With effect from the academic year 2026-2027

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Scheme of Instruction

and

Syllabus of

B.E. (Artificial Intelligence & Machine Learning)

I &II Semesters

2026-2027

UNIVERSITY COLLEGE OF ENGINEERING

(Autonomous)

Osmania University

Hyderabad – 500 007, TS, INDIA

INSTITUTE

Vision

The Vision of the institute is to generate and disseminate knowledge through harmonious blending of science, engineering and technology. To serve the society by developing a modern technology in students‟ heightened intellectual, cultural, ethical and humane sensitivities, fostering a scientific temper and promoting professional and technological expertise.

Mission

- To achieve excellence in Teaching and Research
- To generate , disseminate and preserve knowledge
- To enable empowerment through knowledge and information
- Advancement of knowledge in Engineering, Science and Technology
- Promote learning in free thinking and innovative environment
- Cultivate skills, attitudes to promote knowledge creation
- Rendering socially relevant technical services for the community
- To impart new skills of technology development
- To inculcate entrepreneurial talents and technology appreciation programmes
- Technology transfer and incubation

DEPARTMENT

Vision

To be a leading academic department in the area of Computer Science and Information Technology with Learning and research processes of global standards that contribute to innovations in various scientific disciplines and societal needs and also motivate young engineers to face future technological challenges.

Mission

- To achieve excellence in Teaching in the field of Computer Science and Engineering
- To promote learning in free thinking and innovative environment with the state-of-art-technologies
- To cultivate skills to promote information and communication technology
- Advancement of Knowledge in various specializations of Computer Science and Engineering
- To impart skills to develop technical solutions for societal needs and inculcate Entrepreneurial talents

Programme Educational Objectives (PEO):

PEO1	To provide the necessary background in Basic Sciences and Humanities to build creative Engineering solutions.
PEO2	To train students to acquire problem solving skills in the area of Computer Science & Engineering, Artificial Intelligence, Machine Learning and Applications; in order to pursue higher studies and to be successful in their career
PEO3	To expose the students to industry practices for building practical applications using Software Tools, Artificial Intelligence & Machine Learning Pipe Lines
PEO4	To provide students with soft skills, managerial skills, high standards of ethics, and life-long learning capabilities.

Program Outcomes (PO):

The graduating students of the Computer Science and Engineering program will be able to:

PO	Program Outcome
PO1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and Computer Science & Engineering to solve complex engineering problems.
PO2	**Problem Analysis:** Identify, formulate, review literature, and analyze complex engineering problems using principles of mathematics, natural sciences, and engineering sciences to arrive at substantiated conclusions.
PO3	**Design/Development of Solutions:** Design computing systems, software, components, or processes that satisfy specified requirements while considering public health, safety, cultural, societal, and environmental factors.
PO4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and appropriate research methodologies, including experimental design, analysis, interpretation of data, and synthesis of information to derive valid conclusions.
PO5	**Modern Tool Usage:** Select and apply appropriate modern engineering, computing, and IT tools—including modeling, simulation, and prediction—with an understanding of their limitations.
PO6	**The Engineer and Society:** Apply contextual knowledge to assess societal, legal, health, safety, and cultural issues and understand the responsibilities associated with professional engineering practice.
PO7	**Environment and Sustainability:** Understand the impact of engineering solutions on society and the environment, and promote sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics, responsibilities, and engineering norms.
PO9	**Individual and Team Work:** Function effectively as an individual and as a member or leader in multidisciplinary teams.
PO10	**Communication:** Communicate effectively with the engineering community and society through reports, presentations, technical documentation, and discussions.
PO11	**Project Management and Finance:** Demonstrate knowledge of engineering management principles and apply them to manage projects in multidisciplinary environments.
PO12	**Life-long Learning:** Recognize the need for, and engage in, independent and lifelong learning in response to technological advancements.

SCHEME OF INSTRUCTION AND EXAMINATION

B. E (ARTIFICIAL INTELIGENCE & MACHINE LEARNING)

I – Semester

SNo	Code	Course Title	Scheme of Instruction			Contact Hrs/Wk	Scheme of Evaluation			Credits
			L	T	P		Hrs	CIE	SEE	
Theory										
1		Induction Program	3 weeks							
2	**BS101 MT**	Matrices and Calculus	3	0	-		3	40	60	3
3	**ES101 CS**	Programming for Problem Solving	3	0	-		3	40	60	3
4	**ES101EE**	Basic Electrical Engineering	3	0	-		3	40	60	3
5	**PC 101 CS**	Digital Logic Design	3	0	-		3	40	60	3
6	**HS 101 EG**	Communicative English	3	0	-		3	40	60	3
Practicals										
7	**ES151CS**	Programming for Problem Solving Lab	-	-	3		3	25	50	1.5
8	**ES151EE**	Basic Electrical Engineering Lab	-	-	2		3	25	50	1.5
9	**HS151EG**	Communicative English Lab	-	-	2		3	25	50	1.5
		Total	**15**	**0**	**07**			**275**	**450**	**19.5**

SCHEME OF INSTRUCTION AND EXAMINATION

B. E (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

II – Semester

SNo	Code	Course Title	Scheme of Instruction			Contact Hrs/Wk	Scheme of Evaluation			Credits
			L	T	P		Hrs	CIE	SEE	
Theory										
1	**BS201MT**	Differential Equations and Fourier series	3	0	-		3	40	60	3
2	**PH 101 BS**	Engineering Physics	3	0	-		3	40	60	3
3	**BS201 CH**	Engineering Chemistry	3	0	-		3	40	60	3
4	**PC201CS**	Discrete Mathematics	3	0	-		3	40	60	3
Practicals										
5	**PH 151 BS**	Engineering Physics Lab	-	-	3		3	25	50	1.5
6	**BS251CH**	Engineering Chemistry Lab	-	-	3		3	25	50	1.5
7	**ES251CE**	Engineering Graphics	2	-	4		3	25	50	4
8	**ES252ME**	Workshop Practice	-	-	6		3	25	50	3
		Total	**14**	**0**	**16**			**260**	**440**	**22**

I Semester

BS101MT	Matrices and Calculus					Course Type Core/PF/FE
Prerequisite if any: Mathematical Knowledge of 12th/ Intermediate level	**Contact hours per week**			**Duration of SEE (Hours)**	**Scheme of Evaluation**	**Credits**
	L	**T**	**P**		**CIE** / **SEE**	
	3	-	-	3	40 Marks / 60 Marks	3

Course Objectives:

- To study Matrices as vector spaces, subspaces, linear transformation and its use in solving

  system of linear equations.
- To study Eigenvalue problems, Diagonalizable Matrices and Quadratic Forms.
- To introduce the concepts of Functions of Several Variables and its Applications.
- To introduce the concepts of Multiple Integrals and its Applications.
- To study Vector Differential and Integral Calculus.

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

1. Find vector spaces and subspaces and solutions of system of linear equations.
2. Solve Eigenvalue problems, Similar & Diagonalizable Matrices and Canonical Form of Quadratic Forms
3. Find the maximum and minimum values of multiple variable functions.
4. Use the knowledge of Multiple Integrals in finding the area and volume of any region

   bounded by given curves
5. Apply the knowledge of Vector Calculus to find line, surface and volume integrals.

Course Articulation Matrix:

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

UNIT - I

Matrices and Vector Spaces: Vector Spaces, Subspaces, Linear Independence of Vectors, Dimension and Basis, Linear Transformation, Solution of General linear System of Equations, Elementary row and Column Operations, Echelon form of a Matrix, Gauss Elimination Method for Non – Homogeneous Systems, Homogeneous System of Linear Equations.

UNIT - II

Eigenvalue Problems: Eigenvalues and Eigenvectors, Cayley - Hamilton theorem (without Proof), Similar and Diagonalizable Matrices, Special Matrices, Quadratic Forms, Canonical Form of a Quadratic Form.

UNIT - III

Functions of Several Real Variables: Introduction, Functions of Two Variables, Limits, Continuity, Partial Derivatives, Total Differential and Differentiability, Derivatives of Composite and Implicit Functions, Higher Order Partial Derivatives, Homogeneous functions, Taylor's Theorem (without Proof), Maximum and Minimum Values of Function, Lagrange's Method of Multipliers.

UNIT - IV

Multiple Integrals: Double Integrals, Evaluation of double integrals by two successive integrations, Application of double integrals, Triple Integrals, Application of triple integrals, Evaluation of triple integrals Change of Variables in Integrals.

UNIT - V

Vector Differential and Integral Calculus: Gradient of a Scalar Field and Directional Derivative, Divergence and Curl of a Vector Field, Line Integrals, Line Integrals Independent of the Path and Green's Theorem (without Proof), Surface Integral, Divergence Theorem of Gauss and Stoke's Theorem (without Proof).

Suggested Reading:

1. R. K. Jain & S. R. K. Iyengar, Advance Engineering Mathematics, Narosa Publications, 5th Edition 2016 (Fifteenth Reprint 2026).
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley publications, 11thEdition, 2025.
3. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, 45th Edition, 2024(Reprint 2025).
4. N.P. Bali and M. Goyal, A text book of Engineering Mathematics, Laxmi Publications, 11th Edition, 2025.
5. H. K. Dass and Er. Rajnish Varma, Higher Engineering Mathematics, S. Chand Publications 3rd Revised Edition 2014(Reprint 2025).

e-resources: https://onlinecourses.nptel.ac.in/e-learning/noc26_ma133

ES 101 CS	**PROGRAMMING FOR PROBLEM SOLVING**					
Pre-requisites		**L**	**T**	**P**	**C**	
		3	-	-	3	
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives :	
1	To introduce the basic concepts of Computing environment, number systems and flowcharts
2	To familiarize the basic constructs of C language – data types , operators and expressions
3	To understand modular and structured programming constructs in C
4	To learn the usage of structured data types and memory management using pointers
5	To learn the concepts of data handling using files

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Explain various functional components in computing environment
CO-2	Develop algorithmic solutions to problems and draw the flow charts
CO-3	Explain and use basic constructs of C in writing simple programs
CO-4	Use standard library functions in C and develop modular programs using user defined functions and structured data types

ES101CS – Programming for Problem Solving (Theory)

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1			1				1			1
CO2	3	3	2		1				1			1
CO3	3	2	2		2							1
CO4	3	3	3	1	2				1			1
CO5	2	2	3	1	3				1			1

UNIT – I
Introduction to Computers: Computer Systems, Computing Environments, Computer Languages, Creating and Running Programs, Software Development, Flow charts. **Number Systems**: Binary, Octal, Decimal, And Hexadecimal. **Introduction to C Language -** Background, C Programs, Identifiers, Data Types, Variables, Constants, Input / Output Statements Arithmetic Operators and Expressions: Evaluating Expressions, Precedence and Associativity of Operators, Type Conversions.

UNIT – II
Conditional Control Statements: Bitwise Operators, Relational and Logical Operators, If, If-Else, Switch-Statement and Examples. Loop Control Statements: For, While, Do-While and Examples. Continue, Break and Go to statements **Functions:** Function Basics, User-defined Functions, Inter Function Communication, Standard Functions, Methods of Parameter Passing. **Recursion-** Recursive Functions.
Storage Classes: Auto, Register, Static, Extern, Scope Rules, and Type Qualifiers

UNIT– III
Preprocessors: Preprocessor Commands **Arrays** - Concepts, Using Arrays in C, Inter-Function Communication, Array Applications, Two- Dimensional Arrays, Multidimensional Arrays, Linear and Binary Search, Selection and Bubble Sort.

UNIT – IV
Pointers - Introduction, Pointers for Inter-Function Communication, Pointers to Pointers, Compatibility, L -value and R-value, Arrays and Pointers, Pointer Arithmetic and Arrays, Passing an Array to a Function, Memory Allocation Functions, Array of Pointers, Programming Applications, Pointers to void, Pointers to Functions, Command-line Arguments. **Strings -** Concepts, C Strings, String Input/Output Functions, Arrays of Strings, String Manipulation Functions

UNIT –V
Structures: Definition and Initialization of Structures, Accessing Structures, Nested Structures, Arrays of Structures, Structures and Functions, Pointers to Structures, Self Referential Structures, Unions, Type Definition (typedef), Enumerated Types. **Input and Output:** Introduction to Files, Modes of Files, Streams, Standard Library Input/Output Functions, Character Input/Output Functions.

Suggested Reading:

1	B.A. Forouzan and R.F. Gilberg, "*A Structured Programming Approach in C"* , Cengage Learning, 2007
2	Kernighan BW and Ritchie DM, "*The C Programming Language"*, 2nd Edition, Prentice Hall of India, 2006.
3	Rajaraman V, "*The Fundamentals of Computer"*, 4th Edition, Prentice-Hall of India, 2006.
4	Dromey " *How to Solve it By Computer* , Pearson education, 2006

Course Code	BASIC ELECTRICAL ENGINEERING (CSE,ECE &AIML)						
ES 101 EE							core
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-		40	60	3

Course Objectives :

The course is taught with the objectives of enabling the student to:

1 To understand the fundamentals of DC electrical circuits.

2 To understand the fundamentals of AC electrical circuits

3 To understand the working principles of Transformers

4 To understand the working principles of DC motor and DC generator

5 To understand working principles of protection devices used in electrical circuits.

Course Outcomes:

On completion of this course, the student will be able to :

CO-1 Analyze the performance of simple electrical circuits & Apply different theorems to solve complicated electrical circuits to obtain the current, voltage and power and AC excitations.

CO-2 Analyze the performance of simple electrical circuits exciting with DC

CO-3 understand the working principles of Transformers

CO-4 Understand the main components, characteristics, applications of different DC and AC electrical machines used in industry.

CO-5 Understand the importance of protective devices and their rating used in electrical circuits. Obtain the overall understanding of basic electrical circuits and appliances required for any industry.

.Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO 1	3	3	3	-	-	-	-	-	-	-	-	-
CO 2	3	3	3	-	-	-	-	-	-	-	-	-
CO 3	3	2	2	-	-	1	-	-	-	-	-	-
CO 4	3	2	2	-	-	2	-	-	-	-	-	-
CO 5	3	2	1	-	-	2	-	-	-	-	-	-

Correlation rating**: Low / Medium / High – 1 / 2 / 3** respectively

UNIT - I : DC Circuits

Electrical circuit elements (R, L and C), voltage and current sources, Ohm`s Law, KCL and KVL, series, parallel circuits, analysis of simple circuits with dc excitation. Thevenin`s, Norton`s & Superposition Theorems.

UNIT - II : AC Circuits

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, and RL, RC, RLC combinations (series only). Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT - III: Transformers

Transformers: Electromagnetic induction, Faradays laws, statically induced EMF, EMF equation, ideal and practical transformer, OC & SC tests , losses and efficiency, Auto-transformer and three-phase transformer connections.

UNIT IV: - DC Machines

DC Generators: Dynamically induced emf, **C** onstruction and principle of operation of DC generator, EMF equation, Types of DC Generators, OCC characteristics, applications
DC Motors: Principle of working, Torque expression**,** Types of DC Motors, characteristics, applications.

UNIT - V: Electrical Installations

Components of LT Switchgear: Switch, Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing & types of Earthing. Elementary calculations for energy consumption, power factor improvement by capacitors.

Suggested Reading:

1 J.B.Gupta, “Fundamentals of Electrical Engineering and Electronics” S.K.Kataria & Sons Publications, 2002.
2 J.B.Gupta, “Utilization of Electric Power and Electric Traction” S.K.Kataria & Sons Publications, 2010
3 V.N.Mittle,Aravind Mittal “Basic Electrical Engineering” *Tata Mc.Graw Hill Publicationss* second edition2007.
4 Hughes, "Electrical Technology", VII Edition, International Student -on, Addison Wesley Longman Inc., 1995.
5. Abhijit Chakrabarti, Sudipta Nath, Chandan Kumar C handa,“Basic Electrical Engineering” Tata McGraw Hill, Publications, 2009

PC101CS	**DIGITAL LOGIC DESIGN**					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives :	
1	To introduce concepts of Boolean logic, Postulates and Boolean Theorems.
2	To understand the logic minimization methods and to solve the Boolean logic expressions
3	To understand how to design the combinational and sequential circuits.
4	To understand the state reduction methods for sequential circuits.

Course Outcomes :	
On completion of this course, the student will be able to:	
CO-1	To apply the concepts of Boolean logic, Postulates and Boolean Theorems to solve the Boolean expressions.
CO-2	To solve the Complex Boolean logic expressions using Minimization methods.
CO-3	To design the combinational circuits using basic gates
CO-4	To apply state reduction methods to solve sequential circuits.

UNIT – I

Boolean Algebra: Axiomatic definition of Boolean Algebra Operators, Postulates and Theorems, Boolean Functions, Canonical Forms and Standard Forms, Simplification of Boolean Functions Using Theorems and Karnaugh Map Method.

UNIT – II

Minimization of Switching Functions: Quine-McCluskey Tabular Method, Determination of Prime Implicants and Essential Prime Implicants.

Combinational Logic Design: Single-Output and Multiple-Output Combinational Circuit Design, AND-OR, OR-AND and NAND/NOR Realizations, Exclusive-OR and Equivalence functions.

UNIT– III

Design of Combinational Logic Circuits: Gate Level design of Small Scale Integration (SSI) circuits, Modular Combinational Logic Elements- Decoders, Encoders, Priority Encoders, Multiplexers and De-multiplexers.

Design of Integer Arithmetic Circuits using Combinational Logic: Integer Adders – Binary Adders: Half adder, Full adder, Subtractors: Half subtractor and Full subtractor

UNIT – IV
Design of Combinational Circuits using Programmable Logic Devices (PLDs): Programmable Read Only Memories (PROMs), Programmable Logic Arrays (PLAs), Programmable Array Logic (PAL) devices. **Introduction to Sequential Circuit Elements:** Latch, Various types of Flip-Flops and their Excitation Tables.

UNIT –V
Models of Sequential Circuits: Moore Machine and Mealy Machine, Analysis of Sequential Circuits, State Table and State Transition Diagrams. **Design of Sequential Circuits**: Counters, Methods for Reduction of State Tables and State Assignments.

Suggested Reading:

1	M Morris Mano, *Digital logic and Computer Design*, Pearson Education India, 2016.
2	M Morris Mano and Michael D Ciletti, *Digital Design*, Prentice Hall of India, Sixth Edition, 2018

HS 101 EG	COMMUNICATIVE ENGLISH						
Prerequisite	**Contact hours per week**			**Duration of SEE (Hours)**	**Scheme of Evaluation**		**Credits**
	L	**T**	**P**		**CIE**	**SEE**	
	3	**-**	**-**	**3**	**40**	**60**	**3**

Course Objectives

1. To develop students' listening, speaking, reading, and writing (LSRW) skills for academic and professional communication.
2. To enhance vocabulary, grammar, and language accuracy for effective expression.
3. To improve comprehension and critical thinking through prose, poetry, biographies, and professional ethics.
4. To equip students with technical and professional writing skills such as report writing, email writing, presentations, and resume writing.
5. To enable students to communicate confidently and ethically in professional and social environments.

Course Outcomes:

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

1. Demonstrate effective listening, speaking, reading, and writing skills in academic and professional contexts.
2. Apply appropriate vocabulary, grammar, and language structures to communicate accurately and fluently.
3. Analyze literary and non-literary texts to develop comprehension, critical thinking, and interpretation skills.
4. Prepare professional documents such as reports, emails, letters, resumes, and presentations using appropriate formats and conventions.
5. Demonstrate ethical communication practices and interpersonal skills required for teamwork and professional success.

Course Outcome	**Program Outcomes**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	-	-	-	-	-	-	3	3	-	2
CO2	3	2	-	-	-	-	-	-	2	3	-	2
CO3	2	3	-	-	-	-	-	2	2	2	-	3
CO4	2	2	-	-	1	-	-	-	2	3	-	2
CO5	-	2	-	-	-	2	-	3	3	3	-	2

Correlation Rating: **Low/Medium/High-1/2/3 respectively**

Unit I

Prose: Silent Crisis | *Martha C Nussbaum*
Listening: What is Listening; Process of Listening; Importance of Listening
Speaking: Importance of Communication, Types of Communication (Non-verbal and Verbal)
Reading: Importance of Reading
Writing: Features of Writing Composition: Cohesions, Coherence, Precision and Clarity
Vocabulary and Grammar: Homonyms; Homophones; Homographs; Punctuation; Sentence Structure (Simple, Compound, Complex)

Unit II

Poem: Where the Mind is Without Fear | *Rabrindranath Tagore*
Listening: Types of Listening; Non-Verbal and Verbal Signs of Active Listening
Speaking: Types of Communication (Oral, Written, Visual)
Reading: Reading Skills: Skimming, Scanning
Writing: Discourse Markers and Linking Words; Paragraph Writing; Précis Writing
Vocabulary and Grammar: Root Words: Prefix, Suffix; Synonyms; Antonyms; Idioms and Phrasal Verbs; Concord

Unit III

Biography: Homi J. Bhabha
Listening: Effective Listening: Principles and Techniques
Speaking: Styles of Communication; Channels of Communication (Vertical, Horizontal, Interpersonal, Grapevine)
Reading: Intensive and Extensive Reading
Writing: Essay Writing; Report Writing
Vocabulary and Grammar: Words Often Confused; Tenses

Unit IV

Prose: A World Made by Atoms | *Margaret Cavendish*
Listening: Barriers to Effective Listening
Speaking: Barriers to Communication; Johari Window
Reading: SQ3R Method
Writing: Business Communication: Letter Writing; Resume Writing; Email Writing; Etiquette for WhatsApp /other Messaging Services
Vocabulary and Grammar: One Word Substitutes; Active and Passive; Reported Speech

Unit V

Prose: Professional Ethics
Listening: Note-Taking; Critical Listening Exercises
Speaking: Speaking To Communicate Effectively; Proverb Expansion through JAM

Reading: Critical and Inferential Reading Passages
Writing: Creating Writing
Vocabulary and Grammar: Technical Vocabulary; Common Errors in English; Correct Use of Prepositions and Articles; Avoiding Ambiguity; Misplaced Modifiers; Avoiding Redundancy

Suggested Readings:

1. Ashraf, M. Rizvi. *Effective Technical Communication*. Tata McGraw-Hill, 2006.
2. *Language and Life: A Skills Approach*. Orient Blackswan, 2018.
3. Raman, Meenakshi, and Sangeetha Sharma. *Technical Communication: Principles and Practice*. 2nd ed., Oxford University Press, 2011.
4. Swan, Michael. *Practical English Usage*. Oxford University Press, 1995.
5. Vijaya, B. *Communicative English and Employability Skills*. Orient Blackswan, 2026.

ES151CS	**PROGRAMMING FOR PROBLEM SOLVING LAB**					
Pre-requisites			**L**	**T**	**P**	**C**
			-	-	2	1
Evaluation	**SEE**	50 Marks	**CIE**		25 Marks	

Course Objectives :	
1	To use tools available under LINUX for C programming
2	To gain hands-on experience on basic constructs of C programming
3	To formulate problems and implement algorithmic solutions in C
4	To write modular programs in C using structure programming techniques and data files.
5	To gain hands-on experience in using Python Programming constructs

Course Outcomes :	
On completion of this course, the student will be able to:	
CO-1	Write, compile and debug C programs in Linux environment
CO-2	Write simple programs using control structures, user defined functions and data manipulation using arrays
CO-3	Use standard C library functions to develop modular programs in C
CO- 4	Write basic Python Programs, using conceptual understanding of Programming.
CO-5	Create Programs, solutions for any problem statements with Programmatic, logic based approach.

ES151CS – Programming for Problem Solving Lab

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2		3						1	1
CO2	3	3	2		2						1	1
CO3	3	2	3		2	1					1	2
CO4	3	3	3	2	2						1	1
CO5	3	3	3	2	2						1	2

1. Introducing to programming Environment(Linux commands, editing tools such as vi editor, sample program entry, compilation and execution)
2. Write programs using arithmetic, logical, bitwise and ternary operators.
3. Write programs simple control statements : Roots of a Quadratic Equation, extracting digits of integers, reversing digits ,finding sum of digit ,printing multiplication tables,

Armstrong numbers, checking for prime, magic number,

4. Sin x and Cos x values using series expansion
5. Conversion of Binary to Decimal, Octal, Hexa and Vice versa
6. Generating a Pascal triangle and Pyramid of numbers
7. Recursion: Factorial, Fibonacci, GCD
8. Finding the maximum, minimum, average and standard deviation of given set of numbers using arrays
9. Reversing an array ,removal of duplicates from array
10. Matrix addition , multiplication and transpose of a square matrix .using functions
11. Bubble Sort, Selection Sort ,
12. Programs on Linear Search and Binary Search using recursion and iteration
13. Functions of string manipulation**:** inputting and outputting string , using string functions such as strlen( ),strcat( ),strcpy( )……etc
14. Writing simple programs for strings without using string functions.
15. Finding the No. of characters, words and lines of given text file
16. File handling programs : student memo printing
17. Create linked list, traverse a linked list, insert a node, delete a node, reversing list.
18. Python Basics and Input/Output
    a) Print "Hello, Engineering Students!"
    b) Read two integers and display their sum, difference, product, quotient, and remainder.
    c) Calculate the area and circumference of a circle.
    d) Swap two numbers (with and without a temporary variable).
    e) Convert temperature from Celsius to Fahrenheit.
    f) Calculate simple and compound interest.
19. Develop programs using conditional statements.

    a) Find the largest of three numbers.
    b) Check whether a year is a leap year.
    c) Determine whether a number is positive, negative, or zero.
    d) Check whether a number is even or odd.
    e) Display grades based on marks using if-elif ladder.
    f) Develop a menu-driven calculator using if-elif.

20. Develop programs using loops

    a) Print multiplication table of a given number.
    b) Generate first N Fibonacci numbers.
    c) Find factorial of a number.
    d) Check whether a number is prime.
    e) Reverse a given integer.
    f) Display Armstrong numbers between 1 and 1000.

21. Develop modular Python programs using functions.

a) Write a function to find the maximum of two numbers.
b) Write a function to calculate factorial using recursion.
c) Write a function to check palindrome.
d) Write a function to compute GCD of two numbers.
e) Write a function to determine whether a number is prime.
f) Create a menu-driven mathematical calculator using functions

22. Lists & Tuples - Perform operations on Python collections.

a) Read N numbers into a list and find the largest and smallest.
b) Compute average and median of list elements.
c) Remove duplicate elements from a list.
d) Sort a list in ascending and descending order.
e) Search an element using linear search.
f) Count frequency of each element in a list.

23. Develop programs using dictionaries.

a) Create a student dictionary containing Roll Number, Name, Branch, and CGPA.
b) Count frequency of characters in a string.
c) Count frequency of words in a paragraph.
d) Create a telephone directory using a dictionary.
e) Implement a simple student record management system using dictionaries.
f) Find the student with the highest marks from a dictionary of student names and marks.

Course Code	BASIC ELECTRICAL ENGINEERING LAB (CSE,ECE &AIML)			Course Type Core/PF/FE
ES 151 EE				core
Prerequisite if any: Evaluation	Contact hours per week	Duration of SEE (Hours)	Scheme of Evaluation	Credits

Course Objectives :

The course is taught with the objectives of enabling the student to:

1 To understand the fundamentals of DC and AC electrical circuits.

2. To Analyze the balanced three phase circuits to obtain the current, voltage and power.

3. To understand the working principles of Transformers and three phase transformer connections

4 To understand the working and performance characteristics of DC Motors

5 To understand the Magnetization characteristics of DC Generators

Course Outcomes:

On completion of this course, the student will be able to :

CO-1 Get an exposure to common electrical components and their ratings.

CO-2 To Make electrical connections by wires of appropriate ratings.

CO-3 Understand the usage of common electrical measuring instruments.

CO-4 Analyze the performance of AC and DC circuits with appropriate operating conditions.

CO-5 Understand the basic operation ahd characteristics of transformers and electrical machines.

Course Outcome	Program Outcome											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO 1	3	3	3	-	-	-	-	-	-	-	-	-
CO 2	3	3	3	-	-	-	-	-	-	-	-	-
CO 3	3	2	2	-	-	-	-	-	-	-	-	-
CO 4	3	2	2	-	-	-	-	-	-	-	-	-
CO 5	3	2	2	-	-	-	-	-	-	-	-	-

Correlation rating**: Low / Medium / High – 1 / 2 / 3** respectively

List of Laboratory Experiments/Demonstrations:

I - Cycle

Demonstration: Basic safety and precautions - Introduction and use of measuring instruments, characteristics of

machines: DC machine, and three phase transformer connections.

1. Verification of Kirchhoff's Laws
2. Verification of Thevenin's & Norton's Theorems
3. Verification of superposition Theorem
4. Sinusoidal steady state response of series R-L-C circuits-impedance calculation and verification
5. Open Circuit &Short Circuit Test on single phase Transformer
6. Steady-state and transient time-response of R-C circuit to a step change in voltage
7. Load test on single phase transformer: Measurement of primary and secondary voltages, currents and power
8. Three-phase Transformer: Star and Delta connections. Voltage and current relationship
9. Performance Characteristics of DC-Shunt Motor
10. Magnetization curve of a separately excited DC Generator

Suggested Reading:

1 J.B.Gupta, "Fundamentals of Electrical Engineering and Electronics" S.K.Kataria & Sons Publications, 2002.

2 J.B.Gupta, "Utilization of Electric Power and Electric Traction" S.K.Kataria & Sons Publications, 2010

3 V.N.Mittle,Aravind Mittal "Basic Electrical Engineering" *Tata Mc.Graw Hill Publicationss* second edition2007.

4 Hughes, "Electrical Technology", VII Edition, International Student -on, Addison Wesley Longman Inc., 1995.

5. Abhijit Chakrabarti, Sudipta Nath, Chandan Kumar C handa,"Basic Electrical Engineering" Tata McGraw Hill, Publications, 2009

HS 151 EG	COMMUNICATIVE ENGLISH LAB					
Prerequisite	**Contact hours per week**			**Duration of SEE (Hours)**	**Scheme of Evaluation**	**Credits**
	L	**T**	**P**		**CIE**	**SEE**	
	-	**-**	**3**	**3**	**25**	**50**	**1.5**

Course Objectives:

1. To develop learners' pronunciation skills through an understanding of the English sound system, stress, and intonation.
2. To enhance contextual and collaborative communication skills for academic, social, and workplace settings.
3. To improve fluency, confidence, and interpersonal communication through interactive language activities.
4. To develop employability skills required for interviews, group discussions, presentations, and professional interactions.
5. To foster effective communication, teamwork, and lifelong learning skills necessary for career growth.

Course Outcomes:

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

1. Demonstrate correct pronunciation using the English sound system, stress patterns, and intonation in spoken communication.
2. Communicate effectively in various contexts using appropriate verbal and non-verbal communication skills.
3. Participate actively in collaborative communication activities, demonstrating teamwork and interpersonal skills.
4. Apply employability communication skills in interviews, group discussions, presentations, and workplace interactions.
5. Exhibit confidence, professionalism, and ethical communication practices for lifelong learning and career development.

Course Outcome	**Program Outcomes**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	-	-	-	-	2	3	-	2
CO2	-	1	-	-	-	-	-	1	2	3	-	2
CO3	-	-	-	-	-	-	-	1	3	3	-	2
CO4	-	1	-	-	-	1	-	2	2	3	-	2
CO5	-	-	-	-	-	2	-	3	3	3	-	3

Correlation Rating: **Low/Medium/High-1/2/3 respectively**

Unit I English Sound System

a. Sounds of English
b. Vowels
c. Consonants
d. Using Dictionary to decode Phonetic Transcription
e. Transcription exercise with the help of CALL (Computer Aided Language Lab)

Unit II Stress and Intonation

a. Syllable
b. Word-Stress and its importance
c. Intonation-Falling and Rising tone
d. Listening comprehension: Listening to various accents & Listening practice and exercises

Unit III Contextual Conversation Skills

a. JAM
b. Picture Perception
c. Public Speaking
d. Role plays: Use of dialogues in various situations like Social, Formal, Academic and Professional contexts.

Unit IV Collaborative Communication

a. Group discussion forms and techniques
b. Mock GDs
c. Factual GDs and Controversial GDs
d. Abstract GDs and Case Studies
e. Debate: Form, techniques, topics for mock debates in class

Unit V Employability Communication

a. Presentation Skills
b. Presentations with emphasis on visual aids and body language,
c. Interview Skills: Techniques
d. Frequently asked Interview Questions
e. Mock interviews

Suggested Readings

1. Kumar, E. Suresh, and P. Sreehari. *A Handbook for English Language Laboratories*. Cambridge University Press, 2014.
2. Balasubramanian, T. *A Textbook of English Phonetics for Indian Students*. Macmillan, 2008.
3. Sethi, J., et al. *A Practical Course in English Pronunciation*. Prentice Hall of India, 2005.
4. Prasad, Hari Mohan. *How to Prepare for Group Discussions and Interviews*. Tata McGraw-Hill, 2006.
5. *English for Engineers and Technologists*. Combined ed., vols. 1–2, Orient Blackswan, 2010.
6. Vijaya, B. *Communicative English and Employability Skills*. Orient Blackswan, 2026.

Suggested Software:

- Sky Pronunciation Suite
- K-van Software
- Study Skills
- English Pronunciation Dictionary –CALD

SCHEME OF INSTRUCTION AND EXAMINATION

B. E (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

II– Semester

SNo	Code	Course Title	Scheme of Instruction			Contact Hrs/Wk	Scheme of Evaluation			Credits
			L	T	P		Hrs	CIE	SEE	
Theory										
1	**BS201MT**	Differential Equations and Fourier series	3	0	-		3	40	60	3
2	**PH 101 BS**	Engineering Physics	3	0	-		3	40	60	3
3	**BS201 CH**	Engineering Chemistry	3	0	-		3	40	60	3
4	**PC201CS**	Discrete Mathematics	3	0	-		3	40	60	3
Practicals										
5	**PH 151 BS**	Engineering Physics Lab	-	-	3		3	25	50	1.5
6	**BS251CH**	Engineering Chemistry Lab	-	-	3		3	25	50	1.5
7	**ES251CE**	Engineering Graphics	2	-	4		3	25	50	4
8	**ES252ME**	Workshop Practice	-	-	6		3	25	50	3
		Total	**14**	**0**	**16**			**260**	**440**	**22**

BS201MT	**Differential Equations and Fourier series**						**Course Type Core/PF/FE**
Prerequisite if any:	**Contact hours per week**			**Duration of SEE (Hours)**	**Scheme of Evaluation**		**Credits**
	L	**T**	**P**		**CIE**	**SEE**	
Mathematical Knowledge of 12th/ Intermediate level	3	-	-	3	40 Marks	60 Marks	3

Course Objectives:

- To study the ordinary differential equations of first order.
- To study the linear ordinary differential equations of second and higher order with variable and constant coefficients.
- To apply general methodology to solve linear first order and second order partial differential equations.
- To learn about expansion of functions by Fourier series.
- To study the classification of second order partial differential equations and solve them by using separation of variables methods.

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

1. Find the solutions of ordinary differential equations of first order.
2. Find the solutions of linear ordinary differential equations of second and higher order with variable and constant coefficients.
3. Find the solutions of first and second order PDE.
4. Obtain the Fourier series for a given function.
5. Find solutions of the heat equation, wave equation, and the Laplace equation subject to boundary conditions.

Course Articulation Matrix:

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

UNIT - I

Ordinary Differential Equations of First Order: Exact First Order Differential Equations, Integrating Factors, Linear First Order Equations, Bernoulli Equation, Application of Differential Equations of First Order –Newton's Law of Cooling, Rate of Decay of Radio – Active Materials.

UNIT - II

Linear Differential Equations: Introduction, Solutions of Linear Differential Equations, Linear Independence and Dependence, Methods for Solution of Linear Equations, Differential Operator $\boldsymbol{D}$, Solutions of Second and Higher Order Linear Homogeneous Equations with Constants Coefficients, Method of Reduction of Order for Variable Coefficient Linear Homogeneous Second Order Equations, Solutions of Non- Homogeneous Linear Equations, Method of Variation of Parameters, Solution of Euler – Cauchy Equation, Operator Methods for Finding Particular Integrals Case $\boldsymbol{r(x) = e^{\alpha x}}$, Case $\boldsymbol{r(x) = \cos(\alpha x)\ or\ \sin(\alpha x)}$, Case $\boldsymbol{r(x) = x^{\alpha}, \alpha > 0}$ and integer.

UNIT - III

Partial Differential Equations: Introduction, Formation of First and Second Order Equations, Solution of First Order Equations, Lagrange's Equation, Higher Order Linear Equations with Constant Coefficients.

UNIT - IV

Fourier series: Introduction, Fourier series, Fourier series Expansions of Even and Odd functions, Convergence of Fourier series, Fourier Half - Range Series.

UNIT - V

Applications of Fourier series: Classification of Linear Second Order Partial Differential Equations, Separation of Variables Method (Fourier Method) Fourier series Solution of the Heat Equation, Fourier series Solution of the Wave Equation, Fourier series solution of the Laplace Equation.

Suggested Reading:

1. R. K. Jain & S. R. K. Iyengar, Advance Engineering Mathematics, Narosa Publications, 5th Edition 2016 (Fifteenth Reprint 2026).
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley publications, 11thEdition,

2025.
3. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, 45th Edition, 2024(Reprint 2025).
4. N.P. Bali and M. Goyal, A text book of Engineering Mathematics, Laxmi Publications, 11th Edition, 2025.
5. H. K. Dass and Er. Rajnish Varma, Higher Engineering Mathematics, S. Chand Publications 3rd Revised Edition 2014(Reprint 2025).

e-resources: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ma98

BS 201 PH	Engineering Physics						
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives:

- To understand the fundamental laws of electromagnetism and how they lead static and time-varying electric and magnetic fields and to apply wave theory to optical phenomena, such as interference, diffraction, and polarization
- To appraise significance of stimulated emission and laser light production. Subsequently propagation of light through optical fibers.
- To make student understand the formation of energy bands and classification of the solids based on the band theory and to sensitize the students towards nanomaterials.
- To understand the different types Magnetic materials and Dielectric materials with their origin of evolution.
- To understand Schrodinger's wave equation and its applications and to understand the concept of superconductors.

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

1. Know how electric and magnetic fields lead the behavior of electromagnetic wave. It bridges classical physics and modern optics, empowering learners to analyze complex electromagnetic systems and waves optics.
2. Understand the construction and working of different laser systems and apply them to propagate light through optical fiber cable as cutting edge application.
3. Understand the semiconducting materials and their properties, operating electronic devices, and applying them in circuits and also equips students with the fundamental principles, how materials behave at the nanoscale and how these unique physical, chemical, and biological properties differ from bulk materials.
4. Understand the fundamental physics behind how materials interact with electric and magnetic fields.
5. Enrich and understand the implications of matter waves in quantum mechanics evolution and to equip students with the theoretical skills to analyze, and apply materials that conduct electricity with zero resistance and expel magnetic fields.

Course Articulation Matrix:

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

CO5	**3**	**2**	**3**	**2**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**3**

UNIT-I

Modern Optics: Interference – Newton's Rings by reflected light – Experimental arrangement – Types of diffraction – Diffraction due to single slit - Diffraction due to double slit (qualitative)-diffraction grating (Conditions of maxima and minima) – Polarization – Malus law – Double refraction – Nicol's Prism. – Optical activity and polarimeter.

Electro Magnetic Theory: Basic laws of electricity and magnetism – Derivation of Maxwell's equations in integral and differential forms - Conduction and displacement current – modification of Ampere's law - Equation of plane wave in free space – Poynting theorem.

UNIT-II

Lasers: Characteristics of lasers – Absorption of radiation, spontaneous and stimulated emission of radiation - Einstein's coefficients and their relation - Population inversion– Types of lasers - Ruby laser, Helium-Neon laser and semiconductor laser – state of art applications of lasers.

Fiber Optics: Construction of an optical fiber – Propagation of light through an optical fiber - Acceptance angle - Numerical aperture – Types of optical fibers (Based on number of modes and refractive index profile) – Fiber drawing process (double crucible method) - Applications of optical fibers

UNIT-III

Quantum Mechanics: Schrödinger's time independent and time dependent wave equation – Physical significance of wave function – Particle in 1-D box – Wave function, Probability function – Quantum states – Introduction to quantum technology and applications.

Semiconductor Physics: Classification of materials based on band theory - Kronig-Penney model (qualitative treatment) - Energy band formation in solids - Intrinsic and Extrinsic semiconductors - Concept of a hole - Carrier concentration and conductivity in intrinsic semiconductors – Formation of P-N junction diode, Light Emitting Diode and their I-V characteristics – Thermistor and its characteristics - Hall effect and its applications.

UNIT-IV

Dielectric Materials: Dielectrics - Types of polarizations – Electronic, Ionic, Orientational and Space charge polarizations – Expression for Electronic polarizability - Frequency and temperature dependence of dielectric polarizations - Determination of dielectric constant by capacitance Bridge method - Ferro electricity - Barium Titanate – Piezo electricity – Super capacitor.

Nanomaterials: Introduction - Properties of materials at reduced size - Surface to volume ratio – Quantum confinement effect – Classification of nanomaterials - Preparation of nanomaterials: bottom–up methods (e.g., Sol Gel method and Chemical Vapor Deposition method), Top-down methods (e.g., Ball milling method) - Basic ideas of carbon nanotubes – Applications of nanomaterials and their health hazards.

UNIT-V

Magnetic Materials: Origin of magnetism (Orbital and Spin magnetic moments) - Classification of magnetic materials: dia, para, ferro, antiferro and ferrimagnetic materials – Weiss molecular field theory of ferromagnetism - Magnetic domains - Hysteresis curve - Soft and hard magnetic materials – Ferrites: Applications of ferrites.

Superconductivity: Introduction - General properties of super conductors - Meissner effect - Type I and Type II superconductors - BCS theory (qualitative) – Introduction to High T_c superconductors - Applications of superconductors.

Suggested Reading:

1. M.S. Avadhanulu and P.G. Kshirasagar - Engg. Physics, S.Chand & Co.
2. C.M. Srivastava and C. Srinivasan - Science of Engg. Materials, New Age International.
3. R.K. Gour and S.L. Gupta – Engg. Physics, Dhanpat Rai Publications.
4. B.K. Pandey and S.Chaturvedi – Engineering Physics, Cengage Learning.
5. A.K Bhandhopadhya - Nano Materials, New Age International.

BS 201 CH	**ENGINEERING CHEMISTRY** **For EEE, ECE,CSE & AIML branches**						
Prerequisite if any: Mathematical Knowledge of 12th/ Intermediate level	**Contact hours per week**			**Duration of SEE (Hours)**	**Scheme of Evaluation**		**Credits**
	L	**T**	**P**		**CIE**	**SEE**	
	3	**-**	**-**	**3**	**40**	**60**	**3**

Course Objectives:

- To understand the fundamentals and principles of water chemistry relevant to Engineering chemistry.
- To acquire the knowledge of polymers used for industrial purposes with various applications.
- Interpret spectroscopic data for structural elucidation of molecules.
- Analyze the spontaneity and equilibrium of chemical reactions.
- Apply knowledge of batteries and nanomataerials to aid in engineering and technical applications.

Course Outcomes:

1. Attains knowledge about the disadvantages of hard water for domestic and industrial purposes. Also teaches the techniques of softening of hard water and treatment of water for drinking purpose. Gains knowledge in causes of corrosion and its prevention.

2. Analyze the basic methods of reaction of organic molecules and study their properties.

3. Distinguishes the ranges of electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.

4. Rationalize bulk properties and processes using thermodynamic considerations.

5. Apply the knowledge of basic fundamentals of nanoparticles to design nanosystems in every field.

Course Articulation Matrix:

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

UNIT-I

Water Chemistry and Corrosion:

Water chemistry: Hardness of water-Types and units of hardness, estimation of temporary and permanent hardness of water by EDTA method. Water softening by Ion exchange and Reverse Osmosis methods. Boiler troubles-scales and sludges formation-causes, effects and prevention. Numerical problems.

Specifications of potable water. Water treatment for drinking purpose-coagulation, sedimentation, filtration, sterilization by Chlorination.

Corrosion-causes and its effects. Types of corrosion-Dry or Chemical corrosion and Wet or Electrochemical corrosion and their mechanism. Electrochemical corrosion and its types. Factors influencing rate of corrosion.

Corrosion control methods: Cathodic protection methods- Sacrificial anodic and impressed current cathodic protection methods. Surface coating methods: Hot dipping-Galvanizing and Tinning.

UNIT-II

Reaction Mechanism and Polymers:

Reaction Mechanism: Introduction - Addition, Substitution and Elimination reactions. Addition to C=C and C=O, Nucleophilic substitution in aliphatic system: SN^1 and SN^2 mechanism, Elimination reactions: E^1 and E^2 mechanism

Polymers: Introduction, Classification of polymers -Plastics, Fibres and Elastomers.

Preparation, properties and engineering applications of the following polymers:

Plastics: PVC and Bakelite

Fibers: Nylon 6:6, and Dacron.

Elastomers: Buna-S and Butyl Rubber.

Conducting polymers: Introduction. Mechanism of conduction in polymers. Intrinsic conducting polymers: Poly-acetylene and poly-aniline. Applications of conducting polymers. Biodegradable polymers, Applications of polymers in concrete materials – Epoxy resins.

UNIT-III

Molecular Structures and Spectroscopy:

Molecular Orbital Theory. Linear Combination of Atomic Orbital's (LCAO).Molecular Orbital energy level diagrams of diatomic molecules-O_2, N_2 and NO.

Description of Electromagnetic spectrum.

Principles of UV-Visible Spectroscopy: Statement of Beer-Lambert Law. Chromophores and Auxochromes. Absorption and intensity shifts: Bathochromic, Hypsochromic, Hyper chromic and Hypo chromic shifts with one example each. Principle and applications of UV Sensors.

IR Spectroscopy: Principle of IR Spectroscopy.IR active and IR inactive molecules (two examples each). Types of vibrational bands, Degrees of Freedom for linear and non linear molecule, Principle and applications of IR Sensors.

NMR Spectroscopy: Principle of ^{1}H-NMR Spectroscopy. Multiplicity, Chemical Shift. Example-Ethyl chloride, Principle and Applications of MRI.

UNIT-IV

Thermodynamics and Electro Chemistry:

Thermodynamics: Terminology of Thermodynamics, thermodynamic processes, Work done in Reversible isothermal and adiabatic processes, efficiency of heat engine by Carnot cycle, concept of entropy, physical significance of entropy, Work function, Gibbs free energy and their significance, variation of free energy with temperature and pressure, criteria of spontaneity in terms of entropy and free energy-Numericals.

Electrochemistry: Electrochemical cells- Electrolytic and Galvanic cells, cell-notation, cell reaction and cell potentials. Types of electrodes-Calomel, and Glass electrode. Determination of P^H of a solution by using Quinhydrone electrode. Thermodynamics of emf of cells-Nernst equation and its derivation. Application of Nernst equation & Numericals.
Principles and applications of Conductometric titrations.

UNIT-V

Energy Sources and Nanomaterials:

Batteries: Primary batteries-Zn carbon battery. Secondary batteries-Pb- Acid battery and Ni-Cd battery. Lithium-ion batteries- advantages and applications.

Fuel cells: Concept of fuel cells and their advantages. Construction and working of H_2-O_2 and methanol-Oxygen fuel cells.

Solar cells: Concept of solar energy conversion, photovoltaic cells.

Nanomaterials: Introduction. Properties of nanomaterials. Synthesis of nanomaterials-Top down, Bottom up approach and Sol-gel method. Applications of nanomaterials.

Suggested Readings:

1. Jain & Jain, *Engineering chemistry*, Dhanpat Rai publishing Co., 17 th Edition .
2. Shashi Chawla, Text book of Engineering chemistry. Danpat rai & Co.
3. Arun Bahl and BS Bahl, *A text book of Organic Chemistry*, S. Chand Co. Ltd., S. Chand Publishing, 2017.
4. Robert Silverstein spectrometric identifications of organic compounds, Journal of Chemical Education, ACS Publications.
5. L.D.S. Yadav, Organic Spectroscopy. Springer nature-2005.
6. Y.R. Sharma Elementary organic spectroscopy, S.Chand Publications.

PC201CS	**DISCRETE MATHEMATICS**					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives :	
1	Use mathematically correct terminology and notation.
2	Construct correct direct and indirect proofs.
3	Use division into cases in a proof.
4	Use counterexamples.
5	Apply logical reasoning to solve a variety of problems

Course Outcomes :	
On completion of this course, the student will be able to:	
CO-1	For a given logic sentence express it in terms of predicates, quantifiers, and logical connectives
CO-2	For a given a problem, derive the solution using deductive logic and prove the solution based on logical inference
CO-3	For a given a mathematical problem, classify its algebraic structure
CO-4	Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra
CO-5	Develop the given problem as graph networks and solve with techniques of graph theory.

UNIT – I

Sets, Relation and Function: Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem.

Principles of Mathematical Induction: The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic

UNIT – II

Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination, generating functions.

UNIT– III
Propositional Logic: Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. **Proof Techniques**: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.

UNIT – IV
Algebraic Structures and Morphism: Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups,

UNIT –V
Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form

Suggested Reading:

1	Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw –Hill
2	Susanna S. Epp, Discrete Mathematics with Applications, 4th edition, Wads worth Publishing Co. Inc
3	CL Liu and DP Mohapatra, Elements of Discrete Mathematics A Computer Oriented Approach, 3rd Edition by, Tata McGraw –Hill.

BS 251 PH	**Engineering Physics Lab**						
Prerequisite if any:	**Contact hours per week**			**Duration of SEE (Hours)**	**Scheme of Evaluation**		**Credits**
	L	**T**	**P**		**CIE**	**SEE**	
	-	**-**	**3**	**3**	**25**	**50**	**1.5**

Course Objectives:

- To provide practical, experimental verification of fundamental physics concepts learned in lectures.
- To familiarize students with the operation, calibration, and maintenance of modern laboratory equipment and electronic measuring devices such as Four probe setups, Hall effect setup, polarimeters, diodes, lasers, spectrometers, and multimeters.
- To develop analytical and critical thinking skills. Students learn how to accurately record observations, perform graphical data analysis, apply experimental statistics, and estimate % of error and measurement precision.
- To estimate and evaluate the physical properties of engineering materials and components (e.g., determining energy gap in semiconductors, magnetic hysteresis or dielectric constants).
- To train students in the proper execution and documentation of scientific inquiry. This involves constructing proper experimental setups, drawing valid conclusions from collected data, and accurately maintaining laboratory records.

Course Outcomes:

1. Students learn to correlate theoretical physics concepts with real-world observations.
2. Students able to design experimental setups, conduct measurements, and compare your practical findings with theoretical models or calculations.
3. Students will gain expertise in handling advanced lab instruments (e.g., spectrometers, four-probe setups, and lasers etc.). This includes an understanding of instrument sensitivity, targeted accuracy, and error analysis.
4. This course trains the students in meticulous data recording, graphical representation, and logical deduction.
5. Students learn to identify discrepancies between expected and measured values and draw evidence-based conclusions.

List of Experiments:

1. To Estimate Radius of curvature of given lens by forming Newton's rings.
2. To determine specific rotatory power of a given solution by using Laurent's Half shade polarimeter.
3. To determine the wavelength of prominent spectral lines of mercury vapour lamp by plane diffraction grating with the help of spectrometer by using Normal Incidence Method.
4. To determine the Dielectric constant and Phase transition temperature of Lead Zirconium Titanate (PZT)/Barium Titanate ($BaTiO_3$).
5. To draw the curve between the magnetizing field and the intensity of magnetization of the specimen (soft iron), and find out (a) Coercivity, (b) Retentivity and (c) Hysteresis loss.
6. To draw the I-V Characteristics of P-N Junction diode and to evaluate the value of potential barrier of the diode.
7. To find the values of Electrical conductivity and energy gap of Ge crystal by Four probe method.
8. To study V-I characteristics of Light Emitting Diode.
9. Determination of carrier concentration, Mobility and Hall Coefficient of Ge Crystal using Hall Effect Experiment.
10. To calculate the Numerical aperture (NA), acceptance angle of a given optical fibre.
11. Determination of wavelength of LASER using diffraction grating.
12. To determine the constants of A, B and α of given Thermistor.

BS 251 CH	**ENGINEERING CHEMISTRY LAB** **For EEE/ECE/CSE/ AI&ML branches**						
Prerequisite if any: Mathematical Knowledge of 12th/Intermediate level	**Contact hours per week**			**Duration of SEE (Hours)**	**Scheme of Evaluation**		**Credits**
	L	**T**	**P**		**CIE**	**SEE**	
	3	-	-	**3**	**25**	**50**	**1.5**

Course Objectives:

- To know the quality standards of potable water for health based limits.
- To perform the routine synthesis of commonly used drug in the laboratory.
- Apply electrochemical principles in conductivity, Electrode potentials and verification of Beer' s law.
- To Evaluate Iron content from Iron ores.
- To Synthesize an extensively used polymer in industry.

Course Outcomes:

The chemistry laboratory course use consist of experiments illustrating the principle of chemistry relevant to the study of science and engineering.The students will learn to:

- Estimate te hardness of Water in various water samples.
- Synthesize a small molecule drug.
- Measure of conductance of solutions and redox potentials .
- Analysis of Iron content in Iron ore.
- Synthesize an extensively used polymer in industry

Course Articulation Matrix:

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

List of Experiments:-

I) Water analysis.

1) Determination of Total hardness of water by EDTA method.
2) Determination of Permanent hardness of water by EDTA method.

II) Synthesis of a drug molecule:

3) Synthesis of Aspirin.

III) Colorimetry:

4) Verification of Beers law and Estimation of the given permanganate.
5) Verification of Beers law and Estimation of the given $CuSO_4$.

IV) Conductance measurements:

6) Determination of cell constant.

7) Estimation of HCl and CH_3COOH by conductometric titration.

V) Potentiometric Measurements:

8) Estimation of HCl by potentiometric titration.

9) Estimation of ferrous iron by potentiometric titration.

VI) Extraction of Iron From Hematite:

10) Determination of Iron in Hematite.

VII) Synthesis of Polymer:

11) Preparation of phenol-Formaldehyde Resin.

References:

1. Senior Practical Physical Chemistry, B.D.Khosla, A.Gulati and V.Garg (R.Chand&Co.,Delhi)

2. An Introduction to Practical Chemistry,K.K.Sharma and D.S.Sharma (Vikaspublishing, N.Delhi)

ES251CE	**ENGINEERING GRAPHICS**					
Pre-requisites			**L**	**T**	**P**	**C**
			2	-	4	4
Evaluation	**SEE**	50 Marks	**CIE**		25 Marks	

Course Objectives :	
1	Introduction to fundamentals and need of AUTOCAD software drawings
2	Knowledge about various 2D command of AUTOCAD drawing applicable for drawing and printing options.
3	Inputs on basic concepts of engineering drawing, lettering formats for analyzing various topics via. Conic Sections, Involutes.
4	Awareness towards the various types of projections and the drawings of 2D and 3D views.
5	Introduction to fundamentals and need of AUTOCAD software drawings

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Knowledge on the fundamentals of AUTOCAD 2D commands
CO-2	Application of basic principles of drawing and scales for representation of prototype objects
CO-3	Relate the logic of projections to points, straight lines and various views of 2D and 3D objects
CO-4	Capability to imagine and project the developed surface and truncated portion of 3D solids
CO-5	Assimilation of visualization process to efficiently communicate ideas graphically and provide editable solutions

UNIT – I
Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering. Geometrical Constructions (General method only), Conic sections (General and special method); Cycloid, Epicycloid, Hypocycloid and Involute (line, triangle, square, circle, Regular Polygons), Construction of Tangent and Normal to all General methods of Conic sections, Cycloid,
Epicycloid, Hypocycloid and Involutes.

UNIT – II
Overview of Computer Graphics: Listing the computer technologies that impact on graphical communication, demonstrating knowledge of the theory of CAD software, setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning, Snap to objects manually and automatically; Drawings straight lines using various coordinate

input entry methods, Applying various ways of drawing circles.

UNIT– III
Commands, initial settings, Drawing basic entities, Modify commands, Text and Dimensioning, Blocks Applying dimensions to objects, applying annotations to drawings. Setting up and use of Layers, Create, edit and use customized layers; Changing line lengths through modifying existing lines (Extend/Lengthen); Printing Options

UNIT – IV
Scales – Reduced and Enlarged scales, Representative Fraction, Problems - Plain, Diagonal and Vernier Scales, Projections of Points – projection when placed in different quadrants Projection of Straight lines– Projections when parallel to one plane, perpendicular to one plane, inclined to one plane and inclined to both planes.

UNIT –V
Projections of Planes – Projections when parallel to one plane, perpendicular to one plane, inclined to one plane and inclined to both planes. Projections of Regular Solids – Projections covering those parallel to one plane, perpendicular to one plane, inclined to one plane and inclined to both planes. Sections of Solids - sectional Views of Right regular solids covering Prism, Cylinder, Pyramid, and Cone Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone.

Suggested Reading:

1	Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2	Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3	Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4	Jeyapoovan T. (2015). *Engineering Graphics Using Autocad*, Vikas Publishing House Pvt. Ltd., Noida, 7th Edition
5	S.N. Lal., Engineering Drawing (2018), M/S. Cengage Learning India Pvt. Ltd., Pratap Gunj, Delhi

ES252ME	WORKSHOP PRACTICE						Course Type Core
Prerequisite: ----	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	-	-	6	3	25	50	3

Course Objectives: The course is taught with the objectives of enabling the student to:

1. To train students for identifying, selecting, and use proper tools
2. To impart practical, hands-on skills in basic manufacturing processes and fabrication across multiple trades.
3. To instill a safety-first mindset regarding shop floor operations in an industrial environment
4. To learn the fundamentals of house wiring which is used in daily life
5. To measure mechanical dimensions accurately using standard instruments like Vernier calipers etc.

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

1. Identify and select tools appropriate for specific manufacturing, assembly, and fabrication tasks across various engineering trades.
2. Fabricate physical products by applying hands-on skills in basic manufacturing and fabrication processes like carpentry, fitting, welding, foundry and other trades
3. Practice industrial safety by adhering to shop floor regulations, recognizing potential hazards, and using personal protective equipment.
4. Understand how individual trades work together to manufacture and assemble a complete engineering product.
5. Perform precise measurements on machined or fabricated components using standard metrology instruments like Vernier calipers and gauges

Course Articulation Matrix:

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

LIST OF EXPERIMENTS:

1. **Carpentry shop:**
   a) Making of a cross-lap joint with Wood
   b) Making of End Lap / Tee Lap Joint with wood

2. **Fitting shop**
   a) Making of a step cut with a mild steel flat
   b) Making of semicircular and V-cut with a mild steel flat

3. **Sheet metal shop**
   a) Making of Funnel with GI Sheet
   b) Making of a rectangular box with GI Sheet

4. **House wiring**
   a) Making of Cleat wiring
   b) Making of casing wiring

5. **Welding shop**
   a) Making of Butt joint using Arc Welding
   b) Making of a Lap Joint using Arc Welding

6. **Machine shop**
   a) Making of Step turning on MS cylindrical rod
   b) Making of Taper turning on MS cylindrical rod

7. **Foundry shop**
   a) Preparation of casting using a single-piece pattern
   b) Preparation of casting using a core pattern.

8. **Smithy shop**
   a) Forging of a square-shaped peg from a cylindrical workpiece
   b) Forging of square shape L- bend peg from a cylindrical workpiece

Note: Minimum six trades should be conducted.

Suggested Reading:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., *Elements of Workshop Technology*, Vol. I (2008) and Vol. II (2010), Media Promoters and Publishers Pvt. Ltd., Mumbai.