai — converting text or concepts into visual diagrams, charts, and infographics automatically.

AI for audio and video: ElevenLabs— text-to-speech and voice cloning for presentations and voiceovers; Suno — AI music generation for project videos; Runway — generating short video clips from text prompts;

AI content detection and critical evaluation: GPTZero 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 Integration:Use Napkin.ai to convert a paragraph of text into a diagram; 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 - IV

AI Across Engineering Disciplines

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 cyber security — anomaly detection and intrusion detection; no-code/low-code platforms (Bubble, Glide, Webflow AI); AI for data science (Jupyter AI, DataRobot).

AI 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 - V

Responsible AI, Ethics, And Capstone Project

AI bias and fairness: sources of bias (data, model, deployment); real documented cases — Amazon hiring algorithm (2018), 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: 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 Integration: Read and compare data retention policies of ChatGPT, Claude, and Gemini; classify 5 daily-use AI systems using India's NITI Aayog; use GPTZero and Google Lens to detect AI-generated content; design and present the Capstone Mini-Project integrating tools from all five units.

Reference Books

1. Ethan Mollick, Co-Intelligence: Living and Working with AI, Portfolio/Penguin, 2024.
2. Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson Education, 2020.
3. Reid Blackman, Ethical Machines, Harvard Business Review Press, 2022.
4. Google – Fundamentals of AI – grow.google/intl/en_in/ai-learning-resources
5. Microsoft – AI Skills Navigator – microsoft.com/en-us/ai/ai-skills

Online Resources

1. https://www.youtube.com/@JoyofLearningCSE/featured
2. NITI Aayog – niti.gov.in

NSS/NCC/SCOUTS & GUIDES / COMMUNITY SERVICE

I / II Semester : Common to All Branches							Scheme:2026		
Course Code	Category	Hours/Week				Credits	Maximum Marks		
BS123	BS	L/D	T	Pr	P	C	Continuous Internal Assessment	End Exam	TOTAL
		0	0	0	1	0.5			100

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

CO1: Understand the philosophy, history, and objectives of NSS/NCC/Scouts & Guides and community service programmes.

CO2: Demonstrate leadership, teamwork, and organizational skills through camp/parade/drill activities.

CO3: Plan and execute 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: Develop civic sense, national integration, and sustainable community-development values.

UNIT 1

Foundation of NSS, NCC, Scouts & Guides and Community Service

- 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 2

Leadership, Skill Development, Camping and Disaster Management

- 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 3

Community Projects, Social Awareness and Service Documentation

- 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

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.

Text Books:

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:

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
- India Volunteers – 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

EVALUATION PROCEDURE:

I / II Semester : Common to All Branches							Scheme:2026		
Course Code	Category	Hours/Week				Credits	Maximum Marks		
BS124	BS	L/D	T	Pr	P	C	Continuous Internal Assessment	End Exam	TOTAL
		0	0	0	1	0.5			100

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

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

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

CO3: Design 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.

UNIT 1

Health, Wellness and Preventive Healthcare

- 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 2

Yoga, Pranayama, Meditation and Mind-Body Practice

- 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, Mudra and Bhanda
- Yoga Nidra for sleep and stress relief
- Yoga for specific conditions – stress, back pain, PCOD/PCOS, anxiety
- Shatkarmas and kriya (cleansing processes) – an overview; International Day of Yoga

UNIT 3

Physical Fitness, Sports Skills and Sports Technology

- 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

Text Books:

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:

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, 20111

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
- 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

COMMUNICATIVE ENGLISH (CE)

I / II Semester : Common for all Branches							Scheme : 2026		
Course Code	Category	Hours / Week				Credits	Maximum Marks		
		L/D	T	Pr	P	C	Continuous Internal Assessment	End Exam	Total
HU101	HM	2	0	0	0	2	30	70	100
Sessional Exam Duration: 2 Hrs							End Exam Duration : 3 Hrs		

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

CO1: Identify the fundamentals of communication, grammatical structures, and AI-assisted language tools used for effective oral and written communication.

CO2: Demonstrate effective speaking, active listening, group discussion, presentation, and debate skills using AI-assisted communication tools.

CO3: Interpret written texts using appropriate reading strategies, vocabulary, writing techniques, and AI-assisted tools to develop effective written communication.

CO4: Develop professional documents, including emails, letters, reports, summaries, resumes, and digital profiles, using AI-assisted writing tools.

CO5: Evaluate the applications, limitations, and ethical implications of AI-assisted communication tools for effective and responsible global communication.

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 chatbots 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)

Text Books

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, 3rd 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

1. British Council – Learn English – https://learnenglish.britishcouncil.org

2. NPTEL – Communication Skills – https://nptel.ac.in/courses/109104101
3. Purdue OWL (Online Writing Lab) – https://owl.purdue.edu
4. BBC Learning English – https://www.bbc.co.uk/learningenglish

Question Paper Pattern:

Sessional Exam :

The question paper for Sessional Examination shall be for 50 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 contains Ten short answer questions (2 marks each) for a total of Twenty marks. Remaining Three questions shall be EIHER/OR Type descriptive questions for Ten marks each. Each of these descriptive questions may contain sub-questions.

End Examination:

The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten short answer questions (2 marks each) for a total of Twenty marks, with Two short answer questions from each unit. Remaining Five Questions (Each question covering one unit of syllabus) carrying 10 marks each shall be EITHER/OR Type descriptive questions and may contain sub-questions.

COMMUNICATIVE ENGLISH LAB (CEL)

I / II Semester : Common for all Branches							Scheme : 2026		
Course Code	Category	Hours / Week				Credits	Maximum Marks		
		L/D	T	Pr	P	C	Continuous Internal Assessment	End Exam	Total
HU102	HM	0	0	0	2	1	30	70	100
							End Exam Duration : 2 Hrs		

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

CO1: Pronounce English words using standard phonemic symbols and demonstrate intelligible speech with appropriate fluency and pronunciation.

CO2: Interpret spoken English through active listening and respond appropriately in formal and informal communication contexts.

CO3: Participate effectively in group discussions, presentations, and debates by demonstrating logical reasoning and communication skills.

CO4: Compose grammatically accurate and contextually appropriate professional documents, including emails, reports, and resumes.

CO5: Utilize AI-powered tools to enhance language learning, self-evaluation, and continuous improvement of English communication skills.

List of Experiments

1. Phonetics & Pronunciation Practice
Lab Activities: Record & playback; vowel/consonant articulation; IPA chart drill; minimal pair exercises.
AI Activity: Use AI speech-to-text to detect mispronunciations; real-time phoneme feedback via ELSA Speak
AI Tools: ELSA Speak, Google Speech Recognition, Speechling.

2. Listening Comprehension & Note-Taking
Lab Activities: Listen to TED Talks/podcasts; fill-in-the-blank exercises; summarize audio passages.
AI Activity: Auto-generate transcripts and compare student notes with AI-generated summaries using Otter.ai
AI Tools: Otter.ai, YouTube Auto Captions, Whisper AI.

3. Spoken English & Fluency Building
Lab Activities: Impromptu speaking (1–2 minutes); picture description; story completion tasks.
AI Activity: AI analyses speech of filler words, pace, and clarity; ChatGPT prompts for spontaneous speaking.
AI Tools: Speeko, ChatGPT, Google Assistant.

4. Group Discussion Techniques
Lab Activities: Role-based GD on current topics; turn-taking practice; consensus building.
AI Activity: AI evaluates of argument structure and language; ChatGPT generates counterarguments for practice.
AI Tools: ChatGPT, Gemini, Mentimeter.

5. Public Speaking & Presentations
Lab Activities: Prepare and deliver 3-minute presentations; use of visual aids; Q&A handling.
AI Activity: AI slide deck generation and real-time delivery feedback on pacing and confidence.
AI Tools: Beautiful.ai, Gamma.app, Microsoft Copilot.

6. Interview Skills & Mock Interviews
Lab Activities: HR interview simulation; STAR method answers; body language and eye contact.
AI Activity: AI-powered mock interviews with instant feedback on content, grammar, and tone.
AI Tools: Yoodli, Interview Warmup by Google, ChatGPT.

7. Professional Email & Business Writing
Lab Activities: Draft formal emails, complaints, and requests; subject line writing; netiquette.
AI Activity: AI refinement of email drafts; tone and clarity checking; compare student draft with AI-improved versions.
AI Tools: Grammarly, ChatGPT, Gemini.

8. Resume & Cover Letter Writing
Lab Activities: ATS-friendly resumes design; action verb usage; tailoring cover letters to job descriptions.
AI Activity: Resume scanning, keyword optimization, AI-generated cover letters, and critique.
AI Tools: Kickresume, Resume.io, Jobscan, ChatGPT.

9. Reading Comprehension & Critical Thinking
Lab Activities: Read articles/editorials; identify main ideas, inference, and tone; speed-reading drills.
AI Activity: AI-generated comprehension questions, text summarization, and comparative analysis.
AI Tools: QuillBot, Speechify, NotebookLM.

10. Debate & Argumentation Skills
Lab Activities: Structured debates (for/against); rebuttal techniques; logical fallacy identification.
AI Activity: AI-generated arguments on both sides and evaluation of logical structure.
AI Tools: ChatGPT, Claude.ai, Kialo Edu.

11. Report Writing & Technical Communication
Lab Activities: Prepare laboratory, incident, and project reports; headings and data presentation.
AI Activity: AI-assisted improvement of report coherence, grammar, and voice.
AI Tools: Grammarly Business, ChatGPT, Hemingway Editor.

12. Etiquette, Netiquette & Personal Branding
Lab Activities: Workplace conversation role play; LinkedIn profile creation; professional social media etiquette.
AI Activity: AI review of LinkedIn summaries, digital persona analysis, and personal brand statement generation.
AI Tools: ChatGPT, Canva AI, LinkedIn AI Features.

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.

Reference Books

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

1. BBC Learning English – https://www.bbc.co.uk/learningenglish (Grammar, pronunciation, and listening)
2. British Council Learn English – https://learnenglish.britishcouncil.org
3. TED Talks – https://www.ted.com/talks (Listening & speaking practice)

4. Coursera English Communication Skills Specialisation – https://www.coursera.org
5. edX English for Professional and Academic Purposes – https://www.edx.org
6. Grammarly Blog – https://www.grammarly.com/blog (Writing tips)
7. ELSA Speak (App) – https://elsaspeak.com (AI pronunciation coach)
YouTube Channels
1. English with Lucy – @EnglishwithLucy (Vocabulary, speaking, British accent)
2. Learn English with TV Series – @LearnEnglishWithTVSeries
3. Rachel's English – @rachelsenglish (American accent and pronunciation)
4. TED-Ed – @TEDEd (Critical thinking and communication ideas)
5. Spoken English Hub – @SpokenEnglishHub (Indian context, interview prep)
6. JenniferESL – @JenniferESL (Grammar and business English)

DESIGN THINKING (DT)

I/II Semester: Common to all branches							Scheme: 2026		
Course Code	Category	Hours/Week				Credits	Maximum Marks		
		L	T	Pr	P	C	Continuous Internal Assessment	End Exam	Total
ES101	ES	1	0	4	0	3	30	70	100
Sessional Exam Duration: 2 Hrs							End Exam Duration: 3 Hrs		

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

CO1: Recall and understand the philosophy, principles, and stages of the Design Thinking process and its relevance to human-centred problem solving..

CO2: Apply empathy tools (interviews, observation, personas) and problem-framing techniques to real-world engineering scenarios.

CO3: Analyse user needs and problem statements using the 'How Might We' framework and insight generation tools.

CO4: Evaluate and select the most viable prototype solution through structured testing, user feedback.

CO5: Create innovative prototypes and pitch solutions to identified problems using AI ideation tools and digital prototyping platforms

UNIT – I

Introduction to Design Thinking

Core Concepts

- 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)
- Introduction to Artificial Intelligence in Design Thinking.

Activities

1. Design Challenge (Team-based Innovation Exercise) with possible usage of AI
2. Case Study Analysis

UNIT – II

Empathise and Define Stages

Core Concepts:

- 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-assisted User Insight Generation.

Activities

1. AI application in User Interview and Empathy Mapping
2. AI application in Persona Development and Problem Definition

UNIT – III

Ideation Stage

Core Concepts:

- Creative Thinking Techniques: Brainstorming, 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-assisted Ideation Tools.

Activities (Search for relevant AI tools)

1. Brainstorming and Idea Prioritization
2. AI-assisted Idea Generation

UNIT – IV

Prototyping

Core Concepts:

- Principles of Prototyping: Low-fidelity vs. High-fidelity prototypes
- Paper Prototyping: Sketching UI and physical models
- Digital Wire framing: Introduction to wireframes and mock-ups
- 3D Prototyping Concepts: Introduction to 3D printing and rapid prototyping

Activities (Search for relevant AI tools)

1. Paper/Physical Prototype Development
2. Digital Prototype Development

UNIT – V

Testing, Iteration and AI in Design

Core Concepts:

- 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: Introduction to AI-assisted design

Activities

1. User Testing and Prototype Refinement
2. Final Design Pitch and Prototype Demonstration

Text Books

1. Brown, Tim. (2019). Change by Design: How Design Thinking Transforms

Organizations and Inspires Innovation. Harper Business, 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

Question Paper Pattern:

Sessional Exam :

The question paper for Sessional Examination shall be for 50 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 contains Ten short answer questions (2 marks each) for a total of Twenty marks. Remaining Three questions shall be EIHER/OR Type descriptive questions for Ten marks each. Each of these descriptive questions may contain sub-questions.

End Examination:

The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten short answer questions (2 marks each) for a total of Twenty marks, with Two short answer questions from each unit. Remaining Five Questions (Each question covering one unit of syllabus) carrying 10 marks each shall be EITHER/OR Type descriptive questions and may contain sub-questions.

NETWORK ANALYSIS (NA)

II Semester : ECE							Scheme : 2026		
Course Code	Category	Hours / Week				Credits	Maximum Marks		
		L/D	T	Pr	P	C	Continuous Internal Assessment	End Exam	Total
EE102	PC	2	0	2	0	3	30	70	100
Sessional Exam Duration: 2Hrs							End Exam Duration : 3 Hrs		

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

CO1: Apply circuit analysis techniques and theorems to find the parameters

CO2: Determine the transient response of R-L-C circuits using differential equation & Laplace transform

CO3: Analyze the steady-state response of single-phase R-L-C circuits

CO4: Understand the concepts of resonance and coupled circuits

CO5: Determine the network parameters of two port networks

UNIT - I

Fundamentals of Network Analysis and Network Theorems

DC circuits: Types of circuit components, Kirchoff's laws, Network reduction techniques - series- parallel, star-to-delta and delta-to-star transformation, source transformation technique, mesh analysis and node analysis to DC networks with dependent and independent sources, super mesh and super node analysis, Principle of duality with examples.

Network Theorems-Thevenin's, Norton's, Reciprocity, Superposition, and Maximum Power Transfer theorems — problem solving using dependent sources.

AI Integration:

Use AI/LLM tools to explain mesh and nodal analysis with step-by-step worked examples; solve resistive circuits using KVL/KCL and prints branch currents; prepare a mesh vs. nodal comparison table and validate it using AI tools.

Free/Open-Source AI Tools:

Python (NumPy, SymPy) on Google Colab; Part Sim, Falstad Circuit Simulator; ChatGPT / Gemini; NPTEL Network Analysis lectures.

UNIT - II

Transients & Laplace Transform

Transients:

First-order differential equations, definition of time constants, R-L circuit and R-C circuit with DC excitation, evaluating initial conditions procedure. Second-order differential equations — homogeneous and non-homogeneous — problem solving using R-L-C elements with DC and AC excitation.

Laplace transform: introduction, basic theorems, problem solving using Laplace transform, and partial fraction expansion.

AI Integration:

Use AI/LLM tools to explain the time constant of RL/RC circuits and sketch voltage/current evolution; plot step responses and shows how τ shifts with component values; demonstrate partial fraction expansion and Laplace-based RLC solutions, check answers against initial and final conditions.

Free/Open-Source AI Tools:

Python (NumPy, SciPy, Matplotlib) on Google Colab; Scilab; Falstad Circuit Simulator; ChatGPT / Gemini; NPTEL video lectures.

UNIT - III

Steady State Analysis of AC Circuits

Impedance concept, phase angle, series R-L, R-C, and R-L-C circuits — problem solving. Complex impedance and phasor notation for R-L, R-C, and R-L-C circuits — problem solving using mesh and nodal analysis. Star-Delta conversion.

AI Integration:

Use AI/LLM tools to explain impedance, admittance, and phasor notation; solve a series R-L-C circuit for Z, I, and phase angle. plot impedance vs. frequency to identify resonant frequency; demonstrate Star-Delta conversion and compare series vs. parallel R-L-C behavior.

Free/Open-Source AI Tools:

Python (NumPy, Matplotlib) on Google Colab; Falstad Circuit Simulator; AC phasor calculators online; ChatGPT / Gemini; NPTEL AC circuits lectures.

UNIT - IV

Resonance & Coupled Circuits

Resonance: Introduction, definition of Q-factor, series resonance, bandwidth of series resonance, parallel resonance,

Coupled Circuits: self-inductance, mutual inductance, coefficient of coupling, analysis of coupled circuits, natural current, dot rule of coupled circuits — problem solving.

AI Integration:

Use AI/LLM tools to explain resonant frequency, Q-factor, and bandwidth; verify f_0 and Q and confirm bandwidth = f_0/Q, plot the frequency response; mark the −3 dB points, read bandwidth, and compare with analytical results; apply the dot rule to a coupled circuit for polarity verification.

Free/Open-Source AI Tools:

Python (NumPy, SciPy, Matplotlib) on Google Colab; Falstad Circuit Simulator; ChatGPT / Gemini; NPTEL resonance and coupled circuits lectures.

UNIT - V

Two-Port Networks

Z-parameters, Y-parameters, Transmission (ABCD) parameters, h-parameters, relationships between parameter sets. Series and parallel connection of two-port networks, cascading of two-port networks — problem solving. Insertion loss, attenuators and pads, impedance matching networks.

AI Integration:

Use AI/LLM tools to explain Z, Y, h, and ABCD parameters and demonstrate Z-to-Y conversion via matrix inversion; compute and validate Z/Y parameters; explain ABCD cascading and verify output voltage for two cascaded T-networks with a given load.

Free/Open-Source AI Tools:

Python (NumPy) on Google Colab; two-port network calculators online; ChatGPT / Gemini; NPTEL two-port network lectures; Scilab.

Text Books

1. Van Valkenburg M.E., Network Analysis, Revised 3rd Edition, Prentice Hall of India, 2019.
2. Hayt W.H., Kemmerly J. and Durbin S.M., Engineering Circuit Analysis, 9th Edition, McGraw-Hill, 2020.
3. Textbook of Engineering Mechanics, S.S. Bhavikatti, New Age International Publications, 2018. 4th Edition.

Reference Books

1. Sivanaga Raju, G. Kishor and C. Srinivasa Rao, Electrical Circuit Analysis, Cengage Learning India Publishers, Delhi
2. Roy Choudhury D., Networks and Systems, New Age International Publications, 2013.

3. Edminister J. and Nahvi M., Electric Circuits, Schaum's Outline Series, 7th Edition, Tata McGraw Hill, 2017.
4. Ryder J.D., Network Lines and Fields, 2nd Edition, PHI.
5. Alexander C.K. and Sadiku M.N.O., Fundamentals of Electric Circuits, McGraw-Hill Education.

Question Paper Pattern:

Sessional Exam :

The question paper for Sessional Examination shall be for 50 marks. The question paper shall consist of Four questions. Question No.1 contains Ten short answer questions (2 marks each) for a total of Twenty marks. Remaining Three questions shall be EIHER/OR Type descriptive questions for Ten marks each. Each of these descriptive questions may contain sub-questions.

End Examination:

The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions. Question No.1 shall contain Ten short answer questions (2 marks each) for a total of Twenty marks, with Two short answer questions from each unit. Remaining Five Questions (Each question covering one unit of syllabus) carrying 10 marks each shall be EITHER/OR Type descriptive questions and may contain sub-questions.

ELECTROMAGNETIC FIELDS (EMF)

II Semester: EEE						Scheme: 2026			
Course Code	Category	Hours / Week				Credits	Maximum Marks		
		L/D	T	Pr	P	C	Continuous Internal Assessment	End Exam	Total
EE104	PC	3	0	0	0	3	30	70	100
Sessional Exam Duration: 2Hrs						End Exam Duration: 3 Hrs			

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

CO1: Apply the principles of electrostatics for electromagnetic field problems.

CO2: Analyze the behavior of conductors and dielectrics in electric fields, various capacitances.

CO3: Apply the principles of magnetostatics for electrical engineering systems.

CO4: Apply the principles of magnetic forces, self and mutual inductance in electromagnetic systems and their applications in electrical devices.

CO5: Analyze time varying electromagnetic fields and Maxwell's equations using modern computational and AI tools.

UNIT - I

Electrostatics: Coulomb's law and Electric field intensity (EFI) – EFI due to Continuous charge distributions (line and surface charge)- Electric flux density- Gauss's law (Maxwell's first equation, $\nabla . D = \rho_v$)- Electric Potential- Work done in moving a point charge in an electrostatic field (second Maxwell's equation for static electric fields, $\nabla X E = 0$)- Potential gradient- Laplace's and Poison's equations.

AI Integration: AI-based vector field visualization. Neural networks for electric field prediction. Machine learning models for electrostatic potential estimation. AI-assisted numerical solution of Laplace and Poisson equations.

Free/Open-Source AI Tools: Python (NumPy, SciPy, SymPy); TensorFlow / PyTorch; Jupyter Notebook; GNU Octave.

UNIT - II

Conductors, Dielectrics and Capacitance: Electric dipole and dipole moment – Potential and EFI due to an electric dipole- Torque on an Electric dipole placed in an electric field; Behavior of conductors in an electric field- Polarization- dielectric constant and strength- Current density- conduction and convection current densities- Ohm's law in point form- Continuity equation; Boundary conditions- Capacitance of parallel plate, coaxial capacitors- Energy stored and density in a static electric field.

AI Integration: AI prediction of dielectric properties. Machine learning optimization of capacitor geometry. AI modeling of energy storage behavior. Data-driven analysis of electric field distribution in dielectric materials.

Free/Open-Source AI Tools: Scikit-Learn; FEniCS (Finite Element simulation); OpenModelica; ParaView.

UNIT - III

Magnetic Circuits, Magnetostatics and Magnetic Forces: Basic definition of MMF- flux and reluctance- analogy between electrical and magnetic circuits. Biot-Savart's law and its applications viz. Straight current carrying filament, circular, and solenoid current carrying wire – Magnetic flux density and Maxwell's second Equation ($\nabla . B = 0$); Ampere's circuital law and its applications viz. MFI due to an infinite sheet, long filament, solenoid, toroidal current carrying conductor- point form of Ampere's circuital law- Maxwell's third equation ($\nabla X H = J$).

AI Integration: Neural networks for magnetic flux density prediction. Machine learning models for magnetic field estimation. Intelligent simulation of magnetic forces.

Free/Open-Source AI Tools: Elmer FEM; OpenEMS; Python (SciPy); PyTorch.

UNIT - IV

Magnetic Forces, Self and Mutual Inductance: Magnetic force, moving charges in a magnetic field – Lorentz force equation- force on a straight and a long current carrying conductor in a magnetic field- force between two straight long and parallel current carrying conductors- Magnetic dipole- Magnetic torque and moment.Concept of self and mutual inductance; Dot convention – coefficient of coupling. Determination of self-inductance of a solenoid, toroid, coaxial cable and mutual inductance between a straight long wire and a square loop wire in the same plane – Energy stored and energy density in a magnetic field.

AI Integration: Machine learning prediction of inductance values. Neural networks for magnetic energy storage estimation. Data-driven modeling of mutual inductance.

Free/Open-Source AI Tools: Python (SciPy); FEniCS; OpenEMS; Jupyter Notebook.

UNIT - V

Time Varying Fields: Faraday's laws of electromagnetic induction- Maxwell's fourth equation ($\nabla \times E = -\partial B/\partial t$)- integral and point forms of Maxwell's equations- Statically and Dynamically induced EMF- Displacement current- Modification of Maxwell's equations for time varying fields.

AI Integration: Physics-Informed Neural Networks (PINNs) for solving Maxwell equations. Deep learning models for electromagnetic wave propagation. AI-based EM interference prediction. Intelligent analysis of power flow using Poynting vector.

Free/Open-Source AI Tools: DeepXDE (PINNs); Meep electromagnetic simulator; TensorFlow; OpenEMS.

Text Books

1. Elements of Electromagnetics by Matthew N O Sadiku, Oxford Publications, 7th Edition, 2018.
2. Engineering Electromagnetics by William H. Hayt& John A. Buck, Mc. Graw-Hill, 7th Edition, 2006.

Reference Books

1. Introduction to Electro Dynamics by D J Griffiths, Prentice-Hall of India Pvt. Ltd, 2nd Edition.
2. Electromagnetic Field Theory by K.A. Gangadhar and P.M. Ramanathan, Khanna Publishers, 16th Edition, 2015.
3. Electromagnetic Field Theory by Yaduvir Singh, Pearson India, 1st Edition, 2011.
4. Fundamentals of Engineering Electromagnetics by Sunil Bhooshan, Oxford University Press, 2012.
5. Schaum's Outline of Electromagnetics by Joseph A. Edminister, Mahamood Navi, 4th Edition, 2014.

Web Resources & NPTEL Links

1. NPTEL: Electromagnetic Field Theory: https://nptel.ac.in/courses/108106073
2. MIT OpenCourseWare – Electromagnetics and Applications: https://ocw.mit.edu/courses/6-013-electromagnetics-and-applications/
3. MIT Computational Electromagnetics: https://ocw.mit.edu/courses/computational-electromagnetics/
4. Physics Informed Neural Networks: https://maziarraissi.github.io/PINNs/
5. Python Scientific Computing: https://scipy.org

Recommended Free & Open-Source AI/Computational Tools

1. Python (NumPy, SciPy, SymPy) – free on Jupyter Notebook / Google Colab for vector field and electrostatic computation
2. TensorFlow / PyTorch (free, open-source) – for AI/ML based field prediction and PINN modelling
3. Scikit-Learn (free, open-source) – for regression and optimization of dielectric and capacitor properties
4. FEniCS (free, open-source) – FEM-based electrostatic and magnetostatic simulation
5. OpenModelica (free, open-source) – for system-level electromagnetic modelling
6. ParaView (free, open-source) – for visualization of field simulation results
7. Python (NumPy, SciPy, SymPy) – free on Jupyter Notebook / Google Colab for vector field and electrostatic computation

Question Paper Pattern:

Sessional Exam :

The question paper for Sessional Examination shall be for 50 marks. The question paper shall consist of Four questions. Question No.1 contains Ten short answer questions (2 marks each) for a total of Twenty marks. Remaining Three questions shall be EIHER/OR Type descriptive questions for Ten marks each. Each of these descriptive questions may contain sub-questions.

End Examination:

The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions. Question No.1 shall contain Ten short answer questions (2 marks each) for a total of Twenty marks, with Two short answer questions from each unit. Remaining Five Questions (Each question covering one unit of syllabus) carrying 10 marks each shall be EITHER/OR Type descriptive questions and may contain sub-questions.

ELECTRONICS AND ELECTRICAL ENGINEERING WORKSHOP (EEEW)

I Semester : ECE							Scheme : 2026		
Course Code	Category	Hours / Week				Credits	Maximum Marks		
		L/D	T	P_r	P	C	Continuous Internal Assessment	End Exam	Total
EE101	PC	0	0	0	3	1.5	30	70	100
End Exam Duration : 3 Hrs									

PART A: ELECTRONICS ENGINEERING LAB

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

CO1: Demonstrate the safe handling and use of electronic workshop tools, instruments, and basic electronic component

CO2: Perform basic electrical and electronic measurements and verify experimental results with theoretical values.

CO3: Assemble, test, and analyze simple DC and AC electronic circuits using a PCB.

Activities

1. Familiarization of commonly used workshop tools like breadboard, soldering iron, relays, switches, connectors, fuses, cutters, pliers, wire stripper, etc.; exercises for proper handling and usage.
2. Familiarization with voltmeters, ammeters, multi-meter, LCR meter, power supplies, CRO/DSO, function generator, and frequency counter; perform basic measurement experiments.
3. Identification of components (R, L, C, diodes, transistors, ICs) — type, symbol, colour coding, and package; testing and comparison of theoretical vs. measured values.
4. Assemble any two circuits — one with a DC source and one with an AC source — on a bread board and test their functionality; observe and record output waveforms or measured parameters.

List of Experiments

1. Circuit connections on breadboard, Familiarization workshop tools on soldering iron, relays, switches, connectors, fuses, cutters, pliers, wire stripper, etc.
2. Generate the Signal and measure the Amplitude, frequency and Phase using CRO.
3. Colour Coding of (R, L, C, Components) and Identification Diode , Transistor & ICs
4. Construct AC & DC Circuit and generate output waveforms.

AI Integration Lab Exercises

Note : At least 3 of the following activities are to be performed

1. a) Use AI/LLM tools to query tool datasheets and manufacturer specifications; generate an interactive Q&A to identify tool functions, correct handling postures, and safety hazards for each workshop tool.
   b) Use LLM-generated safety checklists to create a Python-based scoring tool that evaluates a student's handling procedure against a standard rubric.
2. a) Use AI/LLM tools to explain the operating procedures of each instrument (CRO/DSO, LCR meter, function generator) and to interpret measurement results — including scale reading, range selection, and source of error.
   b) Use Python (NumPy/Matplotlib) to plot measured voltage and current data; apply linear regression to verify Ohm's Law and estimate percentage error from ideal values.
3. a) Use AI/LLM tools for AI-assisted component identification — describe a component by its markings or package and receive datasheet summary, pin-out, and typical application;

understand colour-code decoding for resistors and capacitors.

b)Use Python (Scikit-learn) regression to estimate device parameters (static resistance, capacitance, inductance) from LCR meter readings and compare with datasheet nominal values.

4. a) Use AI/LLM tools for PCB layout guidance — component placement rules, trace width calculation for current capacity, and design-rule-check (DRC) criteria; generate a bill of materials (BOM) from the schematic.
   b)Validate the PCB design using MATLAB/Python simulation prior to fabrication; compare simulated and measured performance and quantify deviation using percentage error analysis
5. a) Use AI/LLM tools to interpret the circuit schematic, suggest component values, and debug functional faults based on described symptoms (e.g., no output, distorted waveform, wrong DC level).
   b)Use Python/MATLAB to simulate both the DC and AC circuits before hardware implementation; compare simulated waveforms or voltage levels with measured breadboard results.
6. a)Use AI/LLM tools throughout the project lifecycle — problem statement framing, circuit design justification, component selection rationale, testing strategy, and final report generation including abstract, block diagram description, and conclusion.
   b) Integrate Python/MATLAB for data acquisition, analysis, or prediction within the project (e.g., regression-based energy forecasting, threshold-based fault classifier, sensor signal processing); include model training, validation, and result visualization.

Reference Books

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, Delhi
2. R. P. Jain, Modern Digital Electronics, Tata McGraw Hill, Noida
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education, Delhi

Free Open Source Tools

Python (NumPy, Matplotlib, Scikit-learn) – Google Colab (free); LTspice / Falstad Circuit Simulator (free) – circuit simulation; Virtual Labs – IIT (free) – online electrical experiments.

PART- B : ELECTRICAL ENGINEERING LAB

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

CO1: Understand the measurement of electrical circuit parameters.

CO2: Calculate electrical energy consumption, power and power factor for electrical loads.

Activities

1. Familiarization of commonly used workshop tools like breadboard, soldering iron, relays, switches, connectors, fuses, cutters, pliers, wire stripper, etc.; exercises for proper handling and usage.
2. Familiarization with voltmeters, ammeters, multi-meter, power supplies perform basic measurement experiments.
3. Study of fundamental electrical concepts — voltage, current, power, AC/DC, single-phase, three-phase; understanding the working principles of transformers, generators, and motors.

List of Experiments

1. Measurement of DC and AC circuit parameters.
2. Calculation of Electrical Energy for Domestic Appliances.

3. Measurement of Power and Power Factor using Single-Phase Wattmeter.
4. Measurement of Earth resistance using Megger.

AI Integration Lab Exercises

Note : At least 2 of the following activities are to be performed

1. a) Use AI/LLM tools to relate fundamental electrical concepts (voltage, current, power factor, single/three-phase systems) to real-world applications — household wiring, industrial motors and transformer ratings; generate concept maps.

b) Use Python to simulate single-phase and three-phase phasor diagrams (Matplotlib); model transformer turns ratio and calculate secondary voltage for given primary inputs.

2. a) Use AI/LLM tools to explain energy billing calculations, units (kWh), tariff slabs, and the impact of power factor on energy cost; generate a structured energy audit report for a given premises.

b) Use Python (Google Colab/Scikit-learn) to model and predict monthly energy consumption using linear regression; input appliance wattage and daily usage hours as features.

3. a) Use AI/LLM tools to explain power factor, reactive power compensation, and the effect of capacitive/inductive loads; auto-generate a power quality summary from wattmeter readings.

b) Use Python/MATLAB to plot real power, reactive power, and power factor against load variation; apply regression to model the relationship between load impedance and power factor.

4. a) Use AI/LLM tools to explain earth resistance standards (IS 3043/IEEE 80), the fall-of-potential method used by Megger, and the significance of low earth resistance for human safety; auto-generate a safety compliance report.

b) Use Python to analyse tabulated Megger readings; flag values exceeding safety thresholds using a rule-based classifier and plot resistance vs. electrode depth

Reference Books

1. D. C. Kulshreshtha, Basic Electrical Engineering, Tata McGraw Hill,Noida
2. P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Power System Engineering, Dhanpat Rai & Co., New Delhi
3. Rajendra Prasad, Fundamentals of Electrical Engineering, PHI publishers, Delhi

Free Open Source Tools

Python (NumPy, Matplotlib, Scikit-learn) – Google Colab (free); LTspice / Falstad Circuit Simulator (free) – circuit simulation; Virtual Labs – IIT (free) – online electrical experiments.

ELECTRICAL ENGINEERING WORKSHOP (EEW)

II Semester : EEE							Scheme : 2026		
Course Code	Category	Hours / Week				Credits	Maximum Marks		
		L/D	T	Pr	P	C	Continuous Internal Assessment	End Exam	Total
EE103	PC	0	0	0	2	1	30	70	100
End Exam Duration: 3 Hrs									

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

CO1: Understand the electrical symbols, tools, safety practices, wiring accessories and basic electrical/electronic equipment.

CO2: Understand the wiring techniques, soldering, earthing and electrical parameters measurement using standard instruments.

CO3: Understand the operation and parts of transformers, induction motors, PV cells, energy meters, CFL and LED.

CO4: Apply trouble shooting techniques to identify faults and evaluate the performance of electrical and electronic appliances.

List of Experiments

Note : At least 12 of the following experiments shall be conducted

1. Study of Electrical tools, symbols and abbreviations.
2. Study of types of wires and making “T” joint and straight joint for wires.
3. Measurement of Electrical quantities in RLC circuits.
4. Measurement of Energy using Single phase Energy meter for different loads.
5. Measurement of Energy using Three phase Energy meter for different loads.
6. Study of earthing and measurement of earth resistance.
7. Study and performance of residential wiring.
   (using Energy meter, Fuses, Switches, Indicator, Lamps, etc.).
8. Study of various electrical gadgets (CFL and LED).
9. Study of PV Cell.
10. Study of cross-sectional aspects of Induction motor and Transformer.
11. Assembly of choke or small transformer.
12. Study of trouble shooting of electrical equipment’s.
    (fan, iron box, mixer-grinder, etc.).
13. Introduction to basics of electronic components: Solder practice, Multi meter, Power supply.
14. Measurement of wire gauges using gauge meter.
15. Identification of color code, resistors, ICs, Transistors, capacitors, diodes, SCRs and IGBTs.

Reference Books

1. D. C. Kulshreshtha, Basic Electrical Engineering, Tata McGraw Hill, Noida.
2. P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Power System Engineering, Dhanpat Rai & Co., New Delhi.
3. Rajendra Prasad, Fundamentals of Electrical Engineering, PHI publishers, Delhi.
4. Lab manual of Electrical Engineering by TTTI, Chennai.