LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
(Autonomous)
Approved by AICTE, New Delhi and Permanently Affiliated to JNTUK, Kakinada
Accredited by NAAC with Grade 'A' & ISO: 21001:2018, 50001:2018, 14001:2015 certified
Department of Electrical and Electronics Engineering
Accredited by NBA under Tier-I

VISION

To contribute to the country and the world through technical education, research and consultancy in Electrical and Electronics Engineering.

MISION

- To provide broad based education in Electrical and Electronics Engineering.
- To keep the curriculum industry friendly.
- To undertake sponsored research and provide consultancy services in industrial, educational and society relevant areas in Electrical and Electronics Engineering.
- To promote ethical and moral values among the students so as to make them emerge as responsible professionals

Program Educational Objectives (PEOs):

PEO1: Design and develop innovative products and services in the field of Electrical and Electronics Engineering and allied engineering disciplines.

PEO2: Apply the knowledge of Electrical and Electronics Engineering to solve problems of social relevance, pursue higher education and research.

PEO3: Work effectively as individuals and as team members in multidisciplinary projects.

PEO4: Engage in lifelong learning, career enhancement and adapt to changing professional and societal needs.

Program Outcomes (POs):

PO1 - Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 - Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 - Design / Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 - Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 - Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern

engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6 - The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 - Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 - Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 - Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 - Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 - Project Management and Finance: Demonstrate knowledge and understanding of the ring and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 - Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

PSO1: Specify, design and analyze systems that efficiently generate, transmit and distribute electrical power.

PSO2: Design and analyze electrical machines, modern drive and lighting systems.

PSO3: Specify, design, implement and test analog and embedded signal processing electronic systems.

PSO4: Design controllers for electrical and electronic systems to improve their performance.

R26-COURSE STRUCTURE-EEE

I SEMESTER

S.No	Course code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
1	A2610011	English for Technical Communication	**3**	**0**	**0**	**3.0**	40	60	100
2	A2610002	Linear Algebra & Calculus	3	0	0	3.0	40	60	100
3	A2610201	Physics for Electrical Systems	3	0	0	3.0	40	60	100
4	A2610003	Computational Thinking & Problem Solving using C	3	0	0	3.0	40	60	100
5	A2610202	Basic Electrical Circuits	3	0	0	3.0	40	60	100
6	A2610012	English for Technical Communication and MOODLES Lab	0	0	3	1.5	40	60	100
7	A2610203	Physics for Electrical Systems Lab	0	0	3	1.5	40	60	100
8	A2610008	Computational Thinking & Problem Solving using C Lab	0	0	3	1.5	40	60	100
9	A2610204	Basic Electrical Circuits Lab	0	0	3	1.5	40	60	100
10	A2610013	Environmental Science	2	0	0	0.0	40	-	40
Total			**17**	**0**	**12**	**21**	**400**	**540**	**940**

II SEMESTER

S.No	Course code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
1	A2620201	Chemistry for Electrical Systems	3	0	0	3.0	40	60	100
2	A2620003	Differential Equations & Vector Calculus	3	0	0	3.0	40	60	100
3	A2620203	Semiconductor Devices	3	0	0	3.0	40	60	100
4	A2620202	Engineering Graphics	0	1	3	2.5	40	60	100
5	A2620012	Design Thinking & Innovation	0	1	3	2.5	40	60	100
6	A2620204	Semiconductor Devices Lab	0	0	3	1.5	40	60	100
7	A2620008	AI Tools & Applications	0	1	3	2.5	40	60	100
8	A2620205	Chemistry for Electrical Systems Lab	0	0	3	1.5	40	60	100
9	A2620014	IT and Electronics Workshop	0	0	3	1.5	40	60	100
10	A2620013	Sports and Yoga or NSS/NCC	0	0	2	0.0	40	-	40
Total			**9**	**3**	**20**	**21**	**400**	**540**	**940**

B.Tech.(I Sem)	A2610011- English for Technical Communication (Common to all branches of Engineering)	L	T	P	Cr.
		3	0	0	3

Course Objectives:

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

Course Outcomes: At the end of the course, the student will be able to:
CO1: Comprehend specific information, context, and central ideas from social, academic, or workplace conversations and audio-visual material. (K2)
CO2: Apply appropriate social norms to bridge the gaps and collaborate effectively across diverse cultural backgrounds (K3)
CO3: Evaluate the content, limitations and ethical aspects of AI tools in communication and language learning, and apply them to create concise, accurate essays/summaries/letters/paraphrases. (K5)
CO4: Examine discourse features and writing strategies to participate effectively in informal exchanges, short presentations on technical and general topics and to compile reports/E-mails. (K4)
CO5: Construct well-organized paragraphs, essays, critical reviews, and other professional documents suited to academic and workplace contexts. (K6)

Unit 1 : Effective Communication: Exploring Channels and Methods **10 hrs**
Vocabulary: Roots, Prefixes, and Suffixes Homonyms
Grammar: Articles, Prepositions, Tenses.
Reading: Definition and Importance, Skills and Sub-Skills of Reading Writing :Cohesion and Coherence, Paragraph Writing.
Listening : Listening for main ideas and supporting details, Note-taking
Speaking: Introducing self and others, Describing people and objects, JAM.

Unit 2: Eco-Consciousness: Negotiating for a Sustainable Future **9 hrs**
Vocabulary: Contractions, Phrasal Verbs, Idioms & Phrases
Grammar: Subject-Verb Agreement, Conditional Sentences
Reading: Reading for Inference, Point of View, Tone and Perspective.
Writing : Note making, Summarizing, Paraphrasing.
Listening : Listening to various texts and comprehension
Speaking: Role-plays, Extempore.

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

Unit 4: **Entrepreneurship and Start-Up Culture: Emerging Trends** **10 hrs**
Vocabulary: Business/ Profession/ Career/ Job-related Vocabulary.
Grammar: Sentence Synthesis, Simple, Compound and Complex Sentences.
Reading: Reading various texts for global understanding
Writing : Email Writing, Data Interpretation, Report Writing

Listening : Listening to debates and discussions.
Speaking: Power Point Presentations by Individuals and Teams.

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

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

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

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

B.Tech.(I Sem)	A2610002- Linear Algebra & Calculus (Common to all branches of Engineering)	L	T	P	Cr.
		3	0	0	3

Course Objectives:

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

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

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

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

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

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

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

UNIT I: Matrices, Eigenvalues, Eigenvectors

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

UNIT II: Diagonalization of a matrix

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

UNIT III: Calculus

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

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

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

UNIT V: Multiple Integrals

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

TEXTBOOKS:

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

REFERENCE BOOKS:

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

WEB RESOURCES

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

B.Tech.(I Sem) **A2610201- Physics for Electrical Systems**

L	T	P	Cr.
3	0	0	3

Course Objective:

1. To provide knowledge on wave optics concepts and their applications.
2. To familiarize students with concepts of dielectric and magnetic materials and their applications in energy storage devices.
3. To introduce the electrical properties of metals and semiconductors with relevant engineering applications.
4. To equip students the fundamentals of quantum mechanics and quantum computing with secure communication concepts.
5. To impart knowledge on electromagnetic field theory and its applications in power systems.

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

CO1: Apply the principles of interference, diffraction, and polarization with basic optical analysis in engineering applications **(Apply (K3)).**

CO2: Analyze the significant concepts of dielectric and magnetic materials that lead to potential applications in the emerging micro devices **(Analyze (K4)).**

CO3: Analyze the electrical properties of metals and comprehend use of semiconductors and their applications **(Analyze (K4)).**

CO4: Apply the concepts and principles of Quantum Mechanics relevant to Quantum Computing for secure communication **(Apply (K3)).**

CO5: Apply and Analyze Maxwell's equations and electromagnetic field concepts for energy transport **(Apply and Analyze (K3, K4)).**

UNIT - I: APPLIED WAVEOPTICS **10Hrs**

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

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

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

UNIT - II: DIELECTRICS & MAGNETIC MATERIALS FOR POWER SYSTEMS **10Hrs**

Dielectric Materials: Introduction - Basic definitions - Types of polarizations - Electronic and Ionic polarizations (quantitative) - Orientational and Space Charge Polarizations (qualitative) - Internal field in solids – Clausius - Mossotti relation.

Magnetic Materials and Energy Conversion: Introduction and classification - Dia, Para, Ferro, Ferri, and Anti-ferro - Hysteresis and Eddy current losses in electrical machines –Skin Effect – Soft & Hard magnetic materials.

UNIT - III: FREE ELECTRON THEORY OF METALS & SEMICONDUCTORS **9Hrs**

Free 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.

Semiconductors: Formation of energy bands - Classification of solids - Intrinsic semiconductors - Density of charge carriers - Electrical conductivity - Fermi level - extrinsic semiconductors: density of charge carriers (qualitative) – dependence of Fermi energy on carrier concentration and temperature – Drift and diffusion currents - Einstein’s equation - Hall effect - Hall coefficient - Applications of Hall effect.

UNIT-IV: INTRODUCTION TO QUANTUM MECHANICS & QUANTUM COMPUTING 10Hrs

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

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

UNIT-V: ELECTROMAGNETIC FIELDS IN POWER SYSTEMS 9Hrs

Introduction- Wave Equation in differential form in free space - Vector Analysis - Divergence and Curl of electric field and magnetic field (static) - Gauss' divergence theorem - Stokes' theorem - Derivations of the four Maxwell Equations and their significance. Maxwell's equations in vacuum, Energy transport and Poynting Vector.

Text books:

1. Avadhanulu, M.N., Kshirsagar, P.G., & Murthy, T.V.S.A., A text book of engineering physics, S. Chand Publishing (2019)
2. P. K. Palani Samy, Engineering Physics, SciTech Publications (2019).
3. B. K Pandey and S. Chaturvedi, Engineering Physics, 2nd Edition, CENGAGE learning (2021).

Reference Books:

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

Web Resources

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

B.Tech.(I Sem)	A2610003- Computational Thinking & Problem Solving using C	L	T	P	Cr.
		3	0	0	3

Pre-requisite: Mathematics and logical reasoning at 10+2 level. No prior programming experience is assumed.

Course Objectives: The main objectives of the course are to

- Familiarize students with computers, computational thinking, and the process of algorithmic problem solving.
- Build strong programming fundamentals using the C language, including operators, control structures, and loops.
- Develop the ability to design and implement solutions using arrays, strings, and user- defined data types.
- Impart working knowledge of pointers, recursion, dynamic memory allocation, functions, and file handling for building modular, reusable programs.

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

		Knowledge Level (K)#
CO1	Apply computational thinking techniques (decomposition, abstraction, pattern recognition) to design algorithms and flowcharts for a given problem.	K3
CO2	Develop C programs using appropriate operators, expressions, selection statements, and loops to implement a given logic.	K3
CO3	Analyze problems involving arrays, strings, structures and unions and construct suitable C solutions.	K4
CO4	Apply pointers, recursion, and dynamic memory allocation to solve computational problems efficiently.	K3
CO5	Construct modular C programs using user-defined functions and perform text/binary file input-output operations.	K3

UNIT	CONTENTS	Contact Hours
UNIT – 1	**Computational Thinking and Introduction to C** **Computational Thinking:** Decomposition, Pattern Recognition, Abstraction, Algorithm Design; representing solutions as algorithms, pseudocode, and flowcharts; Number Systems and Data Representation (integers, reals); Overview of Computer Organization and Program Execution. **Introduction to C:** Background, Structure of a C Program, Identifiers, Keywords, Variables, Constants, Basic Data Types, Input/Output statements; Expressions, Operators, type of operators- arithmetic, relational, logical, bitwise, assignment, conditional, increment, decrement, etc., unary, binary, ternary, Operator Precedence and Associativity, Type Conversion; Scope, Storage Classes, and Type Qualifiers.	12
UNIT – 2	**Selection and Decision-Making**: Simple if, Two-Way selection- if-else, nested-if, else-if ladder, and Multi-Way Selection- switch. **Repetition:** Counter- and Event-Controlled Loops: for, while, do-while, and nested loops; Break and continue, Programming Applications combining Selection and Repetition. **Arrays:** One-Dimensional and Two-Dimensional Arrays, Multidimensional Arrays, Array-based Problem Solving (searching, sorting, etc.).	9
UNIT – 3	**Functions:** Designing Structured/Modular Programs, Function Declaration and Definition, Parameter Passing (by value, by reference using pointers), Passing Arrays and Pointers to Functions, Standard Library Functions, Inter-Function Communication.	9

	Recursion: Recursive vs. Iterative Solutions, Designing Recursive Algorithms, Recursion with Arrays and Pointers, Efficiency Considerations. **Strings:** String Representation, Standard String-Handling Functions, Arrays of Strings, String-to-Data Conversion.	
UNIT – 4	**Pointers:** Pointer Fundamentals, Pointer-to-Pointer, Pointer Arithmetic, Pointers and Arrays, Array of Pointers, types of pointers, Compatibility and L-value/R-value concepts. Dynamic Memory Allocation: malloc, calloc, realloc, free. **User-Defined Types:** typedef, Enumerated Types, Structures, Unions, and Nested Structures; Programming Applications using Structures and Arrays of Structures.	9
UNIT – 5	**Pre-processor**: Directives and Macros. Command Line Arguments. **File I/O:** Streams, Text vs. Binary Files, Standard Library File Functions, formatted and Character I/O, Sequential File Processing.	6
	Total	45

Text Books:

1. Behrouz A. Forouzan & Richard F. Gilberg, Computer Science: A Structured Programming Approach Using C, 3rd Edition, Cengage Learning, ISBN-13: 978-0-534-49132-1.
2. Brian W. Kernighan & Dennis M. Ritchie, The C Programming Language, 2nd Edition, Pearson Education / Prentice Hall India, 1988.

Reference Books:

1.Sumitabha Das, "Computer Fundamentals and Programming", 18th Edition, McGraw Hill Education, 2018.
2.Ashok N. Kamthane, Amit Ashok Kamthane, "Programming in C", 4th Edition, Pearson Education, 2025. ISBN: 978-9332543633.
3.Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", 2nd Edition, Oxford University Press, 2013. ISBN: 978-0198068842.

Web References:

1. NPTEL – Programming in C, IIT Kanpur: https://onlinecourses.nptel.ac.in/noc21_cs81/preview
2. Geeks for Geeks – C Programming Language: https://www.geeksforgeeks.org/c-programming-language/
3. Programiz – Learn C Programming: https://www.programiz.com/c-programming
4. cplusplus.com – C Standard Library Reference: https://cplusplus.com/reference/clibrary/
5. TutorialsPoint – C Programming: https://www.tutorialspoint.com/cprogramming/index.html
6. W3Schools – C Tutorial: https://www.w3schools.com/c/

B.Tech.(I Sem)

A2610202- Basic Electrical Circuits

L	T	P	Cr.
3	0	0	3

Course Objectives: The course aims to provide fundamental knowledge of electrical wiring, components, electrical and magnetic circuits, and single-phase AC circuits, while developing the ability to analyze DC and AC networks using appropriate circuit analysis techniques. It also introduces resonance, power factor, electromagnetic induction, and locus diagrams to enable students to understand and apply basic electrical engineering concepts to practical systems.

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

CO1: Estimate electrical loads and select suitable wire sizes for domestic and commercial electrical installations. **(Understand-L2)**

CO2: Apply fundamental circuit laws and systematic network-solving methods to determine electrical quantities in DC circuits with various source configurations. **(Apply-L3)**

CO3: Understand the principles of magnetic circuits and electromagnetic induction and evaluate inductive coupling, flux distribution, and magnetic circuit parameters. **(Understand-L2)**

CO4: Interpret sinusoidal quantities using phasors and complex numbers and evaluate the steady-state performance, power, and power factor of single-phase AC circuits. **(Understand-L2)**

CO5: Examine resonant behavior and frequency characteristics of electrical networks and interpret locus diagrams to assess circuit response, bandwidth, selectivity, and quality factor. **(Understand-L2)**

UNIT-I Electrical Wiring and its Components: Types of wiring systems (cleat, casing-capping, conduit wiring)- wiring accessories — switches, sockets, fuses, MCBs, ELCBs - types of cables and conductors- wiring diagrams for staircase and godown. load estimation and selection of wire size.

UNIT-II Introduction to Electrical Circuits Basic Concepts of passive elements of R, L, C and their V-I relations, Sources (dependent and independent), Kirchhoff's laws, network reduction techniques (series, parallel, series - parallel, star-to-delta and delta-to-star transformation), source transformation technique, nodal analysis and mesh analysis to DC networks with dependent and independent voltage and current sources, node and mesh analysis.

UNIT-III Magnetic Circuits Basic definition of MMF, flux and reluctance, analogy between electrical and magnetic circuits, Faraday's laws of electromagnetic induction – concept of self and mutual inductance, Dot convention – coefficient of coupling and composite magnetic circuit, analysis of series and parallel magnetic circuits.

UNIT-IV AC Fundamentals and Single-Phase Circuits Periodic waveforms (determination of rms, average value and form factor), concept of phasor, phase angle and phase difference – waveforms and phasor diagrams for lagging, leading networks, complex and polar forms of representations. node and mesh analysis. Steady state analysis of R, L and C circuits, power factor and its significance, real, reactive and apparent power, waveform of instantaneous power and complex power.

UNIT-V Resonance - Locus Diagrams series and parallel resonance, selectivity, band width and Quality factor, locus diagram- RL, RC, RLC with R, L and C variables.

Learning Resources

Text Books:

1. Hayt, W. H., & Kemmerly, J. E, (2018). Engineering circuit analysis (9th edition.). McGraw Hill Education.
2. Van Valkenburg, M. E, (2019), Network analysis (3rd edition.). Prentice-Hall of India.

Reference Books:

1. Alexander, C. K., & Sadiku, M. N. O. (2019). Fundamentals of electric circuits (6th edition.). McGraw Hill Education.
2. Herbert P. Richter, Frederic P. Hartwell, (2014) Practical Electrical Wiring: Residential, Farm, Commercial, and Industrial, (22nd edition), Park Publishing, Inc.
3. S. L. Uppal & G. C. Garg, (2018), Electrical Wiring, Estimating and Costing, (6th edition), Khanna Publishers.

Web Resources:

1. https://nptel.ac.in/courses/108105479
2. https://nptel.ac.in/courses/108104139
3. https://nptel.ac.in/courses/117106108

B.Tech.(I Sem)	A2610012- English for Technical Communication and MOODLES Lab	L	T	P	Cr.
		0	0	3	1.5

Part – A

Course Objectives:

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

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

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

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

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

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

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

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

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

List of Experiments

1. **Phonetics & Accent Neutralisation**

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

2. **Introducing Self and Others**

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

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

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

4. **Listening Comprehension**

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

5. **Process Description & Paragraph Writing (Technical Lab Context)**
- Lab-to-Paragraph — After a lab experiment, students write a process description using sequence markers.
- Flowchart to Paragraph — Provide a technical flowchart; students convert it into a coherent paragraph.
- Reverse Engineering — Give a paragraph; students convert it back into steps and check accuracy.

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

7. **Micro Presentations (2–5 minutes)**
- One-Slide Presentation — Students prepare a single slide and speak for 3 minutes.
- Teach a Concept — Students explain a simple technical idea (e.g., "How Wi-Fi works").
- Object Talk — Students bring an object and present its use, history, or mechanism.

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

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

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

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

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

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

15. https://www.youtube.com/channel/UCNfm92h83W2i2ijc5Xwp_IA

Part B

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

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

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

List of Experiments

1. **Introduction to Moodle LMS**

- Introduction to Moodle
- Student login and profile management
- Moodle dashboard and course navigation
- Accessing announcements and course materials
- Notifications and calendars

2. **Learning Through Moodle**

- Accessing PDFs, videos, web resources, and lecture materials
- Downloading and organizing study materials
- Moodle lessons and learning activities
- Tracking course completion
- Managing deadlines and study schedules

3. **Assignments, Quizzes and Assessments**

- Understanding assignment instructions
- Creating and uploading assignments
- File formats and file naming
- Online quizzes and question types
- Viewing marks and teacher feedback
- Re-submission and revision

4. **Academic honesty**

- Plagiarism and how to avoid it
- Copyright and fair use
- Responsible use of AI tools
- Digital privacy and cyber security
- Evaluating reliable online information
- Professional behavior in online environments
- Practical Activities

B.Tech.(I Sem)

A2610203- Physics for Electrical Systems Lab

L	T	P	Cr.
0	0	3	1.5

Course Objective:

1. To develop experimental understanding of fundamental principles of optics, semiconductor physics, quantum physics, magnetism, electromagnetism, and dielectric materials relevant to advanced computing technologies.
2. To experimentally determine important optical, electrical, electronic, magnetic and material parameters using appropriate measurement techniques and instrumentation.
3. To develop skills in experimental data acquisition, graphical analysis, interpretation of characteristics, and application of physical principles to understand the behavior of materials and devices used in modern electronic and computing systems.

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

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

CO2: Analyze the dielectric and magnetic properties of materials through charging–discharging, thermistor, and B–H characteristics and interpret their experimental behavior. **K4 (Analyze)**

CO3: Analyze the electrical and electronic characteristics of semiconductor materials and devices to determine parameters such as temperature coefficient, energy gap, and Hall coefficient using appropriate experimental techniques. **K4 (Analyze)**

CO4: Apply the principles of quantum physics and photoelectric effect to experimentally estimate Planck's constant and relate experimental observations to fundamental quantum concepts. **K3 (Apply)**

CO5: Analyze the magnetic properties and electromagnetic field characteristics of materials and current-carrying systems by studying the magnetic field distribution along the axis of a circular coil. **K4 (Analyze)**

LIST OF EXPERIMENTS

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

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

1. Determination of radius of curvature of a given Plano convex lens by forming Newton's rings.
2. Verification of Brewster's law.
3. Determination of wavelength of Laser and grating element by using a grating.
4. Determination of dielectric constant of given capacitor by charging and discharging method.
5. Determination of temperature coefficients of a thermistor.
6. Determination of the energy gap of a semiconductor using p-n junction diode.
7. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall Effect.
8. Estimation of Planck's constant using photoelectric effect.
9. Study the variation of magnetic field along the axis of a current carrying circular coil by Stewart & Gee's method.
10. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
11. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration.
12. Determination of the thickness of a thin object by the wedge method.
13. Determination of the resolving power of a telescope.
14. Determination of the Resistivity of a semiconductor by the four probe method.
15. Determination of Acceleration due to gravity and Radius of gyration using a Compound pendulum.
16. Determination of magnetic susceptibility by Kundt's tube method.
17. Sonometer: Verification of laws of stretched string.
18. Determination of frequency of electrically maintained tuning fork by Melde's Apparatus.

References:

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

V-Lab: vlab.co.in

B.Tech.(I Sem)	A2610008- Computational Thinking & Problem Solving using C Lab	L	T	P	Cr.
		0	0	3	1.5

Pre-requisite: - Basic understanding of computer fundamentals and problem-solving concepts

Course Objectives: The main objectives of the course are to

- Apply the principles of C language and computational thinking techniques in problem solving.
- Design flowcharts and algorithms, and to develop the ability to trace and debug programs.
- Design and develop C programs using arrays, strings, pointers, recursion, and functions.
- Apply dynamic memory allocation, file operations, and preprocessor commands in program design.

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

CO	Course Outcome Statement	Knowledge Level (K)#
CO1	Apply computational thinking to construct algorithms and flowcharts for a given problem and translate them into working C programs.	K3
CO2	Develop C programs using operators, selection statements and loops to implement a specified logic.	K3
CO3	Develop C programs that manipulate arrays, strings, structures and pointers to solve computational problems.	K3
CO4	Construct modular programs using user-defined functions and recursion, and perform file input-output operations.	K3
CO5	Analyse a C program by tracing and debugging it, and evaluate alternative implementations for correctness and efficiency.	K4

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

- C compiler: GCC (GNU Compiler Collection) — via MinGW-w64 on Windows, or the built-in gcc on Linux/macOS.
- IDE / editor: Code::Blocks, Dev-C++ or Visual Studio Code with the C/C++ extension.
- Command-line terminal to compile and run programs (gcc, ./a.out) and observe the compile–link–run stages.
- Debugger: GDB (GNU Debugger), integrated in Code::Blocks / VS Code, for tracing and step-by-step debugging.
- Operating system: Windows 10/11 or a Linux distribution (e.g., Ubuntu); any 64-bit PC with 4 GB RAM or more.
- No-install alternative: OnlineGDB, Programiz or Replit for quick practice and testing in a browser.

List of Experiments

Exercise 1: Getting Started with

1. Write, compile and run a C program that prints “Hello, World!” on the screen. Identify the source file, the object file and the executable produced, and record the command used at each stage.
2. Write a C program that declares variables of type int, float, char and double, reads a value for each from the user, and displays each value together with the size of its type using sizeof.
3. Write a C program to read the height and width of a rectangle from the user and compute its perimeter and are.

Exercise 2: Operators and Expressions

1. Write a C program to compute the distance between two points whose coordinates are entered by the user.
2. Write a C program that reads four integers p, q, r, s and, using relational and logical operators, prints 'Correct values' if q > r, s > p and (r + s) > (p + q); otherwise 'Wrong values'.
3. Write a C program to compute simple and compound interest for values entered by the user.

Exercise 3: Selection and Decision Making

1. Write a C program to read a character and classify it as a vowel, consonant, digit or special symbol.
2. Write a C program to find the largest of three numbers using nested if-else.
3. Write a menu-driven C program to compute the area of various geometrical shapes (circle, rectangle, triangle, square) using switch-case.

Exercise 4: Loops and Series

1. Write a C program to display the first n even natural numbers and their sum.
2. Write a C program to reverse a given integer and check whether it is a palindrome.
3. Write a C program to display the sum of the harmonic series 1 + 1/2 + 1/3 + ... up to n terms.

Exercise 5: Nested Loops and Number Patterns

1. Write a C program to print the multiplication table pyramid for numbers 1 to n using nested loops.
2. Write a C program to check whether a given number is prime, then extend it to print all prime numbers and all Armstrong numbers below.

Exercise 6: One-Dimensional Arrays

1. Write a C program to print all unique elements of an array, and implement linear search to find a given element in the array.
2. Write a C program to separate the odd and even elements of an array into two different arrays, and implement binary search to find a given element in a sorted array.
3. Write a C program to sort the elements of an array in ascending order using selection sort, and compare the efficiency of linear search vs. binary search on the sorted array by counting the number of comparisons each method takes.

Exercise 7: Matrices

1. Write a C program to perform addition of two square matrices and display the resultant matrices.
2. Write a C program to multiply two square matrices and display the resultant matrices.
3. Write a C program to find the transpose of a given matrix.

Exercise 8: Strings:

Write C programs to perform the following without using string handling functions

- **Find the length** of a given string.
- **Copy** one string into another.
- **Concatenate** two strings.
- **Compare** two strings and display whether they are equal, or which one is greater.
- **Reverse** a given string (using a separate swap function to exchange characters).
- **Search for a character** in a string and display its position (or indicate if not found).
- **Count the number of vowels, consonants, and words** in a given string

Exercise 9: Pointers Fundamentals

1. Write a C program to demonstrate the use of the & (address-of) and * (value-at-address) operators.
2. Write a C program to add two numbers using pointers.
3. Write a C program to swap two values using call by reference.

Exercise 10: Pointers and Dynamic Memory

1. Write a C program to dynamically allocate memory for an array using malloc, find the largest element and the sum of all elements in it, then repeat using calloc and note the difference between the two.
2. Write a C program to count the number of vowels in a string using a pointer.

Exercise 11: User-Defined Functions

1. Write a C program to check whether a number is prime using a user-defined function.
2. Write a C program to compute the GCD and LCM of two numbers using functions.
3. Write a C program to demonstrate a function that returns a pointer.

Exercise 12: Recursion

1. Write a C program to compute the factorial and the n-th Fibonacci term using recursion.
2. Write a C program to compute the sum of digits of a number using recursion.
3. Write a C program to convert a decimal number to its binary equivalent using a recursive function.

Exercise 13: File Handling

1. Write a C program to append multiple lines at the end of an existing text file.
2. Write a C program to copy the contents of one file into another file.
3. Write a C program to count the number of characters, words and lines in a text file.

Web References:

- NPTEL – Programming in C, IIT Kanpur: https://onlinecourses.nptel.ac.in/noc21_cs81/preview
- Virtual Labs – Problem Solving Lab, IIIT Hyderabad: https://ps-iiith.vlabs.ac.in/

GeeksforGeeks – C Programming: https://www.geeksforgeeks.org/c-programming-language/

B.Tech.(I Sem)

A2610204- Basic Electrical Circuits Lab

L	T	P	Cr.
0	0	3	1.5

Pre-requisite: Nil

Course Objectives: The course aims to develop practical knowledge of electrical wiring, measuring instruments, electrical components, DC and AC circuits, magnetic coupling, and resonance through laboratory experiments. It enables students to acquire hands-on skills in circuit construction, measurement, testing, verification, and analysis of electrical quantities and circuit parameters.

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

CO1: Identify and use electrical tools, measuring instruments, wiring accessories, cables, conductors, and protective devices for practical electrical installations. **(Understand-L2)**

CO2: Construct and verify staircase, godown, and single-phase distribution-board wiring and perform measurements of voltage, current, power, energy, and power factor. **(Apply-L3)**

CO3: Verify fundamental electrical laws and determine the electrical parameters of DC and single-phase AC circuits, including impedance, power, and power factor. **(Apply-L3)**

CO4: Determine the parameters of magnetic circuits, including self-inductance, mutual inductance, and coefficient of coupling, and analyze magnetically coupled coils. **(Apply-L3)**

CO5: Determine resonant frequency, bandwidth, and quality factor of series and parallel RLC circuits and construct locus diagrams for RL and RC circuits. **(Apply-L3)**

List of Experiments

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

1. Study various electrical tools, symbols, wiring accessories, Moving Iron, Moving Coil, Energy meter and use of a digital multimeter.
2. Study various types of electrical cables/conductors, switches, sockets, fuses, MCBs, and ELCBs with their specifications and applications.
3. Draw the wiring diagram for control of a lamp from two different locations (staircase wiring).
4. Draw and verify godown wiring for control of a lamp from two different locations.
5. Implementation and Testing of a Single-Phase Power Distribution Board with Main Switch, Energy Meter, MCB, and ELCB for Measurement of Power, Energy, and Power Factor.
6. Verification of Kirchhoff's voltage and current laws.
7. Measurement of voltage, current, and power in a DC circuit;
8. Calculate the impedance, power and power factor of a given series (i) RL (ii) RC (iii) R-L-C circuit
9. Determination of parameters of a choke coil.
10. Determination of self and mutual inductances and coefficient of coupling for a pair of magnetically coupled coils.
11. Determination of resonant frequency, bandwidth, and quality factor of series RLC circuits.
12. Determination of resonant frequency, bandwidth, and quality factor of parallel RLC circuits.
13. Locus diagrams of RL and RC series circuits.

Learning Resources

Text Books:

1. Hayt, W. H., & Kemmerly, J. E, (2018). Engineering circuit analysis (9th edition.). McGraw Hill Education.
2. Van Valkenburg, M. E, (2019), Network analysis (3rd edition.). Prentice-Hall of India.

Reference Books:

1. Alexander, C. K., & Sadiku, M. N. O. (2019). Fundamentals of electric circuits (6th edition.). McGraw Hill Education.
2. Herbert P. Richter, Frederic P. Hartwell, (2014) Practical Electrical Wiring: Residential, Farm, Commercial, and Industrial, (22nd edition), Park Publishing, Inc.
3. S. L. Uppal & G. C. Garg, (2018), Electrical Wiring, Estimating and Costing, (6th edition), Khanna Publishers.

Web Resources:

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

B.Tech.(I Sem)	A2610013- Environmental Science	L	T	P	Cr.
		2	0	0	0

Course Objectives:

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

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

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

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

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

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

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

UNIT I: Ecosystems, Natural Resources, and Biodiversity

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

UNIT II: Environmental Pollution and Control Technologies

Air Pollution: Sources, primary/secondary pollutants, ambient air quality standards, control equipment principles - Electrostatic Precipitators, Baghouses, Scrubbers; **Water Pollution:** Characteristics of wastewater, parameters - BOD, COD, TDS, municipal wastewater treatment principles - Primary, Secondary, Tertiary treatment; **Soil Pollution:** Industrial waste, agricultural runoff, solid waste management Municipal Solid Waste - generation, segregation, incineration, composting, landfilling; **Noise and Thermal Pollution:** Sources, measurement metrics (dB, dBA), physiological impacts, and mitigation techniques; **Case Studies & Activities.**

UNIT III: Global Environmental Issues and Climate Change

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

Assessment (LCA): Carbon Footprint analysis, and Net-Zero carbon engineering; **Case Studies & Activities.**

UNIT IV: Environmental Ethics, Laws, and Sustainable Development

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

UNIT V: Green Technology and Sustainable Engineering

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

Textbook:

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

Reference Books:

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

B.Tech.(II Sem)

A2620201- Chemistry for Electrical Systems

L	T	P	Cr.
3	0	0	3

Pre-requisite: Basic Knowledge of Chemistry (Higher Secondary level).

Course Objectives:

- To analyze corrosion mechanisms in electrical infrastructure and develop protection strategies.
- To understand electrochemical energy storage and conversion for power and mobility applications.
- To study electrical materials (conductors, insulators, semiconductors, magnetic materials) and their chemistry.
- To study methods for production of energy using greener technologies and their significance in sustainable electrical systems.
- To understand the fundamentals of quantum chemistry, including wave-particle duality, and molecular orbital theory relevant to computing materials.

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

CO	Course Outcome Statement	Knowledge Level (K)#
CO1	Summarize electrochemical principles and corrosion mechanisms; apply appropriate corrosion-control techniques.	**K2** (Understand) **K3** (Apply)
CO2	Outline the working principles of batteries, fuel cells and supercapacitors; apply their characteristics to energy-storage applications.	**K2** (Understand) **K3** (Apply)
CO3	Classify electrical and electronic materials based on their properties; apply their characteristics to suitable engineering applications.	**K2** (Understand) **K3** (Apply)
CO4	Compare green-energy technologies and analyse their role in sustainable electrical systems.	**K2** (Understand) **K4** (Analyse)
CO5	Interpret quantum chemistry principles, apply molecular orbital theory to electronic structure and bonding in molecular systems.	**K2** (Understand) **K3** (Apply)

UNIT I: Electrochemistry and Corrosion [10hrs]

Galvanic and electrolytic cells, electrode potential, Electro-chemical series and its uses, Nernst equation and problems, potentiometry (redox reactions). Conductometric titrations.

Corrosion: Definition, chemical and electrochemical corrosion; Pilling-Bedworth rule, Galvanic corrosion, differential aeration corrosion, pitting corrosion, stress corrosion, Galvanic series, factors affecting corrosion.

Protective techniques: Selection and proper design, corrosion inhibitors, cathodic protection (sacrificial anodic and impressed-current protection), Anodic protection. Galvanizing (hot-dip, electro-galvanizing); electroplating and electroless plating (nickel and copper).

Underground-cable and grounding-system corrosion: Stray-current corrosion, earth-electrode and grid corrosion; corrosion in substations, battery terminals, and cooling systems of electrical machines.

UNIT II: Energy storage devices [10 hrs]

Primary batteries: Sodium-air battery (construction, working and applications), zinc-air battery,

Secondary batteries: Lithium-ion battery, sodium-ion battery (construction, charging-discharging reactions and applications). Battery management systems (main functions, basic working, battery protection).

Fuel cells: Types of fuel cells, solid polymer electrolyte and alkaline electrolyte (construction, working, applications).

Supercapacitors: Definition, working principle (EDLC, pseudo-capacitors, hybrid supercapacitors), applications.

Hybrid batteries: Definition, basic principle, applications.

UNIT III: Electrical & Electronic Materials [10hrs]

Conductors: Classification and applications of copper, aluminium, silver, and alloys (brass, bronze); resistivity, conductivity, temperature coefficient.

Semiconductors: Band theory, intrinsic and extrinsic semiconductors (Si, Ge, GaAs); n-type (P, As) and p-type (B, Al) doping.

Organic semiconductors: Definition, types (organic molecular semiconductors and organic polymer semiconductors), applications.

Insulators: Solid insulators, liquid insulators, gaseous insulators.

Polymers: Thermoplastics and thermosetting plastics - cross-linked polyethylene (XLPE), PVC, PTFE, PEEK, polyimide, epoxy resin silicone rubber (preparation, properties, applications).

Nanomaterials: Graphene, carbon nanotubes, nanocomposites (Chemical vapor deposition (CVD) method and applications).

UNIT IV: Green energy technology and its sustainability [9 hrs]

Chemistry in Green hydrogen synthesis: Introduction, methods of producing green hydrogen (steam methane reforming, electrolysis, partial oxidation and biomass gasification), Role of catalysts in hydrogen gas production.

Importance of Sustainability: Basic concepts of renewable energy (solar, wind, hydroelectric, geothermal, tidal), energy efficient electrical systems, smart grids, electric vehicles, E-waste management, ecofriendly electronic materials.

UNIT V: Quantum Chemistry [10 hrs]

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 (time-independent), significance of Ψ and Ψ^2; particle in a one-dimensional box.

Molecular orbital theory: Bonding in homonuclear and heteronuclear diatomic molecules; energy-level diagrams of O_2, N_2, CO, and HF, π-molecular orbitals of butadiene and benzene; calculation of bond order.

Textbooks:

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

Reference Books:

1. Linden, D., & Reddy, T. B. (Eds.). (2001). Handbook of batteries (3rd ed.). McGraw-Hill.
2. Roberge, P. R. (2008). Corrosion engineering: Principles and practice. McGraw-Hill.
3. Shikha, A., & Sharma, R. K. (2019). Engineering chemistry. Krishna Prakashan Media.
4. Dara, S. S., & Umare, S. S. (2018). Engineering chemistry (15th ed.). S. Chand Publishing.

Web Resources (APA Format)

- IEEE Standards Association. (n.d.). IEEE standards. https://standards.ieee.org
- International Electrotechnical Commission. (n.d.). IEC standards for electrical equipment. https://www.iec.ch
- International Renewable Energy Agency. (n.d.). Renewable energy technologies. https://www.irena.org
- U.S. Department of Energy. (n.d.). Energy storage database. https://www.energy.gov
- Bureau of Indian Standards. (n.d.). BIS standards. https://www.services.bis.gov.in

B.Tech.(II Sem) **A2620003- Differential Equations & Vector Calculus**

L	T	P	Cr.
3	0	0	3

Course Objectives: It is aimed

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

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

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

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

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

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

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

UNIT I: Differential equations of first order and first degree

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

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

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

UNIT III: Partial Differential Equations

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

UNIT IV: Vector differentiation

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

UNIT V: Vector integration

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

TEXTBOOKS:

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

REFERENCE BOOKS:

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

WEB RESOURCES

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

B.Tech.(II Sem)

A2620203- Semiconductor Devices

L	T	P	Cr.
3	0	0	3

Pre-requisite: Nil

Course Objectives: The course aims to provide fundamental knowledge of semiconductor devices, their construction, operating principles, characteristics, and applications. It enables students to understand and analyze diode circuits, rectifiers, voltage regulators, BJTs, FETs, power semiconductor devices, and optoelectronic devices for basic electronic circuit applications.

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

CO1: Understand the formation, characteristics, operation, and fundamental parameters of PN junction diodes. **(Understand-L2)**

CO2: Analyze diode-based rectifier, filter, and voltage-regulator circuits and evaluate their performance. **(Apply-L3)**

CO3: Understand the construction, operation, characteristics, configurations, and basic applications of BJTs. **(Understand-L2)**

CO4: Understand the construction, characteristics, operation, and applications of JFETs and MOSFETs and compare them with BJTs. **(Understand-L2)**

CO5: Understand the operation, characteristics, and applications of power semiconductor, switching, and optoelectronic devices. **(Understand-L2)**

UNIT-I

PN Junction Diode: PN junction formation and depletion region; diode V-I characteristics; diode approximations (ideal, second, and third approximation); effect of temperature on diode behaviour.

PN junction formation and depletion-region analysis; diode current (Shockley) equation and its derivation; junction and diffusion capacitance; diode small-signal (AC) resistance.

UNIT-II

Diode Circuits — Rectifiers, Filters and Voltage Regulation: Half-wave and full-wave rectifiers; bridge rectifier; ripple factor and rectification efficiency; capacitor filters; Zener diode characteristics and basic voltage-regulator design; elementary DC power-supply design, Zener-regulator performance analysis — line regulation, load regulation, and output resistance.

UNIT-III

Bipolar Junction Transistors — Construction and Characteristics: BJT construction and operation; CE, CB, CC configurations; current components; input/output characteristics; active, cutoff, and saturation regions; qualitative operating-point concept; Voltage transfer characteristics of BJT device; Transistor based voltage regulator design (Series and Shunt).

UNIT-IV

Field Effect Transistors — Construction and Characteristics: JFET construction and characteristics; MOSFET (enhancement and depletion type) construction and characteristics; transfer characteristics; comparison of BJT and FET (input impedance, noise, typical applications). MOSFET non-ideal effects

UNIT-V

Special Semiconductor and Optoelectronic Devices: Power BJT, Power MOSFET, Second breakdown of BJT, SCR construction, operation, and triggering; UJT and its relaxation-oscillator/triggering application; brief introduction to DIAC and TRIAC; LED and photodiode operation; solar (photovoltaic) cell basics.

Text Books:

1. Ben G. Streetman, Sanjay Banerjee (2015), Solid State Electronic Devices (7th Edition), Pearson.
2. Donald A Neaman, Semiconductor Physics and Devices-Basic Principles (4th Edition), Mcgraw-Hill.

Reference Books:

1. Millman, J., & Halkias, C. C. (2010). Electronic devices and circuits (2nd ed.). McGraw-Hill Education.
2. Ned Mohan, Tore M. Undeland, William P. Robbins (2022), Power electronics, 3ed: Converters, Applications and Design. Wiley.
3. S. M. Sze, Y. Li, and K. K. Ng (2021), Physics of Semiconductor Devices, 4th ed. Hoboken, NJ, USA: John Wiley & Sons.
4. R. S. Ramshaw (1993), Power Electronics Semiconductor Switches, 2nd ed. London, U.K.: Springer.

Web Resources:

1. https://nptel.ac.in/courses/117106091
2. https://nptel.ac.in/courses/108106181

B.Tech.(II Sem)	A2620202- Engineering Graphics	L	T	P	Cr.
		0	1	3	2.5

Common to ME, CE, ASE, EEE

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

Course Objectives: The course aims to:

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

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

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

SECTION A – Manual Engineering Drawing

Exp. Practical Exercise

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

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

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

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

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

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

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

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

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

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

SECTION B – Computer-Aided Engineering Graphics (CAD)

Exp. Practical Exercise

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

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

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

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

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

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

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

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

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

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

Text Books

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

Reference Books

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

B.Tech.(II Sem)

A2620012- Design Thinking & Innovation

L	T	P	Cr.
0	1	3	2.5

Course Objectives

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

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

CO1	Explain the principles, processes and mindset of Design Thinking for engineering problem-solving and innovation	K2
CO2	Apply empathy, observation and problem-framing techniques to identify user needs and define engineering problems	K3
CO3	Apply creative and systematic ideation techniques to generate and select innovative solution concepts	K3
CO4	Analyze solution concepts and prototypes using user feedback and appropriate design criteria for iterative improvement	K4
CO5	Analyze the innovation potential of solutions considering value proposition, feasibility, sustainability, societal impact and basic IPR aspects	K4

UNIT	COURSE CONTENT
UNIT-I	**Design Thinking Foundations & Empathy** Introduction to Design Thinking; Design thinking mindset and principles; Design thinking vs. conventional engineering problem-solving; Human-centered design; Five-stage design thinking process; Creativity, curiosity and observation; Understanding users and stakeholders; Empathy and user research; Interviews, observation and contextual inquiry; Empathy mapping; Personas and user journeys; Identifying explicit and latent/unarticulated needs; Ethical considerations in user research **Practical Activities** • Observation of a real-life problem Conducting • user interviews Preparing an empathy map • Developing a persona • Preparing a user journey map **Unit Outcome** Students will be able to **understand users, identify their needs and translate observations into meaningful design opportunities**.

UNIT-II	**Problem Definition, Analysis & Opportunity Identification** From observations to insights; Data synthesis and affinity mapping; Identifying patterns and pain points; Problem statements; Point-of-View (POV) statements; "How Might We" (HMW) questions; Stakeholder mapping; 5 Whys and root-cause analysis; Problem prioritization; Need Opportunity mapping; Problem validation; Design constraints and specifications; Social, environmental and sustainability considerations; Identifying opportunities for innovation **Practical Activities** • Affinity mapping of interview data • Develop three alternative problem statements Prepare POV • and HMW statements Stakeholder map • Root-cause analysis • Select and validate one problem/opportunity **Unit Outcome:** Students will be able to **analyze user research, identify root causes, frame well-defined problems and recognize opportunities for innovative solutions**
UNIT-III	**Creativity, Ideation & Concept Development** Creativity and innovation mindset; Divergent and convergent thinking; brainstorming and brainwriting; SCAMPER; Mind mapping; Reverse brainstorming; Analogical thinking; Biomimicry; Lateral thinking; Forced connections; Morphological analysis; TRI basic principles; Individual and collaborative ideation; AI-assisted ideation: opportunities and limitations; Idea clustering and screening; Impact feasibility matrix; Concept selection; Design criteria and decision matrix **Practical Activities** • Generate 20–30 ideas for a selected problem SCAMPER • exercise • Brainwriting exercise Biomimicry- • based ideation • AI-assisted idea generation and critical evaluation Prepare an idea- • selection matrix • Select the top 2–3 concepts **Unit Outcome** Students will be able to **generate diverse solution concepts using creative techniques and systematically select promising ideas based on defined criteria**.
UNIT-IV	**Prototyping, Experimentation & Validation** Concept development; Prototype mindset; Types of prototypes: Paper prototype, Physical prototype, Digital prototype, Storyboard, Roleplay, Service prototype; Low-fidelity and high-fidelity prototypes; Rapid prototyping; "Fail fast, learn fast"; Minimum Viable Prototype (MVP) ; Design experimentation; Prototype evaluation; User testing; Think-aloud method; Feedback collection; Usability and functionality testing; Iterative design; Design critique; Documentation of iterations ; Use of CAD, simulation and AI-assisted visualization tools **Practical Activities** • Develop a low-fidelity prototype • Prepare a storyboard • Build a physical/digital prototype • Conduct user testing • Collect structured feedback • Modify the prototype • Prepare an iteration log

UNIT-V	**Innovation, Value Creation & Communication** **Innovation: meaning, characteristics and importance:** Invention vs. innovation ; Incremental, disruptive and radical innovation; Product, process, service and social innovation ; Technology-driven vs. need-driven innovation ; Sustainable and frugal innovation ; Innovation opportunities and emerging technologies ; From prototype to innovation ; Desirability, feasibility and viability ; Value Proposition ; Value Proposition Canvas ; Introduction to Business Model Canvas ; Customer segments and stakeholder value; Innovation validation; Market/user validation. Intellectual Property Rights introduction; Patents, copyright, trademarks and design protection; Responsible innovation; Inclusive and sustainable innovation; Innovation ecosystem and entrepreneurship; Communicating innovative ideas; Innovation pitch **Practical Activities** 1. Classify existing products/services as incremental, disruptive or radical innovations. 2. Identify three innovation opportunities from a campus/community problem. 3. Prepare a **Value Proposition Canvas**. 4. Validate the proposed innovation with potential users. 5. Prepare an introductory **Business Model Canvas**. 6. Identify possible IPR protection. Prepare and deliver a **3-minute Innovation Pitch**.

Text Books

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

Reference Books

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

Web References

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

B.Tech.(II Sem)

A2620204 - Semiconductor Devices Lab

L	T	P	Cr.
0	0	3	1.5

Pre-requisite: Basic Electrical Circuits

Course Objectives: The objective of this course is to provide students with practical knowledge of semiconductor devices and their applications in electrical and electronic circuits. It enables students to experimentally study the characteristics and operation of diodes, BJTs, FETs, SCRs, UJTs, and optoelectronic devices, while developing skills in circuit design, construction, testing, and analysis. The course also provides hands-on experience in using electronic measuring instruments, evaluating circuit performance, and comparing theoretical results with experimental observations.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Analyze the V–I characteristics and basic electrical parameters of PN junction and Zener diodes. **(Apply-L3)**
CO2: Construct and evaluate rectifier, filter, and voltage-regulator circuits and determine their performance parameters. **(Apply-L3)**
CO3: Determine and interpret the characteristics, current gain, and operating regions of BJT circuits and analyze their applications in voltage regulation. **(Apply-L3)**
CO4: Analyze and compare the characteristics and basic applications of JFET and MOSFET devices. **(Apply-L3)**
CO5: Demonstrate and evaluate the operation of SCR, UJT, LED, photodiode, and solar-cell circuits through experimental measurements. **(Apply-L3)**

List of Experiments

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

1. V–I Characteristics of PN Junction Diode.
2. Study of Zener Diode Characteristics and Zener Voltage Regulator
3. Half-Wave and Full-Wave Rectifiers
4. Bridge Rectifier with Capacitor Filter
5. BJT Characteristics in Common-Emitter Configuration
6. Determination of BJT Current Gain and Operating Point
7. BJT-Based Series Voltage Regulator
8. JFET Drain and Transfer Characteristics
9. MOSFET Characteristics
10. SCR V–I Characteristics and Triggering
11. UJT Relaxation Oscillator and SCR Triggering
12. Characteristics of LED, Photodiode and Solar Cell

B.Tech.(II Sem)	A2620008- AI Tools & Applications	L	T	P	Cr.
		0	1	3	2.5

Course Outline:

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

Course Objectives: The main objectives of the course are to

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

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

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

UNIT	CONTENTS	Contact Hours
UNIT – 1	**Introduction to AI and the AI Tools Landscape** **What is AI, Machine Learning, and Generative AI** — basic definitions and how they relate to one another. **Core categories of AI tools**: conversational/text, code assistants, data-analysis tools, image-generation tools, and writing/productivity tools. **Large language models process and generate responses** : conceptual, non-mathematical overview. **Criteria for selecting the right AI tool for a given task** — accuracy needs, cost, data sensitivity, and output format. **Setting up accounts and workspaces**: understanding free-tier versus paid-tier capabilities and limitations. **Widely Used AI Tools by Application:**	9

Category	Example Tools	Typical Application
Conversational / General-Purpose AI	ChatGPT, Claude, Gemini, Perplexity	Writing, research, coding help, file/data analysis, cited web search
AI Coding Assistants	GitHub Copilot, Cursor, Claude Code	In-IDE code completion, AI-native editing, multi-file agentic coding
Data Analysis Tools	ChatGPT (Advanced Data Analysis), Microsoft Copilot in Excel, Julius AI	Upload a dataset, generate statistics/charts, spreadsheet formulas via natural language
Image Generation	Midjourney, DALL·E 3, Stable Diffusion / Flux	Illustrations, concept art, design mockups
Writing & Productivity	Grammarly, Gamma, Fathom, Notion AI	Grammar/style checking, slide generation, meeting summaries, task automation
Audio, Video & Presentation (optional)	ElevenLabs, Runway/Sora, Synthesia	Text-to-speech, AI video generation, script-to-video presentations

Unit Outcome(s):

1. Identify the categories of AI tools available and select an appropriate tool for a given academic or engineering task.

Teacher Practical Examples (for classroom demonstration):

1. Live comparison of the same general engineering query (e.g., "explain the engineering design process") answered by two different AI chatbots, highlighting differences in response style and accuracy.
2. Walkthrough of an AI tool's interface — settings, conversation history, file upload, and model selection — using a common platform.

Student Exercise Problems (for practice):

1. Create accounts on two AI platforms and compare their responses to a simple engineering question (e.g., "explain the difference between analysis and design").
2. Prepare a one-page comparison chart of five AI tools by category and primary use case.
3. Write a short reflection identifying one task in your daily academic life where an AI tool could help.

UNIT – 2

Prompt Engineering and Generative AI Tools

Anatomy of a good prompt — context, clear instruction, desired format, and constraints.

Types of prompt Techniques:

Zero-shot, few-shot, and chain-of-thought prompting techniques and when to use each.

Role-based and context-setting prompts (e.g., asking the AI to respond as a reviewer, tutor, or domain expert).

Iterative prompt refinement — diagnosing a poor AI response and rewriting the prompt to fix it.

Using generative AI ----for brainstorming, summarizing, and drafting technical content.

Unit Outcome(s):

1. Construct clear, well-structured prompts using zero-shot, few-shot, and chain-of-thought techniques to obtain reliable AI output.

9

	Teacher Practical Examples (for classroom demonstration): 1. Refine a vague prompt (e.g., "explain project scheduling") into a precise one step-by-step, showing output improvement at each stage. 2. Demonstrate few-shot prompting by providing examples to guide the AI toward a specific output format (e.g., a formatted comparison table). **Student Exercise Problems (for practice):** 1. Write three versions of a prompt (basic, detailed, role-based) for the same task and compare outputs. 2. Use an AI tool to summarize a one-page technical article and verify the summary against the original. 3. Draft a chain-of-thought prompt to solve a multi-step numerical/logical problem (e.g., a unit-conversion or estimation problem) and check the reasoning.	
UNIT – 3	**AI Tools for Data Analysis and Visualization** AI-assisted spreadsheet and dataset analysis using natural-language commands. Natural-language querying of datasets to extract summary statistics and insights. AI tools for generating charts, graphs, and visual summaries from tabular data. Interpreting AI-generated statistical summaries correctly and recognizing their limitations. Identifying and correcting errors or misinterpretations in AI-generated data analysis. **Unit Outcome(s):** 1. Use AI tools to clean, summarize, and visualize a dataset via natural-language commands, and identify errors in AI-generated analysis. **Teacher Practical Examples (for classroom demonstration):** 1. Upload a small dataset (e.g., class attendance or survey data) to an AI tool and generate a summary-statistics report and chart using natural-language commands. 2. Show an example where an AI tool misinterprets data (e.g., treats a numeric code as text), and demonstrate how to verify and correct it. **Student Exercise Problems (for practice):** 1. Use an AI tool to clean and summarize a small sample dataset (e.g., class attendance or marks data). 2. Generate three different chart types from the same dataset using AI prompts and justify which is most appropriate. 3. Cross-check one AI-generated statistical claim manually and report any discrepancy found.	9
UNIT – 4	**AI Tools for Coding, Writing, and Productivity** AI coding assistants — code generation, explanation, and debugging support for simple programs. AI writing assistants for reports, emails, and technical documentation. AI tools for scheduling, note-taking, and meeting/lecture summarization. AI-assisted presentation and slide-outline generation from a topic prompt. Integrating AI tools into an efficient day-to-day academic and engineering. **Unit Outcome(s):** 1. Apply AI coding assistants and writing tools to complete and refine a simple technical task. 2. Integrate multiple AI tools into a coherent workflow.	9

	Teacher Practical Examples (for classroom demonstration): 1. Use an AI coding assistant to generate a simple program (e.g., a temperature converter), then intentionally introduce a bug and have the AI debug it. 2. Generate a presentation outline and speaker notes from a topic prompt using an AI writing/productivity tool. **Student Exercise Problems (for practice):** 1. Use an AI coding tool to write and debug a simple program for a given problem statement. 2. Draft a formal email or short report using an AI writing assistant, then manually edit it for accuracy and tone. 3. Generate a slide outline for a 5-minute seminar topic using an AI tool and refine it.	
UNIT – 5	**Ethics, Reliability, and Emerging Trends** Bias and hallucination in AI outputs, and techniques for detecting and fact-checking them. Academic integrity and appropriate citation of AI assistance in coursework and submissions. Data privacy and security considerations, including obligations under India's Digital Personal Data Protection Act, 2023 (DPDP Act), when uploading personal or institutional data. Copyright and intellectual property considerations in AI-generated text and image content. Emerging trends — multimodal AI and AI agents — and their implications for future engineering practice. **Unit Outcome(s):** 1. Evaluate AI-generated output for hallucination, bias, and copyright concerns, and apply ethical and data-privacy principles to AI tool use. **Teacher Practical Examples (for classroom demonstration):** 1. Show a documented case of AI hallucination (a fabricated fact or citation) and demonstrate how to fact-check it. 2. Walk through an example of properly citing AI assistance in an academic submission per institutional guidelines. 3. Walk through a worked example of checking whether AI-generated text or image output raises a copyright/IP concern (e.g., close paraphrasing of a source). **Student Exercise Problems (for practice):** 1. Identify and document a hallucination or bias instance produced by an AI tool on a factual query. 2. Draft an "AI usage declaration" for a hypothetical assignment, citing tools and extent of use appropriately. 3. Review the data-handling/privacy policy of one AI tool used in this course and identify one DPDP Act, 2023 compliance consideration relevant to student data.	9
	Total	**45**

Text Books

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

Reference Books

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

Web Resources

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

Review Questions

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

Practical Applications

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

B.Tech.(II Sem)

A2620205- Chemistry for Electrical Systems Lab

L	T	P	Cr.
0	0	3	1.5

Pre-requisite: Concurrent with Chemistry for Electrical Systems (Theory).

Course Objectives:

- To develop understanding of electrochemical principles through EMF measurement, Nernst equation verification, corrosion of metals, galvanic degradation and water electrolysis.
- To train students in assessing resistivity, temperature coefficient of conducting wires and properties of transformer oil.
- To familiarize students with electroanalytical techniques (conductometry, potentiometry, pH-metry) for acid-base and redox titrations.
- To introduce quantum mechanical concepts (photoelectric effect, atomic emission spectra) through experimental verification and expose students to nanomaterial characterization and emerging applications of electrochemical biosensors in sensing technology.
- To develop skills in the preparation and characterisation of nanomaterials and in safe laboratory practice, data analysis and technical reporting.

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

CO	Course Outcome Statement	Knowledge Level (K)#
CO1	Determine the EMF of a galvanic cell and verify the Nernst equation, corrosion of metals, and study electrochemical water electrolysis for hydrogen production.	**K3** (Apply)
CO2	Determine resistivity and temperature coefficient of resistance of conducting wires used in electrical applications, properties of transformer oil.	**K3** (Apply)
CO3	Apply conductometric, potentiometric, and pH-metric methods to perform acid-base and redox titrations, and determine battery electrolyte strength.	**K4** (Analyze)
CO4	Verify quantum mechanical phenomena (photoelectric effect, atomic emission spectra), characterize colloidal nanoparticle size, and evaluate an enzyme-based electrochemical biosensor.	**K4** (Analyze)
CO5	Conduct experiments safely following laboratory protocols, record, interpret and report data working individually and in teams.	**K3** (Apply)

LIST OF EXPERIMENTS

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

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

1. Determination of the EMF of a Daniel cell and verification of the Nernst equation.
2. Particle Size Estimation of Colloidal Nanoparticles (Tyndall Effect and Color-Based Study).
3. Conductometric titration of a strong acid against a strong base.
4. Determination of the corrosion rate of a mild-steel specimen by the weight-loss method.
5. Study of galvanic corrosion between dissimilar metals used in electrical connectors (e.g., Cu–Al couple).
6. Determination of the resistivity and temperature coefficient of resistance of conducting wires (copper/aluminium).
7. Determination of the breakdown voltage (dielectric strength) of transformer oil.
8. Determination of the acid value and moisture content of transformer oil.
9. Determination of the viscosity of an insulating oil using a Redwood viscometer.
10. Determination of the flash point and fire point of a transformer/insulating oil.
11. Verification of the photoelectric effect and estimation of Planck's constant.
12. Study of the emission spectrum of a hydrogen/mercury-vapour lamp using a spectrometer.
13. Determination of a strong acid against a strong base by using potentiometer.
14. Determination of a strong acid against a strong base by using pH meter.

15. Redox titration by using potentiometer.
16. Determination of the concentration/strength of sulfuric acid in Pb-acid battery electrolyte.
17. Study the electrochemical production of hydrogen by water electrolysis. (virtual lab)
18. Construction and performance evaluation of a simple enzyme based electrochemical biosensor for glucose detection. (demo)

References:

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

B.Tech.(II Sem)

A2620014- IT and Electronics Workshop

L	T	P	Cr.
0	0	3	1.5

Pre-requisites: NIL

Course Objectives (CO):

- Familiarize students with computer hardware, operating systems, peripheral devices and software installation.
- Develop practical skills in computer networking, internet technologies and collaborative platforms.
- To develop basic skills in MS Word, MS Excel, and MS PowerPoint for creating documents, working with data, and preparing presentations
- Develop hands-on skills in basic electronics, circuit assembly, soldering, and measurement, testing and troubleshooting.
- Develop an industry-oriented mini hardware prototype by integrating basic electronics, sensors, embedded software and appropriate documentation.

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

CO1: Assemble, configure and troubleshoot computer hardware, operating systems and software systems (K3).

CO2: Configure wired and wireless networks and use internet, cloud collaboration and related digital tools (K3).

CO3: Apply practical skills in Linux, MS Word, MS Excel, and MS PowerPoint to manage files, create documents, analyze data, and prepare presentations. (K3).

CO4: Apply practical skills to identify, test, assemble, solder, and measure basic electronic components and circuits. (K3).

CO5: Develop troubleshooting and problem-solving skills through the construction and demonstration of simple electronic circuits and mini projects (K5).

List of Experiments:

1. PC Hardware Component Identification and Testing
2. Desktop Computer Assembly
3. Windows/Linux Installation and Basic Troubleshooting
4. LAN Configuration and Network Cable Testing
5. Wi-Fi Router Configuration
6. Basic Linux Commands and File Management
7. Using MS Word, create a comprehensive document that integrates certificate creation, project abstract writing, and newsletter design while demonstrating all major formatting, layout, and editing features.
8. Using MS Excel, prepare a scheduler and GPA sheet applying formatting, formulas, charts, and multiple worksheets. Extend the project with data analysis using LOOKUP/VLOOKUP, sorting, logical operators, conditional formatting, and pivot tables.
9. Using MS PowerPoint, create an interactive presentation that demonstrates layouts, WordArt, multimedia insertion, hyperlinks, master layouts, views, backgrounds, and design templates.
10. Identification and Testing of Basic Electronic Components
11. Basic Electronic Circuit Assembly Using Breadboard
12. Soldering and Desoldering Practice
13. Measurement and Testing Using a Digital Multimeter
14. Construction and Troubleshooting of a Simple Electronic Circuit
15. Mini Project Development and Demonstration

Learning Resources:

Text Books:

1. V. K. Mehta and Rohit Mehta, Principles of Electronics, S. Chand & Company.
2. B. S. Raghuwanshi, A Course in Workshop Technology, Dhanpat Rai & Sons.
3. Vishnu P. Singh, Computer Hardware Course, Asian Publishers/Computech Publications.

Reference Books:

1. Comdex Information Technology course tool kit, Vikas Gupta, WILEY Dream tech, 2003
2. IIT Essentials PC Hardware and Software Labs and Study Guide, Patrick Regan– CISCO Press, Pearson Education, 3rd edition
3. Electronic Principles,Albert Malvino & David J. Bates,8th Edition,Components, breadboard circuits, measurements, troubleshooting.
4. Electronic Devices and Circuit Theory,Robert L. Boylestad & Louis Nashelsky,11th Edition,Basic electronic components, diode/transistor testing, simple circuits.

Online Resources:

1. **NPTEL – Computer Networks** – for networking fundamentals and practical concepts.
2. **NPTEL – Computer Networks and Internet Protocol, IIT Kharagpur** – for TCP/IP and Internet fundamentals.
3. **Ubuntu Official Documentation** – for Linux installation, file management, networking and system administration.
4. **NPTEL – Basic Electronics, IIT Bombay** – for basic electronic circuits and components.
5. **NPTEL – Basic Electronics and Lab, IIT Madras** – particularly useful for the practical electronics component.
6. **Tinkercad Circuits** – for virtual breadboard and circuit prototyping.
7. **Arduino Documentation** – for the mini-project/embedded-prototyping component.