With effect from the academic year 2026-27

SCHEME OF INSTRUCTION AND SYLLABI R-26
OF
B.Tech I TO II SEMESTERS OF FOUR YEAR DEGREE COURSE
IN
CHEMICAL ENGINEERING

R-26 (In line with AICTE Model Curriculum) with effect from AY 2026-27

(R-26 Regulation)

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

R-26 (In line with AICTE Model Curriculum) with effect from AY 2026-27

B Tech (Chemical Engineering)

SEMESTER – I

S. No.	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per Week			SEE in Hours	Maximum Marks		
			L	T	P / D		CIE	SEE	
THEORY									
1	26MTC02	Matrix Theory and Advanced Calculus	3	1	-	3	40	60	4
2	26CYC01	Applied Chemistry	3	-	-	3	40	60	3
3	26EEC01	Basic Electrical Engineering	2	1	-	3	40	60	3
4	26CSC01	Problem Solving and Programming using C	3	-	-	3	40	60	3
5	26ADC01	Artificial Intelligence Foundations and Applications	2	-	-	3	40	60	2
PRACTICAL									
6	22CYC02	Applied Chemistry Lab	-	-	3	3	50	50	1.5
7	26EEC02	Basic Electrical Engineering Lab	-	-	2	3	50	50	1
8	26CSC02	Problem Solving and Programming using C Lab	-	-	3	3	50	50	1.5
9	26MEC01	Robotics and Drones Lab	-	1	2	3	50	50	2
10	26MBC02	Community Engagement	-	-	2	-	50	-	1
TOTAL			**13**	**03**	**12**	**27**	**450**	**500**	**22**
Clock hours per week: 28									

L: Lecture **D: Drawing** **CIE - Continuous Internal Evaluation**

T: Tutorial **P: Practical /Project Seminar/Dissertation** **SEE - Semester End Examination**

26MTC02

Matrix Theory and Advanced Calculus
(For CHEM)

Instruction	3 L+1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

Course Objectives:

1. To develop proficiency in solving system of linear equations using matrix methods.
2. To provide a clear understanding of eigenvalues, eigenvectors and their applications.
3. To explain mean value theorems and their geometrical interpretations.
4. To develop the ability to use partial derivatives for analyzing functions of two variables and determining their extreme values.
5. To introduce and apply double and triple integral concepts.

Course Outcomes:

Upon completing this course, students will be able to:

1. Apply matrix methods to solve system of linear equations.
2. Determine eigenvalues and eigenvectors and analyze the nature of quadratic forms.
3. Interpret and analyze mean value theorems and their geometrical significance, including curvature.
4. Determine extreme values of functions of two variables using partial derivatives.
5. Evaluate double and triple integrals and apply them in relevant problems.

CO-PO Articulation Matrix:

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

UNIT-I: Matrices-I

Linear system of equations**,** Echelon form, Rank of a matrix and consistency, solution of Non-homogeneous system of equations, solution of homogeneous system of equations, Linear dependence and independence of vectors. Solution of system of linear equations by Factorization method (Doolittle's method).

UNIT-II: Matrices-II

Eigenvalues, Eigenvectors, Properties of Eigenvalues and Eigenvectors, Cayley Hamilton theorem, Quadratic form, Reduction of quadratic form to canonical form by linear transformation, Nature of quadratic form.

UNIT-III: Differential Calculus

Rolle's Theorem, Lagrange's Mean value theorem, Cauchy's Mean value theorem (without proofs) and their geometrical interpretations. Curvature, Radius of curvature, Centre of curvature, Evolute and Involute (Cartesian curves).

UNIT-IV: Multivariable calculus

Functions of two or more variables, Partial derivatives, Higher order partial derivatives, Total derivative, Differentiation of implicit functions, Jacobian, Taylor's expansion of functions of two variables, Maxima and Minima of functions of two variables.

UNIT-V: Multiple Integrals

Introduction of double integral, Evaluation of double integral, Evaluation of double integral in polar coordinates, Change of order of integration, Triple integral, Change of variables, Area by double integration, Volume as a triple integral.

Text Books:

1. B.S.Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.
2. N.P.Bali and Dr. Manish Goyal, "A text book of Engineering Mathematics", 9th edition, Laxmi Publications, 2017.

Suggested Reading:

1. B.V.Ramana., "Higher Engineering Mathematics", 11th Reprint, Tata McGraw-Hill, New Delhi, 2010.
2. R.K.Jain, S.R.K.Iyengar, "Advanced Engineering Mathematics", 5th edition, Narosa Publications, 2016.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2016.

Online Resources:

Course Code	Course Name	Resource Link
26MTC02	Matrix Theory and Advanced Calculus	1.https://nptel.ac.in/courses/111107112 [(Unit-I&II: Week-1&3)] 2.https://nptel.ac.in/courses/111105160 [(Unit-III,IV&V: Week-2,3,4,5,9&10)]

26CYC01

APPLIED CHEMISTRY
(Chemical Engineering)

Instruction:	3 Hours per week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	60 Marks
Continuous Internal Evaluation:	40 Marks
Credits:	3

Course Objectives:
This course aims to

1. Develop the concepts of structure and stereochemistry of organic compounds.
2. Describe electrochemical energy storage devices like batteries and fuel cells.
3. Explain the chemistry and biological importance of biomolecules.
4. Create awareness about wastewater treatment and environmental protection.
5. Discuss the applications of quantum dots and nano materials in engineering field.

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

1. Illustrate stereo chemical concepts and reaction mechanisms of organic molecules.
2. Analyse the performance and efficiency of electrochemical energy systems.
3. Correlate the structure of biomolecules with their role in bioengineering systems.
4. Evaluate water quality parameters and select appropriate domestic and industrial treatment techniques.
5. Apply fundamental concepts of quantum confinement effect and nanomaterials in modern technology.

CO-PO Articulation Matrix

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

UNIT – I: Introduction to Organic Chemistry

Structure and bonding in organic molecules (hybridzation), Electronic displacement in molecules – inductive, mesomeric, orientation and steric effects.

Stereochemistry: Definition, types of stereoisomerism-conformational isomerism- conformations of n-butane (Newman and Sawhorse representations), configurational isomerism- geometrical and optical isomerism- optical activity, symmetry and chirality. Enantiomers (lactic acid) and diastereomers (tartaric acid). Absolute configurations - Sequence rules for RS notation.

Types of organic reactions: Substitution Reactions- electrophilic substitution (nitration of benzene), nucleophilic substitution (SN^1 and SN^2) and free radical substitution (halogenation of Alkanes). Addition reactions- electrophilic addition (Markovnikov's rule), free radical addition (anti-Markovnikov's rule, peroxide effect) and nucleophilic addition reactions (addition of HCN to carbonyl compounds). Eliminations Reactions- E^1 and E^2 (dehydrohalogenation of alkyl halides), Saytzeff's rule.

UNIT-II: Energy Generation and Storage

Electrode potentials, Cell potentials, Reference electrodes – construction and working of standard hydrogen electrode (SHE) and saturated calomel electrode. Electrochemical series and its applications. Nernst equation and its applications - numericals. Determination of pH using glass electrode and quinhydrone electrode.

Electroanalytical techniques: Principle, method and applications of conductometry (acid-base titration), potentiometry (acid-base, redox titration).

Green energy and sustainability: Priciples of green chemistry. Production, storage and applications of green hydrogen.

UNIT-III: Biomolecules

Carbohydrates as an energy storage system: Classification of carbohydrates, structure of glucose, fructose, cellulose and starch. Determination of the open chain structure of glucose; Haworth (cyclic) structure of glucose, mutarotation.

Lipids: Fatty acids-saturated and unsaturated fatty acids. Oils- tests to check the purity of oils-acid value, saponification value and iodine Value. Applications of lipids in bioengineering.

Amino acids: Structural classification of amino acids based on R group, Zwitterion structures. Synthesis of amino acids by amination of α-halogen acids, Gabriel phthalimide synthesis and Strecker synthesis.

Nucleic acids: The structural features and functions of DNA and RNA.

UNIT–IV: Water Chemistry

Hardness of water: Types, units of hardness and disadvantages of hard water. Alkalinity of water and its estimation. Numerical problems on hardness of water and alkalinity. Boiler troubles – scales and sludge formation, causes, effects and prevention. Softening of water by ion exchange method. Desalination of water by reverse osmosis and electro dialysis method. Specifications of potable and industrial water. Disinfection of water by chlorination method, breakpoint chlorination. BOD and COD- definition, estimation (only brief procedure) and significance. Industrial wastewater treatment by using Zero Liquid Discharge (ZLD) method.

UNIT-V: Quantum dots and Nanomaterials

Nanomaterials: Introduction to nanomaterials and their classification as 0D, 1D, 2D and 3D materials. General applications of nanomaterials. Basic chemical method of preparation: sol-gel method. Carbon nanotubes and their applications. Characterisation of nanomaterials by SEM and TEM (principles only).

Quantum dots: Definition and classification of quantum dots. Concept of quantum confinement. Size dependent optical properties (absorption and photoluminescence). Core and core shell quantum dots - surface capping and functionalization with emphasis on stability. Applications in LEDs, solar cells, bio-imaging and sensing. Raman Spectroscopy (Principle only).

Composite materials: Definition and classification of composites- Particle reinforced, fibre reinforced - glass fibre reinforced and carbon fibre reinforced composites and their applications.

TEXT BOOKS

1. P.C. Jain and M. Jain, “Engineering Chemistry”, Dhanpat Rai Publishing Company Ltd., New Delhi, 17th edition (2025).
2. R.T. Morrison, R.N. Boyd and S.K. Bhattacharjee, “Organic Chemistry”, Pearson, Delhi, 7th edition (2019).
3. G.L. David Krupadanam, D. Vijaya Prasad, K. Varaprasad Rao, K.L.N. Reddy and C.Sudhakar,“Drugs”, Universities Press (India) Limited, Hyderabad (2016).

SUGGESTED READINGS

1. T.W. Graham Solomons, C.B. Fryhle and S.A. Snyder, “Organic Chemistry”, Wiley, 12th edition (2017).
2. T. Pradeep, Nano: The Essentials, Tata McGraw-Hill Education, Delhi, 2018

26EEC01

BASIC ELECTRICAL ENGINEERING

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: This course aims to

1. Understand the behavior of different circuit elements R, L & C, and the basic concepts of electrical AC circuit analysis
2. Comprehend the basic principle of operation of AC and DC machines
3. Infer about different types of cables, wires, safety rules, sensors and methods of Earthing,

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

1. Understand the concepts of Kirchhoff's laws and their application of various theorems to get solutions of simple DC circuits.
2. Predict the steady state response of RLC circuits with AC single phase/three phase supply.
3. Infer the basics of single-phase transformers
4. Describe the construction, working principle of DC machine and 3-phase Induction motor.
5. Acquire knowledge of electrical wires, cables, earthing, and electrical safety precautions to be followed in electrical installations, including electric shock protection, energy calculations, and sensors.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	3	3	2	-	-	-	-	1	2	-	3	3	2
CO 2	3	3	2	-	-	-	-	1	2	-	3	3	2
CO 3	3	3	2	1	-	-	-	1	2	-	3	2	1
CO 4	2	1	-	-	-	-	-	1	2	-	3	2	1
CO 5	2	-	2	-	-	-	-	1	2	-	3	2	3

1 - Slightly; 2 - Moderately; 3 - Substantially

UNIT-I

DC Circuits: Electrical Circuit Elements: R, L and C, voltage and current sources, Kirchhoff current (KCL) and voltage laws (KVL), Analysis of simple circuits with DC excitation: Nodal Analysis, Mesh Analysis, Superposition, Thevenin's and Norton's Theorems.

UNIT-II

AC Circuits: Single Phase 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, series RL and RC.

Three phase balanced circuits: Introduction, Comparison of Single phase and Three Phase System, voltage and current relations in star and delta connections (Elementary treatment only)

UNIT-III

Single Phase Transformer: Construction, Working Principle, EMF Equation, Comparison of Ideal and Practical Transformer, Losses, OC and SC tests and Efficiency.

UNIT-IV

DC and AC Machines: DC Generators: Construction, Principle of operation, EMF equation, Classification, Applications DC Motors: Principle of operation, Classification, Torque Equation, Characteristics & Speed control of DC Shunt Motor, Applications. Three Phase Induction Motors: Principle of operation, Applications

UNIT-V

Electrical Installations and Sensors: Electrical Wiring: Types of wires and cables, Electrical Safety precautions in handling electrical appliances, electric shock, and first aid for electric shock.

Components of LT Switchgear: Fuse, MCB and Earthing (Elementary Treatment only), Elementary calculations for energy consumption.

Sensors: Introduction, Working Principle, Types-Temperature, Humidity, and Motion (Elementary treatment only).

TEXTBOOKS:

1. B. L. Theraja & A. K. Theraja, Electrical Technology in S.I units (Volume-1 and Volume-2), S. Chand Publishing, 2021
2. D.C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2nd edition, 2019
3.Wadhwa, C L, "Basic Electrical Engineering", New Age International Publishers, 5th edition, 2023
4. Jacob Fraden," Handbook of Modern Sensors (Physics, Designs, and Applications)" Fifth Edition, 2016

SUGGESTED READING:

1. D. P. Kothari & I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill,4th edition, 2019.
2. S.K.Sahdev, "Basic Electrical Engineering",Pearson Education, 2015.
3. P.V. Prasad, S. S. Sivanagaraju, R. Prasad, "Basic Electrical and Electronics Engineering" Cengage Learning, 1st Edition, 2012.

ONLINE RESOURCES:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	Basic Electrical Circuits	Prof. Nagendra Krishnapura	IIT Madras
2	Electrical Machines	Prof. Anirban Sengupta	IIT Kanpur
3	Electric Circuits	Prof. S. C. Dutta Roy	IIT Delhi
4	Basic Electrical Technology	Prof. D. P. Kothari	IIT Delhi
5	Introduction to Electrical Engineering	Prof. S. K. Sharma	IIT Kanpur

26CSC01

PROBLEM SOLVING AND PROGRAMMING USING C

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

PREREQUISITES: Basic high school mathematics.

COURSE OBJECTIVES:

This course aims to

1. Understanding the steps in problem solving and formulation of algorithms to problems.
2. Develop programming skills as a means of implementing an algorithmic solution with appropriate control and data structures.
3. Develop intuition to enable students to come up with creative approaches to problems.

COURSE OUTCOMES:

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

1. List and outline the steps to develop algorithmic solutions and identify flowchart symbols.
2. Illustrate programming concepts such as variables, data types, conditionals, loops, print statements, and functions.
3. Develop algorithms using recursion and iteration techniques.
4. Analyze the use of arrays, pointers, initialization, and dynamic memory allocation.
5. Evaluate and develop large-scale programs using multiple files, header files, and make utilities.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	3	1	1	-	1	-	-	-	-	-	1	2	1
CO 2	3	1	1	-	1	-	-	-	-	-	1	2	1
CO 3	3	1	1	-	1	-	-	-	-	-	1	2	2
CO 4	3	1	1	-	1	-	-	-	-	-	1	3	2
CO 5	3	1	1	-	1	-	-	-	-	-	1	3	2

UNIT-I

Introduction: Introduction to Programming, Idea of Algorithm, Representation of Algorithm, Flowchart, from algorithms to programs, source code.

Basics of C: Background, Structure of a C Program, Datatypes, Tokens, Operators and Expressions-Evaluating Expressions, Precedence and Associativity of Operators, Type Conversions, Input and Output Functions.

UNIT-II

Control Statements: Conditional Execution -Selection Statements, Conditional Operator, Switch statement. Iteration Execution - While Construct, For Construct, do-while Construct Goto Statement, Special Control Statements, Nested Loops.

Arrays: One-Dimensional Arrays-Declaration, Initialization, internal representation. Multidimensional Arrays.

UNIT–III

Strings: Strings: One-dimensional Character Arrays, Arrays of Strings: Two-dimensional Character Array.

Search and Sorting: Searching algorithms-linear, binary searching. Sorting algorithms- bubble sort, selection sort.

Functions: Concept, Uses, Prototype, Declaration, Parameter passing techniques, Passing Arrays to Functions, Storage Classes, Recursion.

UNIT-IV

Pointers: Declaring a Pointer, Initializing Pointers, Indirection Operator and Dereferencing, Arrays and Pointers, Pointers and Strings, Pointers to Pointers, Array of Pointers, Pointers to an Array, Two-dimensional Arrays and Pointers, Pointers to Functions and Dynamic Memory Allocation.

UNIT–V

User-defined Datatypes: Structures- Declaring Structures and Structure Variables, Accessing the Members of a Structure, Initialization of Structures, Typedef, Nesting of Structures, Arrays and Structures. Union, Enumeration Types.

Files: Using Files in C, Declaration of File Pointer, Working with Text Files, Character Input and Output, Working with Binary Files, Sequential Versus Random File Access, File Record.

C Preprocessor Directives.

TEXT BOOKS:

1. Pradip Dey and Manas Ghosh “Programming in C 2/e”, 2nd Edition, Oxford University Press, 2012.
2. E. Balaguruswamy, “Programming in ANSI C”, 9th Edition, Tata McGraw-Hill, 2024.

SUGGESTED READING:

1. B.A.Forouzan and Hassan Afyouni “A Structured Programming Approach in C”, 4th Edition, Cengage Learning, 2024.
2. B. W. Kernighan and D.M. Ritchie, "The 'C' Programming Language”, 2nd Edition (Paperback), Prentice Hall India, 2018.
3. Paul Deitel and Harvey Deitel, “C: How to Program”, 9th Edition, Pearson, 2022.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_cs40/preview
2. https://archive.nptel.ac.in/courses/106/105/106105171/

26ADC01

ARTIFICIAL INTELLIGENCE FOUNDATIONS AND APPLICATIONS

Instruction	2 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

PREREQUISITE: NIL

COURSE OBJECTIVES:
This course aims to:
1. Provide a foundational understanding of Artificial Intelligence and its evolution
2. Introduce key AI subfields and their real-world applications across industries
3. Explain the impact of AI on society, including ethical and fairness considerations
4. Study emerging trends such as Generative AI and future directions

COURSE OUTCOMES:
Upon completion of this course, students will be able to:
1. Understand the basic concepts and evolution of Artificial Intelligence
2. Illustrate major AI subfields and their functionalities
3. Develop and describe applications of AI in various domains
4. Elaborate ethical issues, bias, and societal impacts of AI systems
5. Demonstrate emerging trends such as Generative AI and their future implications

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	3	2	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	3	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	3	-	-	-	2	-	-	-	-	-	-	-
CO 4	2	2	-	-	-	2	2	3	-	-	-	-	-
CO 5	2	2	-	-	-	2	2	2	-	-	-	-	-

UNIT - I
INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Evolution of Artificial Intelligence: early developments and growth of AI. Definition and scope of AI. Core components of AI: Machine Learning, Pattern Recognition, Natural Language Processing, and Computer Vision. Concept of Artificial General Intelligence (AGI)

UNIT - II
AI SUBFIELDS AND TECHNOLOGIES

Introduction to AI subfields: Computer Vision - object detection, facial recognition, medical imaging, Natural Language Processing - text classification, translation, summarization, Machine Learning - classification, regression, clustering, recommendation systems, Robotics- types and components, and Knowledge Engineering - representation and reasoning.

UNIT - III

APPLICATIONS OF ARTIFICIAL INTELLIGENCE

Applications of AI in various domains: Healthcare - diagnosis, drug discovery, Finance - risk management, trading, Retail - personalization, customer support, Agriculture -precision farming, Education - personalized learning, and Transportation -traffic management. Challenges in applying AI in real-world scenarios.

UNIT - IV

ETHICS, BIAS AND FAIRNESS IN AI

Ethics in AI systems. Types of bias and fairness issues. Transparency and explain ability. Accountability of AI systems. Privacy and data protection concerns. Security risks in AI systems. Inclusivity, sustainability, robustness, and reliability.

UNIT – V

GENERATIVE AI AND FUTURE DIRECTIONS

AI in research and interdisciplinary domains. Introduction to Generative AI and its evolution. Emerging trends and future directions of Artificial Intelligence. Social implications and impact of AI.

TEXT BOOKS:

1. AI for Everyone: A Beginner's Handbook for Artificial Intelligence, First Edition, Pearson India, 2023.

SUGGESTED READING:

1. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, Fourth Edition, Pearson, 2021
2. Melanie Mitchell, Artificial Intelligence: A Guide for Thinking Humans, First Edition, Farrar, Straus and Giroux, 2019.

WEB RESOURCES:

1. Government of India, Press Information Bureau (PIB), YUVA AI for ALL Initiative Available: https://www.pib.gov.in/PressReleseDetailm.aspx?PRID=2191334
2. FutureSkills Prime (MeitY & NASSCOM), AI Learning Platform. Available: https://futureskillsprime.in
3. India AI Mission (Government of India AI Initiative). Available: https://indiaai.gov.in

26CYC02

APPLIED CHEMISTRY LAB

(Chemical Engineering)

Instruction:	3 Hours per week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	50 Marks
Continuous Internal Evaluation:	50 Marks
Credits:	1.5

Course Objectives:

This course aims to

1. Impart fundamental knowledge in handling the equipment/glassware and chemicals in chemistry laboratory.
2. Get familiarized with the volumetric principles for quantitative analysis.
3. Provide the knowledge in qualitative chemical analysis of organic compounds.
4. Understand & use the various instrumental methods to analyze the chemical compounds.
5. Interpret the theoretical concepts in the preparation of new materials like drugs and polymers.

Course Outcomes:

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

1. Identify the basic chemical methods to analyze the substances quantitatively and qualitatively.
2. Develop analytical thinking and problem-solving skills in identifying unknown samples.
3. Estimate the amount of chemical substances by volumetric analysis.
4. Calculate the concentration and amount of various substances using instrumental techniques.
5. Develop the basic drug molecules and polymeric compounds.

CO-PO Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	3	2	2	1	-	2	-	-	-	-	2	2	2
CO 2	3	2	2	2	-	2	-	-	-	-	2	2	2
CO 3	3	2	2	2	-	2	-	-	-	-	2	2	2
CO 4	3	2	2	2	-	2	-	-	-	-	2	2	2
CO 5	3	2	3	2	-	2	-	-	-	-	2	2	3

List of Laboratory Experiments:

1. Introduction: Preparation of standard solution of oxalic acid and standardisation of NaOH.
2. Identification of organic functional groups (Carboxylic acids & Amines).
3. Estimation of temporary, permanent and total hardness of water using EDTA solution.
4. Determination of alkalinity in the given water sample.
5. Determination of concentration of given $KMnO_4$ solution by colorimetric method.
6. Determination of concentration of given $K_2Cr_2O_7$ solution by colorimetric method.
7. Estimation of amount of HCl conductometrically using NaOH solution.
8. Estimation of amount of HCl and CH_3COOH present in the given mixture of acids conductometrically using NaOH solution.
9. Identification of bio molecules (carbohydrates and proteins) in the given samples.

10. Preparation of Zinc Oxide Nanoparticles.
11. Preparation of nitrobenzene from benzene.
12. Synthesis of aspirin and paracetamol drugs.
13. Synthesis of phenol formaldehyde resin.

TEXT BOOKS

1. J. Mendham and Thomas, "Vogel's text book of quantitative chemical analysis", Pearson education Pvt.Ltd. New Delhi, 6th ed. 2017.
2. Senior practical physical chemistry by B.D.Khosla, V.C.Garg & A.Gulati, R. Chand & Co. : New Delhi (2011).

SUGGESTED READINGS

1. Dr. Subdharani , "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing, 2020.
2. S.S. Dara , "A Textbook on experiment and calculation in engineering chemistry", S.Chand and Company, 9th revised edition, 2015.

26EEC02

BASIC ELECTRICAL ENGINEERING LAB

Instruction	2PHours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

COURSE OBJECTIVES:

This course aims to:

1. To acquire to verify the basic electrical circuit laws and theorems.
2. Explore the concept of single phase AC and Three phase AC concepts
3. To find the characteristics of Transformers, DC, AC Machines and switch gear components

COURSE OUTCOMES:

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

1. Comprehend the circuit analysis techniques using various circuital laws and theorems.
2. Determine the different parameters related Single Phase AC and 3 Phase AC Circuits
3. Determine the turns ration/performance parameters of single-phase transformer
4. Infer the characteristics of the DC shunt motor subjected to different tests.
5. Illustrate different parts of Machines, Protection equipment and Sensors.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	3	2	2	-	-	2	-	-	-	-	2	3	1
CO 2	3	2	1	-	-	2	-	-	-	-	2	3	2
CO 3	3	2	3	-	-	2	-	-	-	-	2	2	2
CO 4	3	2	2	-	-	2	-	-	-	-	2	2	1
CO 5	3	2	3	-	-	2	-	-	-	-	2	2	3

List of Laboratory Experiments/Demonstrations

1. Verification of KCL and KVL.
2. Verification of Thevenin's Theorem.
3. Verification of Superposition Theorem.
4. Verification of Norton’s Theorem
5. Determination of parameters of a choke or coil by Wattmeter Method
6. Active and Reactive Power measurement of a single-phase system using 3-Ammeter method
7. Active and Reactive Power measurement of a single-phase system using 3-Voltmeter method
8. Measurement of 3-Phase Power in a Balanced system
9. Measurement of Energy Using a Single-Phase Energy Meter
10. Verification of Turns/voltage ratio of Single-Phase Transformer.
11. Open Circuit and Short Circuit tests on a Single-Phase Transformer.
12. Brake Test on DC Shunt Motor
13. Speed Control of DC Shunt Motor
14. Demonstration of Fuse & MCB
15. Demonstration of Sensors
16. Study of cut - out section of Electrical Machines

Note: At least 10 experiments need to be conducted.

26CSC02

PROBLEM SOLVING AND PROGRAMMING USING C LAB

Instruction	3PHours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

PREREQUISITES: Basic high school mathematics.

COURSE OBJECTIVES:

This course aims to

1. Setting up programming environment.
2. Develop Programming skills to solve problems.
3. Use of appropriate C programming constructs to implement algorithms.

COURSE OUTCOMES:

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

1. Identify and setup program development environment.
2. Implement the algorithms using C programming language constructs.
3. Analyze programs using arrays, structures and pointers.
4. Evaluate problems in a modular approach using functions.
5. Develop file operations with simple text data.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	-	1	1	1	-	-	-	-	-	1	-	2	1
CO 2	3	2	1	2	-	-	-	-	-	-	-	3	1
CO 3	3	2	1	2	-	-	-	-	-	-	-	3	2
CO 4	3	2	1	2	-	-	-	-	-	-	-	2	2
CO 5	3	1	-	1	-	-	-	-	-	-	-	2	2

LABORATORY / PRACTICAL EXPERIMENTS:

1. Introducing to IDE.
2. Implement programs using arithmetic, relational, bitwise, conditional, logical, and ternary operators.
3. Implement programs using control statements (sequential, selection and iteration).
4. Implement programs using user defined functions and Recursion.
5. Implement Programs using one dimensional arrays.
6. Implement programs on two dimensional arrays with and without using functions.
7. Implement programs on sorting and searching using iteration and recursion. (Bubble Sort, Selection Sort, Linear Search, Binary Search)
8. Implement programs on String manipulation (with and without using string library functions).
9. Implement programs using pointers and dynamic memory allocation.
10. Implement programs using Structures.

11. Implement file handling programs (Modes, Operations, Access).

TEXT BOOKS:

1. Pradip Dey and Manas Ghosh "Programming in C 2/e", 2nd Edition Oxford University Press, 2012.
2. E. Balaguruswamy, "Programming in ANSI C", 9th Edition, Tata McGraw-Hill, 2024.

SUGGESTED READING:

1. B.A.Forouzan and Hassan Afyouni "A Structured Programming Approach in C", 4th Edition, Cengage Learning, 2024.
2. B. W. Kernighan and D.M. Ritchie, "The 'C' Programming Language", 2nd Edition (Paperback), Prentice Hall India, 2018.
3. Paul Deitel and Harvey Deitel, "C: How to Program", 9th Edition, Pearson. 2022.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_cs40/preview
2. https://archive.nptel.ac.in/courses/106/105/106105171/

26MEC01

ROBOTICS AND DRONES LAB

(Common to Mechanical, Civil, ECE, EVL, EEE, Chemical & Bio Tech)

Instruction	1T+2PHours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	2

COURSE OBJECTIVES:

The objectives of this course are to:

1. Develop a fundamental understanding of robotics, Arduino programming, and electronic circuit interfacing used in autonomous systems.
2. Gain practical knowledge of interfacing various sensors such as ultrasonic sensors, IR sensors, and LiDAR sensors with microcontrollers for data acquisition in robotic and drone applications.
3. Acquire proficiency in controlling different types of actuators including servo motors, stepper motors, DC motors, and BLDC motors for robotic and drone movement.
4. Understand the structure, components, and working principles of drones, and develop the ability to assemble basic quadcopter system.
5. Apply basic computer vision techniques using Python and OpenCV for image processing tasks relevant to drone-based applications.

COURSE OUTCOMES:

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

1. Understand the fundamentals of robotics, Arduino programming, and electronic interfacing required for autonomous systems.
2. Interface and utilize sensors such as ultrasonic, IR, and LiDAR sensors to collect and process environmental data for robotic and drone applications.
3. Demonstrate the ability to control various actuators including servo motors, stepper motors, DC motors, and BLDC motors for implementing robotic movements.
4. Assemble and understand the operation of drone systems including mechanical, electrical, and control components required for drone flight.
5. Apply Python and OpenCV techniques for basic image processing tasks such as RGB extraction, shape creation, and region of interest (ROI) extraction (or) to develop simple autonomous systems.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	3	2	2	1	2	1	1	2	2	1	2	3	2
CO 2	2	3	2	3	2	1	1	1	1	1	2	3	3
CO 3	2	2	3	2	2	1	1	2	1	1	2	2	2
CO 4	2	2	3	2	2	1	1	3	2	2	2	2	2
CO 5	2	2	2	2	3	1	1	1	2	1	3	3	3

Lab Exercises:

1 a. Interface Arduino with LEDs to do traffic light simulation

b. Design and implement a system to interface an Arduino board with a seven-segment LED display to show decimal digits from 0 to 9. The Arduino should be programmed to sequentially display each number with a fixed time delay between transitions.

2	a. Interface Arduino with Electronic Devices such as Push Button to control piezo buzzer. b. Interface Arduino with Electronic Devices such as Potentiometer to control blinking time of LED
3	Interfacing Arduino with Ultrasonic Distance Sensor and Displaying Sensor Data on Serial Monitor.
4	Interfacing Arduino with IR Sensor and Reading Sensor Data on Serial Monitor.
5	Implement a system using Arduino to control the precise movement of a Servo Motor.
6	Control and operate a Stepper Motor using Arduino for precise and sequential motion.
7	Construct a two-wheel robot using DC motors controlled by Arduino. Program the robot to: (i) Move forward with controlled acceleration (ii) Move backward with controlled deceleration.
8	Controlling a BLDC motor of a drone using a Servo Tester.
9	Attach a propeller to a BLDC motor and measure the wind speed using an Anemometer.
10	Measure the distance between an obstacle and the drone using a TF-Mini LiDAR Range Sensor.
11	Assemble the mechanical and electrical subsystems of a quadcopter drone by integrating frame arms, BLDC motors, ESCs, power distribution system, and connectors. Verify electrical continuity and correct motor-ESC connections.
12	Integrate drone control components including flight controller, radio receiver, GPS module, battery, and propellers. Study of Drone Take-off, Flight, and Landing Basics.
13	Open CV for Image Processing in Drones: (i) Extraction of RGB values of a pixel (ii) Creation of coloured shapes and saving images (iii) Extraction of Region of Interest (ROI).
14	Open-Ended Autonomous System Project.

Note:

Students shall complete any 10 out of the 14 experiments. The Experiment No. 14 (Open-Ended Project) is mandatory and carries 10 marks in CIE.

TEXT BOOKS:

1. J. M. Hughes, *Arduino: A Technical Reference: A Handbook for Technicians, Engineers, and Makers*. Sebastopol, CA: O'Reilly Media, 2016.
2. S. Monk, *Programming Arduino: Getting Started with Sketches*. New York, NY: McGraw-Hill, 2022.
3. D. McGriffy, *Make: Drones: Teach an Arduino to Fly*. San Francisco, CA: Maker Media, 2016.

SUGGESTED READING:

1. https://www.geeksforgeeks.org/robotics-introduction/
2. https://dronebotworkshop.com/

26MBC02

COMMUNITY ENGAGEMENT

Instruction	2 Hours per week
SEE	Nil
CIE	50 Marks
Credits	1 Credit

COURSE OBJECTIVES:

The main Objectives of this Course are to:

1. develop an understanding of rural life, culture, and socio-economic conditions.
2. Expose students to rural livelihoods, local economic systems, and entrepreneurship opportunities.
3. Familiarize students with rural institutions, governance mechanisms, and development programmes in India.
4. Promote community engagement, social responsibility, and experiential learning through field-based activities.
5. Enable students to analyse community issues and contribute to sustainable rural development solutions.

COURSE OUTCOMES:

After the completion of this Course, Student will be able to:

1. Understand rural society, culture, and development issues.
2. Demonstrate empathy and social responsibility towards communities.
3. Analyse rural livelihood systems and economic activities.
4. Evaluate the role of rural institutions and government programmes.
5. Participate in community-based activities and suggest improvements.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	1	2	2	2	-	3	1	2	-	-	2	-	-
CO 2	-	1	2	2	-	2	-	2	1	-	1	-	-
CO 3	-	1	1	2	-	3	1	3	1	2	1	-	-
CO 4	2	2	3	2	-	2	1	2	2	1	-	-	-
CO 5	1	2	2	1	-	2	-	1	-	1	1	-	-

Module I Appreciation of Rural Society

Rural lifestyle and social structure, Caste and gender relations, Rural values and traditions, Rural infrastructure.

Module II Understanding Rural Economy and Livelihood

Agriculture and allied activities, Rural entrepreneurship, Non-farm livelihoods and artisans, Rural markets and credit systems, Farmer Producer Organizations (FPOs).

Module III Rural Institutions

Panchayati Raj system (Gram Sabha, Gram Panchayat), Self-Help Groups (SHGs), Role of NGOs in rural development

Module IV Rural Development Programmes

Overview of rural development in India, Key government schemes, Mahatma Gandhi National Rural Employment Guarantee (MGNREGA) Scheme, National Rural Livelihood Mission (NRLM), Pradhan Mantri Awas Yojana (PMAY), Swachh Bharat, Skill India, Ayushman Bharat.

TEXT BOOKS:

1. Singh, Katar, Rural Development: Principles, Policies and Management, Sage Publications, New Delhi, 2015.
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002.
3. United Nations, Sustainable Development Goals, 2015, un.org/sdgs
4. M.P Boraia, Best Practices in Rural Development, Shanlax Publishers, 2016.
5. Helen Sheil, "Growing and Learning in Rural Communities" (Revised Edition), 2024.

SUGGESTED READINGS & JOURNALS:

1. Seth Appiah-Opoku , Usha Iyer-Raniga, "Contemporary Rural Development Programs", 2025
2. Journal of Rural development (published by NIRD & PR, Hyderabad).
3. Indian Journal of Social Work, (by TISS, Bombay).
4. Indian Journal of Extension Educations (by Indian Society of Extension Education).
5. Kurukshetra (Ministry of Rural Development, GOI).

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

R26 (In line with AICTE Model Curriculum) with effect from AY 2026-27

B Tech (Chemical Engineering)

SEMESTER –II

S. No.	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per Week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	26MTC05	Applied Vector Calculus and Ordinary Differential Equations	3	1	-	3	40	60	4
2	26PYC07	Physics	3	-	-	3	40	60	3
3	26CHC01	Material and Energy Balance Calculations	3	-	-	3	40	60	3
4	26EGC01	Communicative English	2	-	-	3	40	60	2
PRACTICALS									
5	26PYC10	Physics Lab	-	-	3	3	50	50	1.5
6	26MEC03	Engineering Graphics	-	1	3	3	50	50	2.5
7	26CSC38	Python Programming Workshop	-	-	3	3	50	50	1.5
8	26MEC04	Engineering Workshop and 3D Printing	-	-	3	3	50	50	1.5
9	26EGC02	Communication Skills Lab	-	-	2	3	50	50	1
TOTAL			**11**	**02**	**14**	**27**	**410**	**490**	**20**
Clock hours per week: 27									

L: Lecture **D: Drawing** **CIE - Continuous Internal Evaluation**

T: Tutorial **P: Practical /Project Seminar/Dissertation** **SEE - Semester End Examination**

26MTC05

Applied Vector Calculus and Differential Equations

(For CHEM)

Instruction	3 L+1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

Course Objectives:

1. To develop skills in solving first-order differential equations using appropriate methods.
2. To extend the understanding of higher-order differential equations and their solution techniques.
3. To introduce Laplace transform techniques and their applications in solving differential equations.
4. To develop understanding of scalar and vector functions along with their physical interpretations.
5. To introduce and apply vector calculus concepts including line, surface and volume integrals.

Course Outcomes:

Upon completing this course, students will be able to:

1. Solve first-order linear differential equations using appropriate methods.
2. Solve higher-order linear differential equations using standard techniques.
3. Apply Laplace transforms to solve differential equations effectively.
4. Apply vector differential operators to scalar and vector functions.
5. Evaluate line, surface and volume integrals using Green's, Gauss and Stoke's theorems.

CO-PO Articulation Matrix:

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

UNIT-I: First Order Ordinary Differential Equations

Exact differential equations, Differential Equations reducible to exact equations, Linear equation, Bernoulli's equation, Clairaut's equation, Orthogonal trajectories (Cartesian and polar curves) and LR circuits.

UNIT-II: Higher Order Linear Differential Equations

Higher order linear differential equations with constant coefficients, rules for finding the Complementary function, Particular Integral and General solution. Method of variation of parameters, Solution of Cauchy's homogeneous linear equation and LCR circuits.

UNIT-III: Laplace Transforms

Laplace Transform of Elementary functions, Linearity property, First Shifting property, Change of scale property. Laplace Transform of Periodic functions, Transforms of derivatives, integral's, Multiplication by t^n and division by t. Evaluation of Integrals by Laplace Transforms. Inverse Laplace transform of elementary functions, Inverse Laplace Transform by Method of partial

fractions, Convolution theorem (Without proof) and related problems, Solution of Ordinary Differential Equations by Laplace Transform method.

UNIT-IV: Vector Differential Calculus

Scalar and Vector point functions, operator Del, Del applied to scalar point function-Gradient, Directional derivative, Del applied to vector point function-Divergence, Curl, Solenoidal vectors and Irrotational vectors, Del applied twice to point functions.

UNIT-V: Vector Integral Calculus

Line integral, circulation, work done by force, Surface integral and Volume integral. Verification of Green's theorem in a plane (without proof), verification of Stoke's theorem (without proof) and verification Gauss divergence theorem (without proof).

Text Books:

1. B.S.Grewal, "Higher Engineering Mathematics",44th Edition, Khanna Publishers, 2017.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.

Suggested Reading:

1. N.P.Bali and Dr. Manish Goyal, "A text book of Engineering Mathematics", 9th edition, Laxmi Publications, 2017.
2. R.K.Jain, S.R.K.Iyengar, "Advanced Engineering Mathematics", 5th edition, Narosa Publications, 2016.

Online Resources:

Course Code	Course Name	Resource Link
26MTC05	Applied Vector Calculus and Differential Equations	1.https://nptel.ac.in/courses/111105160 [(Unit-I,II,IV&V: Week-6,7, 9, 10,11&12)] 2.https://nptel.ac.in/courses/111106139 [(Unit-III: Week-2,3,4,&5)]

26PYC07

PHYSICS
(Biotech & Chemical)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: The objectives of the course is to make the student
1. Learn the basic concepts of wave nature of light
2. Know about the properties of magnetic and dielectric materials.
3. Understand the physical properties of crystalline materials.
4. Familiarize with fundamental ideas of quantum mechanics.

Course Outcomes: At the end of the course, the student will be able to
1. Analyse the wave nature of the light by correlating theoretical concepts with experimental results.
2. Categorize lasers and optical fibres for real time applications.
3. Classify different types of cryst als and their imperfections.
4. Identify magnetic and dielectric materials for engineering applications.
5. Interpret the dual nature of matter and its quantum effects.

CO-PO Articulation Matrix:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	3	1	1	1	1	2	1	1	2	1	2	-	-
CO2	3	1	2	1	2	2	1	2	2	2	2	1	1
CO3	2	2	1	1	1	1	1	1	1	2	1	1	1
CO4	2	2	2	2	2	2	2	1	1	2	1	1	1
CO5	2	2	2	2	2	1	2	2	1	2	1	-	-

UNIT-I

Wave Optics: Interference of light by splitting of wavefront and amplitude – Fresnel's biprism – Interference in thin films (reflected light) – Newton's rings – Fraunhofer diffraction at single slit – Double slit – Diffraction grating – Introduction to polarisation – Malus's law – Double refraction – Nicol's prism – Optical activity – Laurant's half shade polarimeter.

UNIT-II

Lasers: Characteristics of lasers – Spontaneous and Stimulated Emissions – Einstein's coefficients – Population inversion – Ruby laser – He-Ne laser – Applications of lasers in engineering and medicine.

Fiber Optics: Introduction – Construction – Principle – Propagation of light through an optical fiber – Numerical aperture and acceptance angle – Step-index and graded-index fibers – Pulse dispersion –Fiber losses – Fiber optic communication system – Applications.

UNIT-III

Crystallography: Space lattice – Unit cell – Crystal systems – Bravais lattices – Number of atoms per unit cell – Coordination number – Atomic radius – Packing fraction (for sc, bcc, fcc) – Lattice planes – Miller indices – Bragg's law – Experimental determination of lattice constant of a cubic crystal by powder X-ray diffraction method – Structure of NaCl.

Crystal Imperfections: Classification of defects – Point defects – Concentration of Schottky and Frenkel defects.

UNIT-IV

Dielectric Materials: Introduction – Dielectric polarization – Types of dielectric polarization (qualitative): electronic, ionic, orientational and space-charge polarizations – Frequency and temperature dependence of dielectric polarization – Ferroelectricity – Barium titanate – Applications of ferroelectrics.

Magnetic Materials: Origin of magnetism – Magnetic moment – Bohr magneton – Classification of magnetic materials: dia, para, ferro, anti-ferro and ferrimagnetic materials – Weiss molecular field theory – Domain theory –Hysteresis curve – Soft and hard magnetic materials.

UNIT-V

Quantum Mechanics: Introduction – de-Broglie hypothesis – Wave-particle duality –Born's interpretation of the wave function – Verification of matter waves by Davisson-Germer's experiment – Uncertainty principle – Schrodinger wave equation (time-dependent and time-independent) – Particle in an infinite square well potential.

TEXT BOOKS:

1. B.K. Pandey and S. Chaturvedi, *Engineering Physics*, Cengage Publications, 2012.
2. M.N. Avadhanulu and P.G. Kshirsagar, *A Text Book of Engineering Physics*, S. Chand Publications, 2014.
3. M. Arumugam, *Materials Science*, Anuradha Publications, 2015.
4. S.L. Gupta and Sanjeev Gupta, *Modern Engineering Physics*, Dhanpat Rai Publications, 2011.

SUGGESTD READING:

1. R. Murugeshan and Kiruthiga Sivaprasath, *Modern Physics*, S. Chand Publications S. Chand Publications, 2014.
2. V. Rajendran, *Engineering Physics*, McGraw-Hill Education Publications, 2013.
3. P.K. Palanisamy, *Engineering Physics*, Scitech Publications, 2012.
4. V. Raghavan, *Materials Science and Engineering*, Prentice Hall India Learning Private Limited; 6th Revised edition, 2015.
5. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury *Concepts of modern physics* , 7th edn, McGraw Hill publications, 2017.

26CHC01

MATERIAL AND ENERGY BALANCE CALCULATIONS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Basis for all further chemical engineering courses that are part of the curriculum.
2. Basic calculations of process engineering.
3. Material balance calculations for with and without chemical reactions.
4. Properties and laws for analyzing vapors and liquids
5. Energy balance calculations and its importance.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Convert physico-chemical quantities between different systems of units and express system compositions on various calculation bases.
2. Apply material balance principles to solve problems involving single and multi-unit non-reactive systems.
3. Analyze and solve material balance problems involving chemical reactions.
4. Apply energy balance concepts to solve problems for non-reactive systems.
5. Estimate and **calculate** the heat of reaction for reactive systems.

CO-PO-PSO Matrix

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

UNIT-I

Introduction to process calculations: Units and Dimensions-Conversion of Units – Dimensional homogeneity; Unit operations and unit processes, Process and process variables – process flow sheet, process unit, process streams, density, specific gravity, specific gravity scales, mass and volumetric flow rates, mole concept and mole balance, molecular and equivalent weights; Composition of streams on different basis; Gases, Vapors and Liquids: Equations of state, mixture of ideal gases- Dalton's and Amagat's laws, Vapor pressure, Clausius-Clapeyron equation, Cox chart, Duhring's plot, Raoult's law.

UNIT-II

Solving material balance (M.B) problems without chemical reaction: Basic laws of conservation; Process classification; Material balance equation, general steps for solving material balance problem, M.B for single unit and multi-unit systems; Degrees of freedom analysis and significance; M.B problems of various unit operations – mixing, splitter, absorption, distillation, evaporation, crystallization, leaching, extraction, drying, Solubility, dissolution and crystallization under steady state conditions; Material balances for by-pass, recycle and purge Operations.

UNIT-III

Material Balance with Chemical Reaction: Material Balance with chemical reaction, Concept of stoichiometry and mole balances, limiting and excess reactant, % conversion, % excess, yield and selectivity; examples; Combustion calculations - Proximate and ultimate analysis of coal and analysis of flue gas.

UNIT-IV

Energy Balances on non-reactive processes: Thermo physics–Energy balance equation for open and closed system, Procedure, Heat Capacity, changes in pressure and temperature; Calculation of enthalpy changes without and with phase change, Heat of solution and mixing.

UNIT-V

Energy balances on reactive processes: Thermo chemistry - Standard heat of reaction, formation and combustion, Hess Law, Effect of temperature; Kirchoff's equation; Energy balances on reactive systems; combustion and fuels – Adiabatic flame temperature; Simultaneous material and energy balances.

TEXTBOOKS:

1. Hougen O.A., Watson K.M., Ragatz R.A., Chemical Process Principles (Part-I): Material and Energy Balances, 2nd Edition, CBS Publishers, 2004.
2. Bhatt, B.I., Vora, S.M. "Stoichiometry", Fourth Edition, Tata McGraw Hill Publishing Company Ltd, 2004
3. Himmelblau, D.M., Riggs, J.B. "Basic Principles and Calculations in Chemical Engineering", Eighth Ed., Pearson India Education Services.

SUGGESTED READING:

1. Felder,R.M.; Rousseau, R.W. "Elementary Principles of Chemical Processes", Third Edition, John Wiley & Sons, 2000.
2. Narayanan K.V. Lakshmikutty B., "Stoichiometry and Process Calculations", PHI Learning Pvt. Ltd., 7thEdition, 2015.
3. Sikdar, D.C., "Chemical Process Calculations", Prentice Hall of India, 2013.

26EGC01

COMMUNICATIVE ENGLISH

(BE/B.Tech - Common to all Branches)

Instruction	2P Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

PREREQUISITE: Basic knowledge of English grammar and vocabulary and communicative abilities.

COURSE OBJECTIVES:

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

1. Improve their understanding of communication skills to apply in real life situations.
2. Equip themselves with Reading Comprehension strategies and texts and textuality
3. Enhance their writing skills through paragraphs, précis and essays by using devices of cohesion and coherence.
4. Build appropriate tone and tonality around office communication through meaningful sentences.
5. Demonstrate knowledge of drafting formal reports to define, describe and classify the processes by following a proper structure.

COURSE OUTCOMES:

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

1. Create the awareness of communication skills in life and usefulness of proficiency.
2. Apply effective reading techniques through critical reading exercises to enhance quality of life and to support lifelong learning.
3. Develop their ability to write paragraphs independently on any context with cohesion, edit essays coherently while realizing brevity through précis writing.
4. Construct sentences clearly and comprehensively to write effective business letters and draft emails for a better professional communication.
5. Advance efficiency in writing, distinguish formal from informal reports and demonstrate advanced writing skills by drafting formal reports.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	-	-	-	-	1	1	1	2	2	2	2	1	1
CO 2	-	-	-	-	1	1	1	1	1	2	1	1	1
CO 3	-	1	-	-	-	1	1	1	1	2	1	1	1
CO 4	-	1	-	-	-	1	1	2	2	2	2	2	2
CO 5	-	1	-	1	1	2	2	2	2	2	2	1	1

UNIT-I

Dynamics of Communication

Introduction, nature and importance of communication; Process of communication; Types of communication: verbal and non-verbal; Barriers to communication; Intrapersonal, Interpersonal communication; Johari Window. LSRW, CS & LA.

Vocabulary & Grammar: The concept of Word Formation - Root words, Use of prefixes and suffixes to form derivatives, Standard abbreviations. Tenses.

Reading Task I: Rene Descartes' "*I think therefore, I am*"

UNIT-II
Introduction to Reading
The Reading process, purpose, different kinds of texts; Reading Comprehension; Techniques of comprehension – skimming, scanning, drawing inferences and conclusions. Practice in Critical Reading passages
Vocabulary and Grammar: Use of Synonyms and Antonyms, Construction of Sentences **Reading Task II:** Bertrand Russell's "*Knowledge and Wisdom*" (Essay)

UNIT-III
Introduction to Writing Writing Skills
Paragraph Writing. – Structure and features of a paragraph; Précis writing
Vocabulary & Grammar: Use of Discourse Markers, Cohesion and Coherence in writing
Reading Task III: Rudyard Kipling's "*If"*

UNIT-IV
Professional Writing Skills
Professional Communication: Letter Writing – Structure, format of a formal letter; Letter of Request and Response, Drafting Emails.
Vocabulary and Grammar: Phrasal verbs, Subject-verb agreement in sentences
Reading Task IV: Chetan Bhagath's "*The Cut-off*"

UNIT-V
Professional Writing Skills: Engineering Specific Input.
Report writing – Importance, structure, elements & style of formal reports; Writing a formal report.
Vocabulary and Grammar: Words often Confused, Common Errors.
Reading Task IV: *Nightfall in the City of Hyderabad* by Sarojini Naidu

TEXT BOOKS:
1. Sanjay Kumar & Pushp Lata, "English Language and Communication Skills for Engineers", Oxford University Press,2018.
2. "Language and Life: A Skills Approach", Board of Editors, 2018th Edition, Orient Black Swan, 2018.

SUGGESTED READINGS:
1. Ashraf, M Rizvi, "Effective Technical Communication", Tata McGraw-Hill, 2006.
2. Michael Swan, "Practical English Usage", Oxford University Press, 4th Edition,2016.
3. Meenakshi Raman and Sangeetha Sharma, "Technical Communication: Principles and Practice" 3rd Edition, Oxford University Press, 2015.

26PYC08

PHYSICS LAB
(Biotech & Chemical)

Instruction	3P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives: The objectives of the course is to make the student
1. Apply theoretical physics knowledge in doing experiments
2. Understand the behaviour of the light experimentally
3. Analyze the physical properties of magnetic and dielectric materials
4. Familiarize with motion of electrons in electric and magnetic fields

Course Outcomes: At the end of the course, the student will be able to
1. Interpret the errors in the results of an experiment.
2. Demonstrate the wave nature of light experimentally
3. Utilize physical properties of magnetic and dielectric materials for various applications
4. Make use of lasers and optical fibers for engineering applications
5. Explain motion of electrons in electric and magnetic fields

CO-PO Articulation Matrix:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	3	2	2	3	1	2	3	3	2	1	2	-	-
CO2	3	2	1	2	2	2	2	2	1	1	3	-	-
CO3	3	2	3	2	3	2	2	3	2	1	2	-	-
CO4	3	3	2	2	2	2	3	2	1	1	3	-	-
CO5	3	1	2	3	2	1	2	2	2	1	2	-	-

LIST OF EXPERIMENTS:

1. Error Analysis : Estimation of errors in the determination of time period of a torsional pendulum
2. Fresnel's Biprism : Determination of wavelength of given monochromatic source
3. Newton's Rings : Determination of wavelength of given monochromatic source
4. Single Slit Diffraction : Determination of wavelength of given monochromatic source
5. Diffraction Grating : Determination of wavelengths of two yellow lines of light of mercury lamp
6. Malus's Law : Verification of Malus's law
7. Double Refraction : Determination of refractive indices of O-ray and E-ray of given calcite crystal
8. Polarimeter : Determination of specific rotation of glucose
9. Laser : Determination of wavelength of given semiconductor laser
10. Optical Fiber : Determination of numerical aperture and power losses of given optical fiber

11.	Dielectric constant	:	Determination of dielectric constant of given PZT sample
12.	M & H Values	:	Determination of magnetic moment M of a bar magnet and absolute value H of horizontal component of earth's magnetic field
13.	B-H curve	:	Determination of hysteresis loss of given specimen
14.	Planck's constant	:	Determination of Planck's constant using photo cell
15.	e/m of an Electron	:	Determination of specific charge of an electron by J.J. Thomson method

NOTE: A minimum of TWELVE experiments should be done.

26MEC03

ENGINEERING GRAPHICS
(Common to Mechanical, Civil, ECE, EVL, EEE, Chemical & Bio Tech)

Instruction	1T+3D Hours per week
Duration of SEE	3Hours
SEE	50Marks
CIE	50Marks
Credits	2.5

COURSE OBJECTIVES:

This course aims to

1. Get exposure to a cad package and its utility.
2. Understand orthographic projections.
3. Visualize different solids and their sections in orthographic projection
4. Prepare the student to communicate effectively by using isometric projection.
5. Prepare the student to use the techniques, skills, and modern tools necessary for practice.

COURSE OUTCOMES:

Upon completion of this course, student will be able to

1. Become conversant with appropriate use of CAD software for drafting and able to draw conic sections.
2. Understand orthographic projections of points and straight lines.
3. Draw the projections of planes and solids.
4. Draw the sectional views and develop the surfaces of solids.
5. Create an isometric projections and views.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	3	2	2	2	3	-	-	1	1	1	1	2	1
CO 2	3	2	1	1	2	-	-	1	1	1	1	2	1
CO 3	3	2	1	1	2	-	-	1	1	1	1	2	1
CO 4	3	3	2	2	2	3	-	1	1	1	1	2	1
CO 5	3	2	2	1	2	2	-	1	1	1	1	2	2

LIST OF EXERCISES:

1. Introduction to Auto CAD package: Settings, draw, modify tools, dimensioning, documentation and practice exercises.
2. Construction of Conic Sections by General method.
3. Orthographic projection: Principles, conventions, Projection of points.
4. Projection of straight lines in simple position, inclined to one plane & both the reference planes (without traces and mid-point).
5. Projection of perpendicular planes.
6. Projection of solids in simple position.
7. Projection of solids with axis Inclined to one plane.
8. Sections of Prisms and Pyramids in simple position.
9. Development of the surfaces of a right regular prism and a cone in simple positions.
10. Isometric projections of regular solids.
11. Conversion of isometric views to orthographic views and vice-versa.

TEXT BOOKS:

1. N.D.Bhatt, “Elementary Engineering Drawing”, Charotar Publishers, 2012.
2. K.Venugopal, “Engineering Drawing and Graphics + AutoCAD”, New Age International Pvt.Ltd, 2011.
3. Basanth Agrawal and C M Agrawal, “Engineering Drawing”, 2/e, McGraw-Hill Education (India) Pvt. Ltd.

SUGGESTED READING:

1. Shaw M.B and Rana B.C., “Engineering Drawing”, 2/e, Pearson, 2009.
2. K.L. Narayana and P.K. Kannaiah, “Text Book of Engineering Drawing”, Scitech Publications, 2011.

26CSC38

PYTHON PROGRAMMING WORKSHOP

(For Civil, Mechanical, EEE, ECE, ECE-EVL (VLSI), Chemical, Biotech)

Instruction	3 P Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

PREREQUISITE: Basic Computer Skills, Interest in Problem Solving, Basic Mathematical Skills.

COURSE OBJECTIVES: This course aims to

1. Master the fundamentals of writing Python scripts.
2. Learn Python elements such as variables, flow controls structures, functions and modules.
3. Discover how to work with lists and sequence data, and files.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Inspect and identify suitable programming environment to work with Python.
2. Choose appropriate control constructs, data structures to design and build the solutions.
3. Develop the solutions with modular approach using functions to enhance the code efficiency.
4. Analyze and debug the programs to verify and validate code.
5. Demonstrate use of Standard Template Libraries and modules to build file handling / Searching / sorting applications.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	2	-	-	1	1	-	-	-	-	-	2	2	1
CO 2	3	3	3	1	1	1	-	-	-	-	2	3	1
CO 3	3	3	3	1	2	1	-	-	-	-	2	3	2
CO 4	3	3	3	1	1	1	-	-	-	-	2	2	2
CO 5	3	3	3	1	2	1	-	-	-	-	2	3	2

1-Slightly, 2-Moderately, 3-Substantially

LABORATORY / PRACTICAL EXPERIMENTS:

1. Explore various Python Program Development Environments. eg: Vscode, IDLE, PyCharm, anaconda etc.,
2. Design Flowcharts using raptor / draw.io tools.
3. Simple scripts to demonstrate the use of various data types and operators.
4. Demonstrate the use of control structures.
5. Experiments using Comprehensions with List, Dictionary, Set.
6. Implementation using Functions, Lambda functions and parameter passing.
7. Experimentation with Arrays using array and numpy modules.
8. Experiments using Searching and Sorting techniques.
9. Simple scripts to demonstrate the use of built-in modules.(Ex: math, random).
10. Demonstration of File Handling.

TEXT BOOKS:

1. Jeeva Jose, "Taming Python by Programming", 2nd Edition, 2019, Khanna Book Publications.
2. Reema Thareja, "Python Programming", 1st Edition, 2017, Oxford Press.

SUGGESTED READING:

1. Zed A. Shaw, "Learn Python3 the Hard Way", 1st Edition, 2018, Pearson Education Inc.
2. R.S. Salaria, "Programming in Python", 1st Edition, 2024, Khanna Publishing House.
3. Yashavant Kanetkar and Aditya Kanetkar, "Let Us Python", 1st Edition, 2019, Edition, BPB Publications.

ONLINE RESOURCES:

1. https://onlinecourses.swayam2.ac.in/cec24_cs01/preview.
2. https://www.coursera.org/specializations/python.
3. https://www.python.org.
4. https://www.visual-paradigm.com/tutorials/decision-table-in-action.jsp.

26MEC04

ENGINEERING WORKSHOP & 3D PRINTING

Instruction	3P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Prerequisite: Nil

COURSE OBJECTIVES:

This course aims to:

1. Give a feel of Engineering Practices and develop holistic understanding of various Engineering materials and Manufacturing processes.
2. Develop skills of manufacturing, safety, precision, quality, intelligent effort, optimization, positive and team work attitude to get things right the first time.
3. Provide basic knowledge of steel, plastic, composite, and other materials for suitable applications.
4. Study of principle and hands on practice on techniques of fabrication, manufacturing, and allied skills.
5. Advance important, hard and pertinent soft skills, productivity, create skilled manpower which is cognizant of industrial workshop components and processes and can communicate their work in a technical, clear and effective way.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Students will be able to fabricate a square tray and perform a lap joint on mild steel using proper marking, welding, and finishing techniques.
2. Apply house-wiring techniques to construct and verify single-point, series, parallel, and staircase circuits.
3. Apply pipe fitting techniques to thread, assemble, and verify GI pipe systems as per given diagrams.
4. Perform 3d modeling using solid works software and pre-processing operations on STL files for 3D printing, also understand reverse engineering process.
5. Conceptualize and produce simple device/mechanism of their choice.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	1	2	1	1	-	-	1	-	-	-	1	-	-
CO 2	1	-	1	-	-	-	-	-	-	-	1	-	-
CO 3	1	-	1	-	-	1	-	-	-	-	1	-	-
CO 4	1	-	1	-	-	1	-	-	-	-	1	-	-
CO 5	2	2	2	1	3	1	1	1	2	-	2	-	-

Lab Experiments

Group 1: Workshop Practice

1. To make a square tray from the given sheet metal
2. Fabricate a funnel from the given sheet metal and join it using soldering.
3. Wiring of Single Light Point and Socket with Switches, and Series–Parallel Connection of Two Light Points with Verification .
4. Stair case wiring of one light point controlled from two different places independently using two 2way switches.

5. To make external threads for GI/uPVC pipes using die and connect the GI/uPVC pipes as per the given diagram using taps, couplings, and bends.
6. Assemble GI/uPVC pipes as per the diagram using fittings, install a shower, tap, and valves, and demonstrate operation with a water connection.

Group 2: Additive Manufacturing /3D Printing

1. Introduction to Additive manufacturing and modeling Software
2. To create a 3D CAD model (Door Bracket and Door handle) using modeling software.
3. To perform preprocessing operations and print a door bracket model using an extruder type 3D printer.
4. To create a 3D CAD model using Reverse engineering.
5. To demonstrate Engraving, Drilling and Cutting operations on printed circuit boards using CNC PCB Mate.
6. To design an innovative component using the CAD software/print the selected innovative component using a 3D printer.

TEXT BOOKS:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I, 2008 and Vol. II, Media promoters and publishers private limited, Mumbai, 2010.
2. Sabrie Soloman , "3D Printing & Design ", 1st edition,khanna Publishing House,2020

SUGGESTED READING:

1. Gowri P. Hariharan and A. Suresh Babu, "Manufacturing Technology.
2. Oliver Bothmann, 3D Printers: A Beginner's Guide, January 1, 2015.

26EGC02

COMMUNICATION SKILLS LAB

(BE/B.Tech - Common to all Branches)

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Basic Knowledge of English Communication.

COURSE OBJECTIVES:

This course will introduce the students

1. To nuances of Phonetics and give them sufficient practice in correct pronunciation through computer-aided multi-media instruction.
2. To the significance and application of word stress and intonation.
3. To sufficient practice in listening to English spoken by educated English speakers in different socio-cultural and professional settings.
4. To activities enabling them overcome their inhibitions while speaking in English with the focus being on fluency rather than accuracy.
5. To team work, role behaviour while developing their ability to use language appropriately, to discuss in groups and make presentations.

COURSE OUTCOMES:

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

1. Define the speech sounds in English and understand the nuances of pronunciation in English.
2. Produce speech with clarity and confidence using correct word stress, and intonation.
3. Achieve improved ability to listen, understand, analyse, and respond to English spoken in various settings.
4. Determine the context and speak appropriately in various situations.
5. Design effective posters collaboratively through creative decisions, give presentations, and efficiently participate in Group discussions.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	-	-	-	-	-	-	-	1	1	-	1	-	-
CO 2	-	-	-	-	-	1	-	1	2	-	1	-	-
CO 3	-	-	-	-	-	1	1	1	2	-	1	1	1
CO 4	1	1	1	1	1	1	2	2	3	-	1	1	1
CO 5	-	1	1	1	1	2	2	2	3	1	2	2	1

Exercises

Computer-Aided Language Learning Lab

1. **Introduction to English Phonetics**: Introduction to English Phonetics and organs of speech.
2. **Sound System of English**: Speech sounds- Vowels and Consonants - Basic phonetic transcription practice.
3. **Syllable Division and Word stress**: Introduction to syllables- structure of syllables - Rules of word stress.
4. **Intonation**: Types of Intonation, Practice in Articulation – MTI – Common Errors in pronunciation.

5. **Listening Skills**: understanding Listening- types of listening- Practice in Listening comprehension texts.

Interactive Communication Skills Lab

1. **Public Speaking –** Speaking with confidence and clarity in different contexts on various issues.
2. **Group Discussions -** Understanding the Dynamics and techniques of a Group Discussion, and Non-Verbal Communication.
3. **Debate -** Learning speaking dynamics in a formal discourse, discussion and oral addresses.
4. **Role Play -** Practicing the nuances of situational language, simulating the real-world conversations in a designed environment.
5. **Poster Presentation –** Working on a Theme, Poster preparation and presentation.

TEXT BOOKS:

1. T Balasubramanian, "A Textbook of English Phonetics for Indian Students", Macmillan, 2nd Edition, 2017.
2. J Sethi et al., "A Practical Course in English Pronunciation (with CD)", Prentice Hall India, 2005.
3. Priyadarshi Patnaik, "Group Discussions and Interview Skills", Cambridge University Press Pvt. Ltd., 2nd Edition, 2023.
4. Aruna Koneru, "Professional Speaking Skills", Oxford University Press, 2018.

SUGGESTED READING:

1. "English Language Communication Skills – Lab Manual cum Workbook", Cengage Learning India Pvt. Ltd., 2022.
2. KN Shoba& J. Lourdes Javani Rayen."Communicative English – A workbook", Cambridge University Press, 2019.
3. Sanjay Kumar& Pushp. Lata. "Communication Skills: A Workbook. Oxford University Press", 2019.
4. Veerendra Mishra et al. "English Language Skills: A Practical Approach", Cambridge University Press, 2020.

SUGGESTED SOFTWARE:

1. K-VAN Multi-Media Language Lab
2. TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS).
3. Digital All
4. Orell Digital Language Lab (Licensed Version).