JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
(Established by Govt. of A.P., ACT No.30 of 2008)
KAKINADA – 533 003 (A.P) INDIA
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Vision and Mission of the University

Vision

The University is primarily promoting quality of education in the areas of Science, Technology, Engineering, Mathematics (STEM) and also Management disciplines, as academic pillars of education, to excel in teaching, learning, research, consultancy, placements through innovative practices with a global perspective and entrepreneurship skills

Mission

The University is moving forward with a mission of promoting excellence, access, inclusion, and relevance in quality in Science, Technology, Engineering, Mathematics, and Management disciplines, viz.,

- Design an Industry relevant curriculum from time to time with a Global perspective.
- Promoting quality education by embracing ICT delivery mechanism with continuous pedagogy through e-learning mechanism.
- Spread across for industry collaborations with a focus on pre-training and placements for technology transfer to society.
- Establishing centers of excellence to promote research and innovations in multidisciplinary areas to bring in patent culture and consultancy practices.
- International Collaborations for student outreach facilitating international students to study in JNTUK to infuse cross-culture learning practices.
- Academic Excellence, Research & Innovation, People Technology & Creativity, Social & Environmental Responsibility, Human & Intellectual Knowledge.

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Vision and Mission of the Institute

Vision and Mission of the Department

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B.Tech

Program Educational Objectives (PEOs) – Program Educational Objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve
BoS needs to include PEOs (Three to Five)

Mapping of PEOs with Mission statements

	PEO1	PEO2	PEO3	PEO4
M1				
M2				
M3				
M4				

Program Outcomes (POs)

POs are statements that describe what students are expected to know and be able to do upon completion of the program. These relate to the skills, knowledge, attitude and analytical ability and behavior that students acquire through the program.

(As defined by NBA)

Program Outcomes (POs)

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

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for

i) independent and life-long learning
ii) adaptability to new and emerging technologies and
iii) critical thinking in the broadest context of technological change.

BoS needs to include up to THREE Program Specific Outcomes (PSOs)

Categories of Courses:

BSC : Basic Science Courses
HSM : Humanities, Social Sciences including Management
ESC : Engineering Science Courses
PCC : Professional Core Courses
PEC : Professional Elective Courses (including Skill Enhancement)
OEC : Open Elective Courses (including Free 1 credit courses)
MNC : Mandatory Non-Credit Courses

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Credits Distribution – Based on Category (Credits per year - for 1, 2, 3 years are - 42 ONLY)

	I year		II year		III year		IV year		
Category/ Semester	I	II	III	IV	V	VI	VII	VIII	Credits
BSC	7.5	7.5	3	3	0	0	0	0	21
HSM	4.5	0	0	0	0	4	0	0	8.5
ESC	9	6	5.5	0	0	0	3	0	23.5
PCC	0	7.5	12	18.5	14	8	0	0	60
PEC	0	0	0	0	3	5	16	0	24
OEC	0	0	0	0	3	3	0	5	11
Internship & Project work	0	0	0	0	2	0	2	12	16
MNC	0	0	0	0	0	0	0	0	0
Total	21	21	20.5	21.5	22	20	21	17	**164**

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B.Tech Program Course Structure & Syllabus

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B.TECH - ELECTRICAL & ELECTRONICS ENGINEERING

Course Structure

B.Tech. – I Year I Semester (I semester)

S.No.	Course Category	Course Code	Title	L	T	P	Credits
1	BSC		Linear Algebra and Calculus	3	0	0	3
2	BSC		Physics for Electrical Systems	3	0	0	3
3	ESC		Computational Thinking and Problem Solving with C	3	0	0	3
4	ESC		Basic Electrical Circuits	3	0	0	3
5	HSM		English for Technical Communication	3	0	0	3
6	BSC		Physics for Electrical Systems Lab	0	0	3	1.5
7	ESC		Computational Thinking and Problem Solving with C Lab	0	0	3	1.5
8	HSM		English for Technical Communications and Moodles Lab	0	0	3	1.5
9	ESC		Basic Electrical Circuits Lab	0	0	3	1.5
10	MNC		NSS / NCC / Community Service	0	0	2	0
		Total		**15**	**0**	**14**	**21**

B.Tech (I year - II Semester) – II semester

S.No.	Course Category	Course Code	Title	L	T	P	Credits
1	BSC		Differential Equations and Vector calculus	3	0	0	3
2	BSC		Chemistry for Electrical Systems	3	0	0	3
3	PCC		Electrical Circuit Analysis	3	0	0	3
4	PCC		Semiconductor Devices	3	0	0	3
5	ESC		Engineering Graphics	0	1	3	2.5
6	BSC		Chemistry for Electrical Systems Lab	0	0	3	1.5
7	PCC		Electrical Circuit Analysis Lab	0	0	3	1.5
8	ESC		Design Thinking and Innovation	0	1	3	2.5
9	ESC		IT & Electronic Workshop	0	0	2	1
10	MNC		Sports and Yoga	0	0	2	0
		Total		**12**	**2**	**16**	**21**

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B.Tech.– II Year I Semester (III Semester)

S.No.	Course Category	Course Code	Title	L	T	P	Credits
1	BSC		Numerical Methods and Complex Variables	3	0	0	3
2	PCC		Analog Electronic Systems	3	0	0	3
3	PCC		Electromagnetic Field Theory	3	0	0	3
4	PCC		DC Machines and Transformers	3	0	0	3
5	ESC		Data Structures using C	3	0	0	3
6	ESC		AI Tools and Applications	0	1	3	2.5
7	PCC		Analog Electronic Systems Lab	0	0	3	1.5
8	PCC		DC Machines and Transformers Lab	0	0	3	1.5
9	MNC		Environmental Science for Engineers	2	0	0	0
Total				**17**	**1**	**9**	**20.5**

B.Tech. II Year II Semester (IV Semester)

S. No	Course category	Course Code	Title	L	T	P	Credits
1	BSC		Probability and Statistics	3	0	0	3
2	PCC		Induction and Synchronous Machines	3	0	0	3
3	PCC		Operational Amplifiers and Linear IC applications	3	0	0	3
4	PCC		Digital System Design	3	0	0	3
5	PCC		Generation and Transmission of Electrical Power	3	0	0	3
6	PCC		Electrical & Electronic Measurements	2	0	0	2
7	PCC		Induction & Synchronous Machines Lab	0	0	3	1.5
8	PCC		Operational Amplifiers and Linear IC applications Lab	0	0	3	1.5
9	PCC		Digital Systems Design Lab	0	0	3	1.5
10	MNC		Indian Knowledge and Creative Thinking	2	0	0	0
Total				**19**	**0**	**9**	**21.5**
Mandatory Industry Internship / CSP / Mini Project of 06 weeks duration during summer vacation							

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III B.Tech I Semester (V Semester)

S. No.	Course Category	Course Code	Title	L	T	P	Credits
1	PCC		Power Electronics	3	0	0	3
2	PCC		Signals and Systems	2	0	0	2
3	PCC		Control Systems	3	0	0	3
4	PCC		Power System Analysis and Stability	3	0	0	3
5	PEC		Professional Elective-I • Digital VLSI • Electrical Distribution Systems • Utilization of Electrical Energy • Sensors & Actuators for IoT	3	0	0	3
6	OEC		Open Elective-I	3	0	0	3
7	PCC		Power Electronics Lab	0	0	3	1.5
8	PCC		Power Systems Lab	0	0	3	1.5
9	Internship /Project work		Evaluation of industry Internship/ CSP / Mini Project*	0	0	0	2
10	MNC		Universal Human Values-II	2	0	0	0
Total				**19**	**0**	**6**	**22**

* performed during IV to V Semester break

Courses offered under Open Elective-I (for other department students):

1. Renewable Energy Systems
2. Fundamentals of Electric Vehicles
3. Introduction to Microcontrollers & Embedded Interfacing

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III B.Tech II Semester (VI Semester)

S.No.	Course Category	Course Code	Title	L	T	P	Credits
1	PCC		Microcontrollers & Embedded C Programming	3	0	0	3
2	PCC		Switch Gear and Protection	2	0	0	2
3	HSM		Engineering Economics and Financial Analysis	3	0	0	3
4	PEC		Professional Elective-II • CMOS Analog IC Design • Advanced Power Converters • HVDC Transmission & FACTS • Digital Signal Processing	3	0	0	3
5	PEC		Professional Elective –III • Power Quality & Harmonics • Advanced control systems • Solar PV Systems Engineering • AI applications in Electrical Engineering	2	0	0	2
6	OEC		Open Elective-II	3	0	0	3
7	HSMC		Soft Skills	0	0	2	1
8	PCC		Microcontrollers & Embedded C Programming Lab	0	0	3	1.5
9	PCC		Control & Measurements Lab	0	0	3	1.5
10	MNC		Research Methodology	2	0	0	0
Total				**18**	**0**	**8**	**20**
Industry Internship / Mini Project of 06 weeks duration during summer vacation							

Courses offered under Open Elective-II (for other department students):

1. Energy Auditing & Conservation
2. Basics of Power Electronic Converters
3. Electrical Wiring, Earthing & Safety

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IV year – I Semester (VII Semester)

S.No	Course Category	Course Code	Title	L	T	P	Credits
1	ESC		Fundamentals of Quantum Computing	3	0	0	3
2	PEC		Professional Elective-IV • Electric Drives • Smart Grid Technologies • Wind Energy Conversion Systems • Advanced Power System Protection	3	0	0	3
3	PEC		Professional Elective-V • Electric Vehicles • Power System Operation and Control • Digital Control Systems • Industrial Automation & PLC Programming	3	0	0	3
4	PEC		Professional Elective-VI • Energy Storage Systems • Distributed Generation and Microgrids • Communication Systems • Power System Deregulation	3	0	0	3
5	PEC		Professional Elective -VII • IoT Applications in Electrical Engineering • Electrical System Design, Estimating and Costing • Battery Management Systems and Charging Stations • Skill based Courses offered by SWAYAM Plus	3	0	0	3
6	PEC		Professional Elective –VIII • Energy Auditing and Management • Smart Automation and Sensing Technologies • Applied Finite Element Analysis (FEA) for Electrical Systems • Skill based Courses offered by SWAYAM Plus	3	0	0	3
7	PEC		Professional Elective –IX • IoT Applications in Electrical Engineering Lab • PCB Design and Prototype Fabrication Lab • Power Electronic Converter Analysis Simulation Lab • Digital controllers for Power Electronic Converters Lab	0	0	2	1
8	Internship/ project		Evaluation of Industry Internship / Mini Project*	0	0	0	2
Total				**18**	**0**	**2**	**21**

*Includes evaluation of mini project

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IV B.Tech. II Semester (VIII Semester)

S.No	Course Category	Course Code	Title	L	T	P	Credits
1	OEC		Open Elective -III / SWAYAM/NPTEL 12 week course	3	0	0	3
2	OEC		Open Elective – IV / SWAYAM/NPTEL 8 week course	2	0	0	2
3	Internship / Project work		Project Work / Industrial Internship	0	0	24	12
Total				**5**	**0**	**24**	**17**

Courses offered under Open Elective- III (for other department students):

1. Fundamentals of Utilization of Electrical Energy
2. Fundamentals of Digital Electronics
3. SWAYAM / NPTEL MOOC (BoS need to suggest the courses)

Courses offered under Open Elective- IV (for other department students):

1. Fundamentals of Control Systems
2. Introduction to Internet of Things
3. SWAYAM / NPTEL MOOC (BoS need to suggest the courses)

Minors Courses offered by EEE to other Departments

S.No	Year-Sem	Course Title	L	T	P	C
1	II - I	Power Electronics	3	0	0	3
2	II - II	Electric Drives and Motor Control	3	0	0	3
3	II - II	Power Electronics Lab	0	0	3	1.5
4	III - I	Electric Drives and Motor Control Lab	0	0	3	1.5
5	III - I	EV Powertrain & Battery Management Systems	3	0	0	3
6	III - II	EV Charging technologies	3	0	0	3
7	IV - I	Solar & Wind Energy Systems	3	0	0	3
Total			**15**	**0**	**6**	**18**

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Honor's Courses offered by EEE Department

S.No	Year-Sem	Course Title	L	T	P	C
1	III - I	Applications of Power Electronic Converters	3	0	0	3
2	III - I	Switched Mode Power Conversion	3	0	0	3
3	III - II	Electrical Machine Modelling and Analysis	3	0	0	3
4	IIII - II	Advanced Electric Drives	3	0	0	3
5	IV - I	Digital Controllers for Power Electronic Applications	3	0	0	3
6	IV - I	Advanced Power Converters Lab	0	0	3	1.5
7	IV - I	Electric Drives Lab	0	0	3	1.5
Total			**15**	**0**	**6**	**18**

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COURSE CODE	LINEAR ALGEBRA AND CALCULUS (Common to All Branches)	CATEGORY BSC	L-T-P-C 3-0-0-3

Pre-requisite: Mathematics of 10+2 / Intermediate level (algebra, matrices and basic calculus)

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

CO1: Apply matrix algebra and numerical techniques to determine the rank, inverse, eigenvalues and eigenvectors of matrices, solve homogeneous and non-homogeneous systems of linear equations using direct and iterative methods, and analyze their applications in engineering and scientific problems (K2, K3, K5).

CO2: Analyze and solve engineering problems by applying matrix diagonalization, Singular Value Decomposition (SVD), the Cayley-Hamilton Theorem for matrix inverses and powers, and orthogonal transformations to classify and reduce quadratic forms to canonical forms (K2, K3, K5).

CO3: Find the mean value of a given function and use it to estimate the bounds of a given function (K2, K3, K5).

CO4: Compute change in the dependent variable with respect to many independent variables and Jacobians. Apply the knowledge in optimizing functions of several variables (K2, K3, K5).

CO5: Compute double and triple integrals of functions of several variables and must be able to change the coordinate systems from Cartesian to polar, spherical and cylindrical coordinates (K2, K3, K5).

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	H	M											
CO2	H	H	M											
CO3	H	H	M											
Co4	H	H	M											
CO5	H	H	M											

UNIT-I

Matrices, Eigenvalues, Eigenvectors: Rank of a matrix by echelon form, normal form. Inverse of Non-singular matrices by Gauss-Jordan method, System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations, Gauss elimination method, Jacobi and Gauss Seidel Iteration Methods**.** Eigenvalues, Eigenvectors and their properties.

UNIT-II

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

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 theorems with remainders (without proof), Problems and applications on the above theorems. Taylor's and Maclaurin 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 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-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).

Learning Resources:

Text Books:

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

Reference Books:

1. Ramana, B.V. (2017). Higher Engineering Mathematics. McGraw Hill Education.
2. James, G. (2018). Advanced Modern Engineering Mathematics. 5th Edition Pearson publishers.
3. Dass, H.K. (2022). Advanced Engineering Mathematics, 22nd Edition. S. Chand Publications.

Web Resources:

- https://en.wikipedia.org/wiki/System_of_linear_equations
- https://en.wikipedia.org/wiki/Eigenvalues_and_eigenvectors
- https://www.math.hmc.edu/calculus/tutorials/eigenstuff/
- https://en.wikipedia.org/wiki/Quadratic_form
- https://en.wikipedia.org/wiki/Calculus
- https://en.wikipedia.org/wiki/Partial_derivative
- https://www.whitman.edu/mathematics/calculus_online/section14.03.html
- https://en.wikipedia.org/wiki/Multiple_integral
- http://tutorial.math.lamar.edu/Classes/CalcIII/MultipleIntegralsIntro.aspx

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COURSE CODE	PHYSICS FOR ELECTRICAL SYSTEMS (For Electrical and Allied Branches of Engineering)	CATEGORY BSC	L-T-P-C 3-0-0-3

Course Objectives

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

CO1: Apply the principles of interference, diffraction, and polarization with basic optical analysis in engineering applications. (K3)
CO2: Analyze the significant concepts of dielectric and magnetic materials that leads to potential applications in the emerging micro devices. (K4)
CO3: Analyze the electrical properties of metals and comprehend use of semiconductors and their applications. (K4)
CO4: Enlightenment of the concepts and principles of Quantum Mechanics relevant to engineering applications such as Quantum Computing for secure communication. (K2)
CO5: Apply and analyze Maxwell's equations and electromagnetic field concepts for energy transport. (K3,K4)

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	M	–	–	M	–	–	–	–	L	M			
CO2	H	M	M	L	H	–	–	–	L	L	M			
CO3	H	H	M	M	H	–	–	–	L	L	M			
CO4	M	H	M	M	M	L	–	–	L	L	M			

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

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

Diffraction and Optical Surveying: 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 **10**Hrs

Dielectric Materials: Introduction – Basic definitions – Types of polarizations – Electronic and Ionic polarisations (quantitative) – Orientational and Space Charge Polarisations (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: ELECTRICAL PROPERTIES OF METALS & SEMICONDUCTORS **9**Hrs

Electrical Properties 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 **10**Hrs

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

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

UNIT - 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.

Textbooks

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

Reference Books

1. Nielsen & Chuang, Quantum Computation & Quantum Information, Cambridge (2010).
2. D. J. Griffiths, Introduction to Electrodynamics, Cambridge.

Learning Resources & NPTEL Links

- NPTEL – nptel.ac.in
- MIT OpenCourseWare – ocw.mit.edu

- HyperPhysics – hyperphysics.phy-astr.gsu.edu
- Feynman Lectures – feynmanlectures.caltech.edu
- PhET Simulations – phet.colorado.edu
- Library of Congress – loc.gov/rr/scitech/selected-internet/physics.html

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COURSE CODE	COMPUTATIONAL THINKING AND PROBLEM SOLVING WITH C	CATEGORY ESC	L-T-P-C 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 is 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, student will be able to*

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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	H	M	L	-	-	-	-	-	-	L			
CO2	H	M	H	-	M	-	-	-	-	-	-			
CO3	H	H	H	M	-	-	-	-	-	-	L			
CO4	H	H	H	M	M	-	-	-	-	-	-			
CO5	H	M	H	L	M	-	-	-	L	-	L			

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; Expressions, Operators, type of operators- arithmetic, logical , relational, assignment, conditional, increment, decrement, etc., unary, binary, ternary, Operator Precedence and Associativity, Type Conversion; Scope, Storage Classes, and Type Qualifiers.

Bitwise Operators: Logical Bitwise Operators, Shift Operators 12Hrs

UNIT – 2: Selection and Decision-Making: Relational and Logical Operators, Two-Way and Multi-Way Selection (if-else, switch), Nested Conditionals.
Repetition: Pre-test and Post-test Loops, Counter- and Event-Controlled Loops, for/while/do-while, break and continue, Nested Loops; Programming Applications combining Selection and Repetition.
Arrays: One-Dimensional and Two-Dimensional Arrays, Multidimensional Arrays, Array-based Problem Solving (searching, sorting, averaging). 9Hrs

UNIT – 3: Strings: String Representation, Standard String-Handling Functions, Arrays of Strings, String-to-Data Conversion.
User-Defined Types: typedef, Enumerated Types, Structures, Unions, and Nested Structures; Programming Applications using Structures and Arrays of Structures.
Programming Applications: Applications combining sections and repetitions 9Hrs

UNIT – 4: Pointers: Pointer Fundamentals, Pointer-to-Pointer, Pointer Arithmetic, Pointers and Arrays, Array of Pointers, Compatibility and l-value/r-value concepts. Dynamic Memory Allocation: malloc, calloc, realloc, free.
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.
Recursion: Recursive vs. Iterative Solutions, Designing Recursive Algorithms, Recursion with Arrays and Pointers, Efficiency Considerations. 9 Hrs

UNIT – 5: Preprocessor: Directives and Macros.
File I/O: Streams, Text vs. Binary Files, Standard Library File Functions, formatted and Character I/O, Sequential File Processing. 6 Hrs

Learning Resources

Text Books:

1. Forouzan, B. A., & Gilberg, R. F. (2007). Computer science: A structured programming approach using C (3rd ed.). Cengage Learning.
2. Kernighan, B. W., & Ritchie, D. M. (1988). The C programming language (2nd ed.). Prentice Hall.

Reference Books:

1. Das, S. (2018). Computer fundamentals and programming (18th ed.). McGraw Hill Education.
2. Kamthane, A. N., & Kamthane, A. A. (2025). Programming in C (4th ed.). Pearson Education.
3. Dey, P., & Ghosh, M. (2013). Computer fundamentals and programming in C (2nd ed.). Oxford University Press.

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/

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE CODE	BASIC ELECTRICAL CIRCUITS	CATEGORY ESC	L-T-P-C 3-0-0-3

Pre-requisite: NIL

Course Objectives:

1. To familiarize students with standard electrical wiring systems, protective devices, and load calculation methodologies for domestic/industrial installations.
2. To impart a strong foundation in DC circuit analysis using fundamental laws, network reduction techniques, and nodal/mesh approaches for dependent and independent sources.
3. To enable students to understand electromagnetic principles, analyze magnetic circuits, and evaluate mutual inductance in coupled coils.
4. To develop the ability to perform steady-state analysis of single-phase AC circuits using phasor algebra and compute real, reactive, and apparent power with power factor correction.
5. To introduce resonance phenomena in AC networks and teach the graphical interpretation of circuit behaviour through locus diagrams.

Course Outcomes:

CO1: Design electrical wiring layouts (staircase/godown), select protective devices (MCBs, ELCBs), and estimate load for proper cable sizing**.** (K3)
CO2: Analyze complex DC networks using Kirchhoff's laws, source transformation, star-delta conversion, and solve via Mesh and Nodal analysis (including dependent sources) (K4)
CO3: Analyze series/parallel magnetic circuits by calculating MMF, flux, reluctance, self/mutual inductance, and interpret dot conventions with coupling coefficients. (K4)
CO4: Compute RMS/average values of AC waveforms, perform steady-state phasor analysis of RLC circuits, and evaluate real, reactive, apparent, and complex power with power factor significance. (K4)
CO5: Evaluate series/parallel resonance parameters (bandwidth, selectivity, Q-factor) and construct/interpret locus diagrams for RL, RC, and RLC circuits with varying R, L, or C. (K5)

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	H	L	L	M	--	--	--	--	--	-			
CO2	H	H	L	L	M	--	--	--	--	--	-			
CO3	H	H	M	M	M	--	--	--	--	--	-			
CO4	H	H	M	M	M	--	--	--	--	--	-			
CO 5	H	H	M	M	H	--	--	--	--	--	-			

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

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE CODE –	ENGLISH FOR TECHNICAL COMMUNICATION	CATEGORY HSM	L-T-P-C 3-0-0-3

Pre-requisites: NIL

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: Examine discourse features and speech strategies to participate effectively in group discussions, informal exchanges, and short presentations on technical and general topics. (K4)

CO4: Evaluate the content, limitations and ethical aspects of AI tools in communication and language learning, and apply them to create concise, accurate essays/summaries. (K5)

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

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	L	M	–	–	L	M	–	–	L	H	L			
CO2	L	L	L	–	L	H	M	M	H	H	M			
CO3	L	M	L	L	L	M	L	L	H	H	M			
CO4	M	H	M	M	H	L	L	H	M	H	H			
CO5	L	M	L	L	L	M	L	L	H	H	H			

Unit 1 : Effective Communication: Exploring Channels and Methods
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
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
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
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 Wrtiting
Listening : Listening to debates and discussions.
Speaking: Power Point Presentations by Individuals and Teams.

Unit 5: Ethical Leadership: Integrating Social Responsibility and Core Values
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). NextGen 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 Blackswan 2010 (Combined edition, Vol.1 &2).
4. The Oxford Guide to Writing and Speaking by John Seely, Oxford University Press, 2004.

Web Resources:

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

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE CODE	PHYSICS FOR ELECTRICAL SYSTEMS LAB (For Electrical and Allied Branches of Engineering)	CATEGORY BSC	L-T-P-C 0-0-3-1.5

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

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COURSE CODE	COMPUTATIONAL THINKING AND PROBLEM SOLVING WITH C LAB	CATEGORY ESC	L-T-P-C 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, student will be able to*

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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	H	M	L	H	-	-	L	L	-	M			
CO2	H	M	H	-	H	-	-	L	L	-	M			
CO3	H	H	H	M	H	-	-	L	L	-	M			
CO4	H	H	H	M	H	-	-	L	L	-	M			
CO5	H	H	M	M	H	-	-	L	L	-	H			

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

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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/

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COURSE CODE –	ENGLISH FOR TECHNICAL COMMUNICATIONS AND MOODLES LABORATORY	CATEGORY HSM	L-T-P-C 0-0-3-1.5

Part – A

Course Objectives:

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

Course Outcomes:

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

CO1: Apply a variety of strategies to interpret and comprehend spoken texts/ discourse using contextual clues.
CO2: Apply appropriate reading 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.

COs\POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	–	M	–	–	L	M	–	M	M	H	–			
CO2	L	H	–	M	M	M	–	–	–	M	M			
CO3	–	M	–	–	M	M	–	H	H	H	M			
CO4	–	M	–	–	M	M	–	M	M	H	M			
CO5	–	M	–	–	L	M	–	H	H	H	M			
CO6	–	M	–	–	H	M	–	M	M	M	H			
CO7	–	M	L	M	H	M	M	H	H	H	H			

List of Experiments for the subject English for Technical Communication Lab
(Any 10 experiments in Part A)

1. Phonetics & Accent Neutralisation
   - Sound Lab Drills — Students record minimal pairs (/p/–/b/, /t/–/d/) and compare waveforms 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. Audio-based Note Taking & Narrating Events
   - Event Reconstruction — Play an audio describing an incident; students reconstruct the event in 5–6 bullet points.
   - Timeline Creation — Students listen to a process or story and create a chronological timeline.
   - Peer Narration — One student listens to an audio; narrates it to a partner who writes notes.

6. 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.

7. 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.

8. 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.

9. Explaining Concepts – Technical Text-based
   - Concept Simplification — Students take a technical paragraph and rewrite it for a layperson.
   - Peer Teaching — Each student teaches a concept from their discipline to a partner from another discipline.
   - Diagram Explanation — Provide a technical diagram; students explain it verbally.

10. 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).

11. 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.

12. 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

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Part B
(Any 4 Experiments in Part B)

Moodle Learning Management System: Digital learning an 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, CultureWizard, 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
- Resubmission and revision

4. Digital Communication and Collaboration

- Moodle forums and discussions
- Academic email etiquette
- Online communication and netiquette
- Group activities and peer learning
- Collaborative learning tools
- Digital presentation skills

5. Academic Skills for Engineering Students

- Effective note-taking
- Reading and understanding technical material
- Time management and study planning
- Problem-solving and critical thinking
- Basic research and information-search skills
- Preparing reports and presentations
- Introduction to citations and referencing

6. Academic honesty

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

7. Students can complete activities such as:

- Create and update a Moodle profile.
- Download course material and organize it into folders.
- Submit an assignment through Moodle.
- Attempt an online quiz.
- Participate in a Moodle discussion forum.
- Upload a revised assignment after receiving feedback.
- Prepare a short technical presentation.

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COURSE CODE –	BASIC ELECTRICAL CIRCUITS LAB	CATEGORY ESC	L-T-P-C 0-0-3-1.5

Pre-requisite: Nil

Course Objectives:

1. To familiarize students with electrical wiring accessories, protective devices, and the practical assembly of a single-phase distribution board for power/energy measurement.
2. To understand and verify practical control wiring circuits (staircase/godown) and experimentally validate fundamental DC network laws.
3. To enable students to measure basic electrical parameters (V, I, P) in DC circuits and compute impedance, power factor, and choke coil parameters in AC circuits.
4. To analyze magnetic coupling between coils and evaluate the frequency response characteristics (resonance, bandwidth, Q-factor) of series and parallel RLC networks.
5. To visualize and interpret the trajectory of current/voltage phasors when circuit parameters (R, L, or C) are varied in AC circuits.

Course Outcomes: *After successful completion of this course, the student will be able to*:

CO1: Identify electrical tools, cables, switches, protective devices (MCB/ELCB), and implement a functional single-phase distribution board to measure power, energy, and power factor. (K3)

CO2: Draw and verify staircase and godown wiring control diagrams, and experimentally validate Kirchhoff's Voltage Law (KVL) and Current Law (KCL) in DC circuits. **(K3)**

CO3: Measure V, I, and P in DC circuits; compute impedance, power, and power factor for series RL, RC, and RLC circuits; and determine the equivalent parameters of a choke coil. (K3)

CO4: Determine self-inductance, mutual-inductance, and coefficient of coupling for coupled coils; and evaluate resonant frequency, bandwidth, and Q-factor for both series and parallel RLC circuits. (K4)

CO5: Construct and interpret the locus diagrams for RL and RC series circuits to analyze the variation of current with changing resistance or reactance. (K4)

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	M	M	M	-	-	-	-	-	-	-	-			
CO2	H	H	H	-	-	-	-	-	-	-	-			
CO3	H	H	M	M	M	-	-	-	-	-	-			
CO4	H	H	M	M	M	-	-	-	-	-	-			
CO5	H	H	M	M	M	-	-	-	-	-	-			

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

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COURSE CODE –	NSS / NCC / COMMUNITY SERVICE	CATEGORY MNC	L-T-P-C 0-0-2-0

Pre-requisite: Nil

Course Objectives:

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

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

CO1: Understand the importance of discipline, character and service motto.

CO2: Solve some societal issues by applying acquired knowledge, facts, and techniques.

CO3: Explore human relationships by analyzing social problems.

CO4: Determine to extend their help for the fellow beings and downtrodden people.

CO5: Develop leadership skills and civic responsibilities.

UNIT I Orientation

General Orientation on NSS/NCC/ Scouts & Guides/Community Service activities, career guidance.

Activities:

i Conducting –ice breaking sessions-expectations from the course-knowing personal talents and skills
ii Conducting orientations programs for the students –future plans-activities-releasing road map etc.
iii Displaying success stories-motivational biopics- award winning movies on societal issues etc.
iv Conducting talent show in singing patriotic songs-paintings- any other contribution.

UNIT II Nature & Care

Activities:

i. Best out of waste competition.
ii. Poster and signs making competition to spread environmental awareness.
iii. Recycling and environmental pollution article writing competition.
iv. Organising Zero-waste day.
v. Digital Environmental awareness activity via various social media platforms.
vi. Virtual demonstration of different eco-friendly approaches for sustainable living.
vii. Write a summary on any book related to environmental issues.

UNIT III Community Service

Activities:

i. Conducting One Day Special Camp in a village contacting village-area leaders- Survey in the village, identification of problems- helping them to solve via media- authorities-experts-etc.
ii. Conducting awareness programs on Health-related issues such as General Health, Mental health, Spiritual Health, HIV/AIDS,
iii. Conducting consumer Awareness. Explaining various legal provisions etc.
iv. Women Empowerment Programmes- Sexual Abuse, Adolescent Health and Population Education.
v. Any other programmes in collaboration with local charities, NGOs etc.

Reference Books:

1. Nirmalya Kumar Sinha & Surajit Majumder, *A Text Book of National Service Scheme* Vol; I, Vidya Kutir Publication, 2021 (ISBN 978-81-952368-8-6)
2. *Red Book - National Cadet Corps* – Standing Instructions Vol I & II, Directorate General of NCC, Ministry of Defence, New Delhi
3. Davis M. L. and Cornwell D. A., "Introduction to Environmental Engineering", McGraw Hill, New York 4/e 2008.
4. Masters G. M., Joseph K. and Nagendran R. "Introduction to Environmental Engineering and Science", Pearson Education, New Delhi. 2/e 2007
5. Ram Ahuja. *Social Problems in India*, Rawat Publications, New Delhi.

General Guidelines:

1. Institutes must assign slots in the Timetable for the activities.
2. Institutes are required to provide instructor to mentor the students.

Evaluation Guidelines:

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totalling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject.

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COURSE CODE	DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS (Common for all branches)	CATEGORY BSC	L-T-P-C 3-0-0-3

Pre-requisite: Mathematics of 10+2 / Intermediate level (algebra, matrices and basic calculus)

Course Objectives:

- This course 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: *After successful completion of this course, the student will be able to*:

CO1: Model simple physical problems involving rate as first order differential equations and solve the resulting equation (K2, K3, K5).

CO2: Apply differential equation techniques to formulate and solve homogeneous and non-homogeneous differential equations, solve simultaneous linear differential equations, and apply these methods to model and analyze L-C-R circuit problems and simple harmonic motion (K2, K3, K5).

CO3: Solve partial differential equations that model physical processes (K2, K3, K5).

CO4: Apply the knowledge of gradient, divergence and curl and interpret the physical meaning of different operators (K2, K3, K5).

CO5: Compute the work done against a field, circulation and flux using vector calculus methods (K2, K3, K5).

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	H	M											
CO2	H	H	M											
CO3	H	H	M											
Co4	H	H	M											
CO5	H	H	M											

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. Orthogonal Trajectories, Applications: Newton's Law of cooling – Law of natural growth and decay- Electrical circuits.

UNIT-II

Linear Differential Equations of Higher Order (Constant Coefficients): Definitions, Homogeneous and non-homogeneous, Complementary function, Particular integral, General solution, Method of variation of parameters- Wronskian. Simultaneous linear equations, Applications to L-C-R Circuit problems and Simple Harmonic motion.

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, Non-linear partial differential equations using Charpit'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.

Learning Resources:

Text Books:

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

Reference Books:

1. Ramana, B.V. (2017). Higher Engineering Mathematics. McGraw Hill Education.
2. James, G. (2018). Advanced Modern Engineering Mathematics. 5th Edition Pearson publishers.
3. Dass, H.K. (2022). Advanced Engineering Mathematics, 22nd Edition. S. Chand Publications.

Web Resources:

- https://mathworld.wolfram.com/First-OrderOrdinaryDifferentialEquation.html
- https://en.wikipedia.org/wiki/Differential_equation
- https://en.wikipedia.org/wiki/Partial_differential_equation
- https://en.wikipedia.org/wiki/Vector_calculus
- https://en.wikipedia.org/wiki/Vector_calculus

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COURSE CODE	CHEMISTRY FOR ELECTRICAL SYSTEMS (For Electrical and Allied Branches of Engineering)	CATEGORY BSC	L-T-P-C 3-0-0-3

Pre-requisite: NIL

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 greener technologies.
- To understand quantum chemistry concepts relevant to electronic systems.

Course Outcomes (COs)

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

CO1. Apply electrochemistry principles and evaluate corrosion mechanisms in electrical infrastructure and design appropriate protection strategies for cables, substations, and grounding systems. (K3, K5)

CO2. Analyze electrochemical energy-storage systems (batteries, supercapacitors, fuel cells) and select suitable technologies for power and mobility applications. (K3, K4)

CO3. Analyze and select electrical and electronic materials (conductors, semiconductors, insulators, polymers, nanomaterials) based on their chemical and physical properties. (K3, K4)

CO4. Apply green chemistry and sustainability principles to evaluate renewable-energy technologies, energy efficient electrical systems, e-waste management and environmentally friendly electrical materials. (K3, K5)

CO5. Apply quantum-chemistry concepts for materials and energy analysis relevant to electrical engineering. (K3, K5)

CO/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	H	M	H	H	M	M	L	L	M	L			
CO2	H	H	M	M	M	M	L	-	-	L	M			
CO3	H	H	H	M	H	L	L	M	M	L	M			
CO4	H	H	H	M	H	L	L	M	M	L	H			
CO5	H	M	L	M	L	-	-	-	-	-	M			

UNIT 1: Electrochemistry and Corrosion **9hrs**

- 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, 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 **9hrs**

- Primary batteries: Dry cell, Lithium battery, sodium-air batteries (construction, working and applications), zinc-air battery, secondary batteries: lead-acid, Ni-Cd, lithium-ion, sodium ion batteries (construction, charging-discharging reactions and applications). Battery management systems (main functions, basic working, Battery protection).
- Fuel cells: Types of fuel cells (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 (one preparation method and applications).

UNIT IV Green energy technology and its sustainability **10hrs**

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 **9hrs**

- Fundamentals of quantum chemistry: Black-body radiation, photoelectric effect, wave-particle duality, de Broglie wave equation, Heisenberg's uncertainty principle.
- Fundamentals of quantum mechanics: Schrödinger wave equation, significance of Ψ and Ψ^2; quantum numbers; particle in a one-dimensional box.
- Molecular orbital theory: bonding in homo- and hetero-nuclear diatomic molecules; energy-level diagrams of O_2, N_2, HF and CO.
- π-molecular orbitals of butadiene and benzene; calculation of bond order.

Learning Resources

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.

Web Resources

- 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

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COURSE CODE	ELECTRICAL CIRCUIT ANALYSIS	CATEGORY PCC	L-T-P-C 3-0-0-3

Pre-requisite: Basic Electrical Circuits

Course Objectives:

1. To equip students with network theorem skills for simplifying and solving linear circuits under both DC and AC excitations.
2. To develop competency in analyzing balanced and unbalanced three-phase AC systems, including phase/line relationships and power measurement.
3. To enable students to solve transient behaviour of first and second-order DC circuits using classical differential equations and Laplace transforms.
4. To extend transient analysis skills to AC circuits using differential equation and Laplace transform approaches.
5. To introduce two-port network parameters and their interrelations for cascaded system modelling.

Course Outcomes: *After successful completion of this course, the student will be able to*:

CO1: apply Superposition, Thevenin, Norton, MPT, Reciprocity, Millman, and Compensation theorems to simplify linear DC and AC networks (K3)

CO2: analyze balanced/unbalanced three-phase star/delta circuits, compute line/phase quantities, and measure power using the two-wattmeter method**.** (K4)

CO3: analyze and evaluate the transient response of first- and second-order DC circuits using differential equations and Laplace transforms. (K4)

CO4: analyze and evaluate the transient response of first- and second-order AC circuits using differential equations and Laplace transforms. (K4)

CO5: determine Z, Y, ABCD, Hybrid and g parameters of two-port networks, derive their interrelations, and analyze cascaded connections. (K4)

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	H	M	M	M	--	--	--	--	--	-			
CO2	H	H	M	M	M	--	--	--	--	--	-			
CO3	H	H	M	M	M	--	--	--	--	--	-			
CO4	H	H	M	M	M	--	--	--	--	--	-			
CO5	H	H	M	M	M	--	--	--	--	--	-			

UNIT-I

Network theorems (DC & AC Excitations)

Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem, Reciprocity theorem, Millman's theorem and compensation theorem.

UNIT-II

Three phase AC circuits

Phase sequence, star and delta connection of sources and loads, relation between line and phase voltages and currents, Balanced and Unbalanced Three-phase circuits, analysis of balanced three-phase circuit: measurement of active and reactive power. Analysis of three-phase unbalanced circuits: Loop method, Star-Delta transformation technique, two wattmeter method for measurement of three phase power.

UNIT-III

Transient Analysis in DC Circuits

Transient response of First order (R-L, R-C) and second order (R-L-C) circuits using differential equations. Transient response of First order (R-L, R-C) and second order (R-L-C) circuits using Laplace transforms.

UNIT-IV

Transient Analysis in AC circuits

Transient response of First order (R-L, R-C) and second order (R-L-C) circuits using differential equations. Transient response of First order (R-L, R-C) and second order (R-L-C) circuits using Laplace transforms.

UNIT-V

Two Port Networks

Two port network parameters – Z, Y, ABCD, Hybrid and g parameters and their relations, cascaded networks.

Learning Resources

Text Books:

1. Hayt, W. H., & Kemmerly, J. E. (2018). Engineering circuit analysis (9th ed.). McGraw Hill Education.
2. Alexander, C. K., & Sadiku, M. N. O. (2019). Fundamentals of electric circuits (6th ed.). McGraw Hill Education.

Reference Books:

1. Van Valkenburg, M. E. (2019). Network analysis (3rd ed.). Prentice-Hall of India.
2. Boylestad, R. L. (2019). Introductory circuit analysis (13th ed.). Pearson Education.

Web Resources:

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

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COURSE CODE – R26XXXX I B.Tech II Semester	SEMICONDUCTOR DEVICES	CATEGORY PCC	L-T-P 3-0-0	CREDITS 3

Pre-requisite: Nil

Course Objectives:

- To introduce the construction and characteristics of a PN junction diode.
- To develop the ability to analyze and design basic diode rectifier, filter, and voltage-regulation circuits.
- To emphasize the construction and characteristics of bipolar transistors
- To emphasize the construction and characteristics of field-effect transistors
- To familiarize students with special-purpose semiconductor and optoelectronic devices used in electrical systems.

Course Outcomes: *After successful completion of this course, the student will be able to*:

CO1: Understand the formation, characteristics, approximations, and electrical behavior of PN junction diodes (K2)
CO2: Apply diode characteristics and circuit concepts to analyze rectifiers, filters, Zener voltage regulators and basic DC power supplies. (K3)
CO3: Analyze the construction, characteristics, operating regions, configurations, and applications of bipolar junction transistors and transistor-based voltage regulators. (K4)
CO4: Analyze the construction, characteristics, transfer characteristics, and applications of JFETs and MOSFETs and compare their performance with BJTs. (K4)
CO5: Explain the operation and applications of power semiconductor devices, thyristors, UJT, DIAC,TRIAC, and optoelectronic devices including LEDs, photodiodes, and solar cells. (K2)

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	M	–	–	L	–	–	–	–	–	–			
CO2	H	H	M	–	M	–	–	–	–	–	–			
CO3	H	H	M	–	M	–	–	–	–	–	–			
CO4	H	H	M	–	M	–	–	–	–	–	–			
CO 5	H	M	L	–	L	–	–	–	–	–	–			

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.

Learning Resources:

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

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COURSE CODE	ENGINEERING GRAPHICS (Common to all branches of Engineering)	CATEGORY ESC	L-T-P-C 0-1-3-2.5

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

Pre-requisites: NIL

Course Objectives: *The course aims to*

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

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

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

CO\ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	M	M	–	M	L	–	M	M	H	–			
CO2	H	H	H	M	M	L	–	M	M	M	–			
CO3	H	H	H	M	H	M	–	M	M	M	–			
CO4	H	H	H	M	H	L	–	M	M	H	M			
CO5	H	H	H	M	H	M	M	H	H	H	M			

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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

Exp. Practical Exercise

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:

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

Reference Books:

1. Venugopal, K., & Prabhu Raja, V. (2019). Engineering drawing and graphics (5th ed.). New Age International.
2. Gopalakrishna, K. R. (2018). Engineering drawing (Vols. 1–2). Subhas Stores.

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COURSE CODE – R26XXXX I B.Tech II Semester	CHEMISTRY FOR ELECTRICAL SYSTEMS LAB (For Electrical and Allied Branches of Engineering)	CATEGORY BSC	L-T-P 0-0-3	CREDITS 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, and water electrolysis.
- To familiarize students with electroanalytical techniques (conductometry, potentiometry, pH-metry) for acid-base and redox titrations.
- To train students in assessing corrosion and galvanic degradation of metals used in electrical components and connectors.
- 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.

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

CO1: Determine the EMF of a galvanic cell and verify the Nernst equation, and study electrochemical water electrolysis for hydrogen production. (K3).

CO2: Determine resistivity and temperature coefficient of resistance of conducting wires used in electrical applications. (K3)

CO3: Apply conductometric, potentiometric, and pH-metric methods to perform acid-base and redox titrations, and determine battery electrolyte strength. (K4)

CO4: Verify quantum mechanical phenomena (photoelectric effect, atomic emission spectra), characterize colloidal nanoparticle size, and evaluate an enzyme-based electrochemical biosensor. (K4)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	M	L	H	M	M	L	-	M	L	M			
CO2	H	M	L	H	M	M	L	-	M	L	M			
CO3	H	H	M	H	M	M	L	-	M	L	M			
CO4	H	H	M	H	M	M	L	-	M	L	M			

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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

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COURSE CODE – R26XXXX I B.Tech II Semester	ELECTRICAL CIRCUIT ANALYSIS LAB	CATEGORY PCC	L-T-P 0-0-3	CREDITS 1.5

Pre-requisite: Basic Electrical Circuits

Course Objectives:

- To experimentally validate the foundational DC circuit analysis techniques and the most frequently used linear network theorems.
- To experimentally verify DC network theorems
- To determine the condition for maximum power delivery to a load and to extract all standard two-port network parameters for circuit modelling.
- To enable students to measure active power, power factor, and reactive power in three-phase AC circuits under both balanced and unbalanced loading conditions using the two-wattmeter method.

Course Outcomes: *After successful completion of this course, the student will be able to*:

CO1: verify Mesh analysis, Nodal analysis, Superposition theorem, and Thevenin's & Norton's theorems on linear DC resistive networks. (K3)

CO2: verify Thevenin's & Norton's theorems and Maximum Power Transfer theorem on DC resistive networks. (K3)

CO3: apply Millman's theorem to parallel source networks and experimentally verify Compensation and Reciprocity theorems. (K3)

CO4: determine the Z, Y, H, and ABCD parameters of given two-port networks. (K4)

CO5: measure active power, power factor (for balanced/unbalanced loads), and reactive power (for balanced loads) in three-phase circuits using the two-wattmeter method. (K4)

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	--	--	--	--	--	--			
CO2	3	3	3	2	2	--	--	--	--	--	--			
CO3	3	3	3	2	2	--	--	--	--	--	--			
CO4	3	3	3	2	2	--	--	--	--	--	--			
CO5	3	3	3	2	2	--	--	--	--	--	--			

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List of Experiments

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

1. Verification of mesh and nodal analysis.
2. Verification of superposition theorem.
3. Verification of Thevenin's and Norton's theorems
4. Application of Millman's theorem to a circuit with multiple parallel voltage sources.
5. Verification of Compensation theorem.
6. Verification of Reciprocity theorem.
7. Verification of maximum power transfer theorem.
8. Determination of open-circuit (Z) and short-circuit (Y) parameters.
9. Determination of hybrid (H) and transmission (ABCD) parameters.
10. Measure power and power factor in 3-phase load by Two-wattmeter method for balanced loads.
11. Measure power and power factor in 3-phase load by Two-wattmeter method for unbalanced loads.
12. Measurement of 3- phase reactive power for a balanced load.

Learning Resources

Text Books:

1. Hayt, W. H., & Kemmerly, J. E. (2018). Engineering circuit analysis (9th ed.). McGraw Hill Education.
2. Alexander, C. K., & Sadiku, M. N. O. (2019). Fundamentals of electric circuits (6th ed.). McGraw Hill Education.

Reference Books:

1. Van Valkenburg, M. E. (2019). Network analysis (3rd ed.). Prentice-Hall of India.
2. Boylestad, R. L. (2019). Introductory circuit analysis (13th ed.). Pearson Education.

Web Resources:

1. https://www.multisim.com/content/KpFNZUsUdN2X76G4XqX7NE/lab-3-kirchhoffs-laws-and-mesh-and-nodal-analysis-1/
2. https://asnm-iitkgp.vlabs.ac.in/List%20of%20experiments.html
3. http://vlabs.iitkgp.ac.in/asnm/#

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COURSE CODE – R26XXXX I B.Tech II Semester	DESIGN THINKING AND INNOVATION	CATEGORY ESC	L-T-P 0-1-3	CREDITS 2.5

Pre-requisites: NIL

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

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

Course Outcomes: *After successful completion of the course, 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)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	M	M	L	–	–	L	–	–	L	L	M			
CO2	M	H	H	L	L	H	M	L	M	M	M			
CO3	L	M	H	L	M	L	L	–	H	M	M			
CO4	H	H	H	M	H	M	M	L	H	M	M			
CO5	L	M	H	L	M	H	H	M	M	H	H			

UNIT I — Design Thinking Foundations & Empathy

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

Practical Activities

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

Unit Outcome

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

UNIT II — Problem Definition, Analysis & Opportunity Identification

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

Practical Activities

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

Unit Outcome

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

UNIT III — Creativity, Ideation & Concept Development

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

Practical Activities

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

Unit Outcome

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

UNIT IV — Prototyping, Experimentation & Validation

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

Practical Activities

- Develop a low-fidelity prototype
- Prepare a storyboard
- Build a physical/digital prototype
- Conduct user testing
- Collect structured feedback
- Modify the prototype
- Prepare an iteration log

UNIT V — Innovation, Value Creation & Communication

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

Practical Activities

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

Learning Resources:

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 Resources:

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

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COURSE CODE – R26XXXX I B.Tech II Semester	IT & ELECTRONIC WORKSHOP	CATEGORY ESC	L-T-P 0-0-2	CREDITS 1

Pre-requisite: NIL

Course Objectives:

- Assemble, configure, install, and maintain computer hardware, operating systems, drivers, utilities, and security software.
- Introduce students to operating system installation, basic networking, and IT infrastructure fundamentals.
- Use spreadsheet, presentation, diagnostic, measurement, and documentation tools to analyse data and communicate technical results.
- Identify, test, measure, and apply electronic components and circuits using digital multimeters, function generators, DSOs, and breadboards.
- Design, fabricate, assemble, solder, desolder, test, and troubleshoot a basic PCB-based electronic system using EDA and workshop techniques.

Course Outcomes: *After successful completion of this course, the student will be able to*:

CO1: Identify and describe the functions of standard computer hardware components, peripherals, and IT infrastructure elements. (K1)

CO2: Explain the procedure for operating system installation, software configuration, and basic computer network setup. (K2)

CO3: Use Excel and PowerPoint to process academic-performance data, calculate statistical measures, create charts, and prepare a structured technical presentation. (K4)

CO4: Identify and test electronic components and use a DMM, function generator, DSO, and breadboard to measure signals and implement basic rectifier and switching circuits. (K4)

CO5: Implement a simple regulated power-supply circuit on a custom-designed PCB by applying standard EDA layout rules, executing chemical fabrication, and performing reliable component assembly. (K3)

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	-			
CO2	1	2	1	3	2	-	-	-	-	-	-			
CO3	2	3	2	3	3	-	-	-	2	1	-			
CO4	2	3	2	3	3	-	-	-	-	-	-			
CO 5	3	3	3	3	2	1	-	-	-	1	-			

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List of Experiments

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

Experiment 1: PC Hardware Assembly and Component Identification

- Disassemble and reassemble a standard desktop PC.
- Identify core internal parts: motherboard, CPU, RAM modules, Switched-Mode Power Supply (SMPS), CMOS battery, and storage drives (SSD/HDD).
- Study the functions of peripherals and standard computer hardware components.

Experiment 2: OS Installation and Drive Partitioning

- Configure BIOS/UEFI boot priority settings.
- Create a bootable USB drive, partition a storage disk, and perform a clean installation of an operating system (such as Ubuntu Linux or Windows).
- Install device drivers and perform basic OS troubleshooting.

Experiment 3: Ethernet Cable Crimping and LAN Testing

- Cut, strip, and arrange twisted-pair wires according to T568A and T568B wiring standards.
- Crimp RJ-45 connectors onto Cat6 cables to create both straight-through and crossover cables.
- Verify connections using a LAN tester and configure a small LAN with IP addressing and subnetting.
- Test network connectivity using ping and tracert commands.

Experiment 4: System Utility and Security Software Installation

- Install and configure basic system utility software (backup tools).
- Install and configure security software (antivirus, firewall).

Experiment 5: Hardware and Software Troubleshooting

- Troubleshoot common hardware faults using diagnostic tools and structured fault-isolation procedures.
- Troubleshoot common software faults (boot failures, driver conflicts, application crashes).
- Use system diagnostic tools to identify and resolve system issues.

Experiment 6: Creating a Data-Driven Academic Performance Presentation using Excel and PowerPoint

- Create a student marks dataset in Excel – use gridlines, format cells, apply text formatting, and use auto-fill to populate sequential data.
- Use Excel formulae – SUM, AVERAGE, STDEV, MIN, MAX, and COUNT functions with appropriate cell referencing (relative, absolute, and mixed).
- Create charts (bar charts, pie charts, line graphs) to visualize academic performance data.
- Understand PowerPoint orientation – work with slide layouts, insert and format text, apply WordArt, use bullets and numbering, and insert AutoShapes, lines, and arrows for visual enhancement.
- Create interactive elements – add hyperlinks to slides and external resources, insert images, Clip Art, audio, video, and additional objects, tables, and charts to enhance the presentation.
- Explore different slide views (Normal, Outline, Slide Sorter, Notes Page, Reading View, Slide Show) and apply design templates, background styles, textures, and hidden slides for a professional delivery.

Experiment 7: Electronic Component Familiarisation and Testing

- Study and identify active components (diodes, BJTs, MOSFETs, ICs) and passive components (resistors, capacitors, inductors).
- Use a digital multimeter (DMM) to test component functionality, check diode health, measure resistance, and verify capacitor values.
- Decode resistor color codes and verify component datasheet characteristics.

Experiment 8: Waveform Generation and Measurement with DSO

- Learn the operation of a Function Generator to generate sine, square, and triangular waves of varying frequencies.
- Use a Digital Storage Oscilloscope (DSO) to measure peak-to-peak voltage (Vpp), RMS voltage (Vrms), time period, and frequency.

Experiment 9: Solderless Breadboard Circuit Prototyping

- Understand the internal connections of a breadboard.
- Wire a Full-Wave Bridge Rectifier circuit with a capacitor filter.
- Analyze the input AC versus filtered DC output waveforms on an oscilloscope.
- Design and test a simple switching circuit (e.g., transistor-based LED driver / relay control circuit) on a breadboard.

Experiment 10: PCB Layout Design using EDA Tools

- Introduce Electronic Design Automation (EDA) software like KiCad, EasyEDA, or Autodesk Eagle.
- Create the schematic diagram for a simple 5V regulated DC power supply (using a 7805 IC).
- Design the single-sided PCB layout for the power supply circuit.

Experiment 11: PCB Fabrication and Etching

- Transfer a printed PCB layout onto a copper-clad laminate board using the iron-on/toner-transfer method.
- Perform chemical etching using Ferric Chloride ($FeCl_3$).
- Drill component holes and test trace continuity using a multimeter.

Experiment 12: Soldering and Desoldering Techniques

- Mount and solder discrete components onto a general-purpose PCB to build an multi-pin Integrated Circuits (ICs).
- Practice desoldering multi-pin Integrated Circuits (ICs) cleanly from a scrap circuit board using a desoldering pump and wick.
- Practice through-hole component soldering and rework on a practice PCB.

Learning Resources:

Textbooks

1. Sai, S., & Chaturvedi, A. (2020). *Basic electronics engineering: Including laboratory manual*. Springer.
2. David Anfinson and Ken Quamme, *IT Essentials: PC Hardware and Software Companion Guide*.

Reference Books

1. Boylestad, R. L., & Nashelsky, L. (2013). Electronic devices and circuit theory (11th ed.). Pearson.
2. Meyers, M. (2019). CompTIA A+ certification all-in-one exam guide (10th ed.). McGraw-Hill Education.

Web Resources

1. https://nptel.ac.in/courses/122106025
2. Virtual Labs – Computer Organisation and Hardware: https://www.vlab.co.in/broad-area-computer-science-and-engineering

Laboratory and Tool References

- KiCad official documentation: KiCad Documentationdocs.kicad
- KiCad getting-started guide: Getting Started in KiCaddocs.kicad
- KiCad learning resources: KiCad Learning Resourceskicad
- Ubuntu desktop documentation: Ubuntu Desktop Documentation
- Ubuntu installation tutorial: Install Ubuntu Desktop
- Microsoft Windows installation media: Create Windows Installation Media
- Cisco Networking Academy: Cisco Networking Academy
- Microsoft Excel help: Excel Help and Learning
- Microsoft PowerPoint help: PowerPoint Help and Learning
- Microsoft Windows troubleshooting: Windows Troubleshooting
- NIST Cybersecurity resources: NIST Cybersecurity
- Tektronix oscilloscope resources: Oscilloscope Basics
- Fluke digital multimeter resources: Digital Multimeter Resources
- LTspice official website: LTspice
- EasyEDA official website: EasyEDA
- Autodesk Eagle resources: Autodesk Fusion Electronics

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
(Established by Govt. of A.P., ACT No.30 of 2008)
KAKINADA – 533 003 (A.P) INDIA
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE CODE – R26XXXX I B.Tech II Semester	SPORTS AND YOGA (NON-CREDIT MANDATORY)	CATEGORY MNC	L-T-P 0-0-2	CREDITS 0

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

Course Outcomes: After completion of the course the student will be able to
CO1: Understand the importance of yoga and sports for Physical fitness and sound health.
CO2: Demonstrate an understanding of health-related fitness components.
CO3: Compare and contrast various activities that help enhance their health.
CO4: Assess current personal fitness levels.
CO5: Develop Positive Personality

UNIT I
Concept of health and fitness, Nutrition and Balanced diet, basic concept of immunity Relationship between diet and fitness, Globalization and its impact on health, Body Mass Index (BMI) of all age groups.
Activities:
- i Organizing health awareness programmes in community
- ii Preparation of health profile
- iii Preparation of chart for balance diet for all age groups

UNIT II
Concept of yoga, need for and importance of yoga, origin and history of yoga in Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and meditation, stress management and yoga, Mental health and yoga practice.
Activities:
Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar

UNIT III
Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and Modern Olympics, Asian games and Commonwealth game.
Activities:
i. Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc. Practicing general and specific warm up, aerobics
ii. Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running.

Reference Books:
1. Gordon Edlin, Eric Golanty. Health and Wellness, 14th Edn. Jones & Bartlett Learning, 2022
2. T.K.V.Desikachar. The Heart of Yoga: Developing a Personal Practice
3. Archie J.Bahm. Yoga Sutras of Patanjali, Jain Publishing Company, 1993
4. Wiseman, John Lofty, SAS Survival Handbook: The Ultimate Guide to Surviving Anywhere Third Edition, William Morrow Paperbacks, 2014

5. The Sports Rules Book/ Human Kinetics with Thomas Hanlon. -- 3rd ed. Human Kinetics, Inc.2014

General Guidelines:

1. Institutes must assign slots in the Timetable for the activities of Health/Sports/Yoga.
2. Institutes must provide field/facility and offer the minimum of five choices of as many as Games/Sports.
3. Institutes are required to provide sports instructor / yoga teacher to mentor the students.

Evaluation Guidelines:

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totalling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject.