



First Year Curriculum

Admission Year 2026-27

**Bachelor of Technology
Chemical Engineering**

Faculty of Engineering & Technology

Parul University

Vadodara, Gujarat, India

Semester 1

- a. **Course Name:** Introduction to Chemical Engineering
- b. **Course Code:** 03010301PC01
- c. **Prerequisite:** Fundamental Knowledge of basic sciences subjects
- d. **Rationale:** The Introduction to Chemical Engineering course provides foundational knowledge in core engineering principles, bridging science with industrial applications. It equips students with problem-solving skills, process understanding, and safety awareness essential for engineering practice
- e. **Course Learning Objective:**

CLOBJ 1	To enable students to interpret fundamental chemical principles and theories.
CLOBJ 2	To develop students' ability to apply quantitative skills for chemical calculations.
CLOBJ 3	To familiarize the students with principles and applications of latest advancements in the field of chemistry.
CLOBJ 4	To enable the students to evaluate the relationships between different elements and compounds.

f. **Course Learning Outcomes:**

CLO 1	Interpret fundamental chemical principles and theories.
CLO2	Apply quantitative skills for chemical calculations.
CLO 3	Explain the principles and applications of latest advancements in the field of chemistry.
CLO 4	Evaluate the relationships between different elements and compounds.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage (%)	Teaching Hours
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1	Introduction to quantum theory for chemical systems: Schrodinger equation, Applications to Hydrogen atom, atomic orbitals, many electron atoms	16%	7
2	Chemical bonding in molecules MO theory, Structure, bonding and energy levels of bonding and shapes of many atom molecules, Coordination Chemistry, Electronic spectra and magnetic properties of complexes with relevance to bio-inorganic chemistry, organometallic chemistry	20%	10
3	Introduction to Stereochemistry Stereo descriptors 'R, S, E, Z. Enantiomers and Diastereomers. Racemates and their resolution. Conformations of cyclic and acyclic systems	16%	7
4	Reactivity of organic molecules factors influencing acidity, basicity, and nucleophilicity of molecules, kinetic vs. thermodynamic control of reactions	16%	7
5	Strategies for synthesis of organic compounds Reactive intermediates substitution, elimination, rearrangement, kinetic and thermodynamic aspects, role of solvents	16%	7
6	Electrochemistry Laws of electrolysis and their applications. Difference between galvanic and electrolytic cells, E.M.F. galvanic cells, free energy changes in cells, reversible electrode potentials, single electrode potential and its determination. Nernst equation and its derivation, reference (hydrogen and calomel) electrode. EMF series and its applications. Primary and secondary cells, electrochemical cell.	16%	7
	Total	100%	45

i. Text Book and Reference Book:

1. Organic Chemistry Bahl and Bahl; S Chand & Co. Ltd, New Delhi
2. Essential of Physical Chemistry Bahl and Tuli; S Chand & Co. Ltd. New Delhi
3. Engineering chemistry b. Sivsankar; Tata McGrawhill
4. Engineering chemistry Marry Jane & Shult; Cencage learning
5. Engineering chemistry Jain & Jain; Dhanpat rai
6. Engineering chemistry, O.P Agrawal; Khanna

- a. **Course Name:** Linear Algebra and Calculus
- b. **Course Code:** 03019101BS02
- c. **Prerequisite:** Elementary Algebra, Matrices, Differentiation and Integration
- d. **Rationale:** This syllabus builds essential mathematical tools for engineering applications, covering differential equations, Laplace transforms, and vector calculus.
- e. **Course Learning Objective:**

CLOBJ 1	To develop a fundamental understanding of matrices, determinants, vector spaces, and systems of linear equations used in engineering and scientific applications.
CLOBJ 2	To provide knowledge of differential and integral calculus for analyzing mathematical models and engineering problems.
CLOBJ 3	To enable students to apply concepts of multivariable calculus, vector calculus, and differential equations in solving real-world problems.
CLOBJ 4	To enhance analytical and problem-solving skills through mathematical techniques relevant to engineering, biomedical, and technological applications.

f. **Course Learning Outcomes:**

CLO 1	Understand the concept of eigenvalues and eigenvectors of a matrix.
CLO 2	Formulate first-order differential equation to solve the real-world problem.
CLO 3	Apply partial differentiation to optimize multivariable function.
CLO 4	Evaluate multiple integration in Cartesian and polar coordinates.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theor y	P	
4	-	-	4	20	20	-	60	-	100

L-Lectures; T- Tutorial; P-Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continues Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. NO.	Topics	W (%)	T
1	Linear Algebra Review of Determinant and Matrices, types of matrices, Rank of a matrix, System of Linear equations-homogenous and non-homogenous equations, solving techniques- Gauss Elimination method, Gauss-Jordan method, Consistency and inconsistency of the system, Eigenvalues and Eigenvector: Eigenvalues and Eigenvector, Algebraic multiplicity and Geometric multiplicity, Caley-Hamilton theorem, Diagonalization	30%	18
2	First order ordinary differential equations and applications Exact and non-exact differential equations, Integrating factor-function of x only and functions of y only, Linear and nonlinear differential equations, Applications: Newton's Law of cooling, Growth model and RL-Circuit and RC-Circuit	20%	12
3	Partial Differentiation and its application Functions of several variables, Limit of function, continuity, partial differentiation, chain rule, Implicit functions and their derivatives, Homogeneous functions and Euler's theorem Applications of Partial Differentiation: Tangent plane and normal line, Maxima and minima.	30%	18
4	Multiple Integration Double integration, change of order, change into polar form, triple integrations Applications: Area, Volume	20%	12
Total:		100%	60

i. Text Book and Reference Book:

- a. Advanced Engineering Mathematics (TextBook) By Erwin Kreyszig | Willey India Education
- b. Elementary Linear Algebra By Howard Anton, Chris Rorres | Willy India Edition | 9th Edition
- c. Calculus with early transcendental functions By James Stewart | Cengage Learning
- d. Thomas' Calculus By Maurice D. Weir, Joel Hass, Frank R. Giordano | Pearson Education

a. Course Name: Mechanics of Solids

b. Course Code: 03010402ES01

c. Prerequisite: Understanding of Physics, Mathematics, units, force, and basic engineering concepts.

d. Rationale: Mechanics of Solids is a fundamental subject that applies principles of mechanics to analyze and design engineering structures. It builds the conceptual foundation required to understand forces, stresses, and structural behavior in real-world engineering applications.

e. Course Learning Objective:

CLOBJ	Description
CLOBJ 1	To understand force systems and equilibrium of rigid bodies
CLOBJ 2	To learn centroid and moment of inertia concepts
CLOBJ 3	To study stresses and strains in materials
CLOBJ 4	To analyze beams and their behavior under loading
CLOBJ 5	To understand bending and shear stress distribution
CLOBJ 6	To study friction and its engineering applications

f. Course Learning Outcomes:

CLO	Description
CLO 1	Analyze force systems and determine resultant and moments in 2D and 3D
CLO 2	Evaluate centroid and moment of inertia of different geometries
CLO 3	Apply concepts of stress and strain in engineering problems
CLO 4	Analyze beams for shear force and bending moment
CLO 5	Determine bending and shear stresses in structural elements
CLO 6	Apply principles of friction in engineering applications

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme				
L	T	P	C	MSE	CE	P	Theory (ESE)	Total
3	-	0	3	20	20	-	60	-

Legend: L- Lectures; T- Tutorial; P- Practical; C- Credit

MSE- Mid-Semester Evaluation; CE- Continuous Evaluation;
ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	Introduction: Force systems, equilibrium, free body diagrams, concurrent and non-concurrent forces, moments	15	6
2	Centroid and Moment of Inertia: Centroid of areas and volumes, Pappus-Guldinus theorem, MI by integration, parallel axis theorem	15	6
3	Stresses and Strains: Types, Hooke's law, elastic constants, thermal stress, principal stresses, Mohr's circle	30	12
4	Beams: Types of beams and loads, reactions, shear force and bending moment diagrams, bending theory, shear stress	30	12
5	Friction: Laws of friction, coefficient, angle of friction, applications, belt friction	10	4
Total		100	40

i. Text Book and Reference Book:

Text Books:

1. Engineering Mechanics: Statics and Dynamics – R.C. Hibbeler
2. Engineering Mechanics: Statics and Dynamics – S. Rajasekaran

Reference Books:

1. Engineering Mechanics – J.A. Desai & B.B. Mistry
2. Engineering Mechanics – S.S. Bhavikatti & K.G. Rajashekarappa
3. Theory of Structures – R.S. Khurmi
4. Theory of Structures – S. Ramamrutham
5. Engineering Mechanics – J.L. Meriam & L.G. Kraige

- a. **Course Name:** Engineering Graphics and Design
- b. **Course Code:** 03010901ES02
- c. **Prerequisite:** Zeal to learn the subject.
- d. **Rationale:** Engineering Graphics is the language of communication for Engineers. Engineering Graphics course provides tools and techniques of communication for various fields of Engineering.
- e. **Course Learning Objective:**

CLOBJ 1	Understand the use of drawing instruments, BIS standards, scales, and engineering drawing conventions.
CLOBJ 2	Develop the ability to construct various engineering curves using standard drafting techniques.
CLOBJ 3	Understand and draw projections of points, lines, and planes using orthographic projection methods.
CLOBJ 4	Develop skills in drawing sections of solids and development of surfaces using reference planes.
CLOBJ 5	Apply principles of orthographic and isometric projections for visualization of 3D objects.
CLOBJ 6	Introduce basic 2D and 3D drafting techniques using AutoCAD software.

f. **Course Learning Outcomes:**

CLO 1	Understand the uses of drawing instruments, accessories, scales and BIS drawing standards in engineering graphics.
CLO 2	Form various engineering curves using basic drafting techniques.
CLO 3	Illustrate the projections of points, lines and planes in different quadrants using orthographic projection techniques.
CLO 4	Draw section of solids and development of surfaces using reference planes.
CLO 5	Draw orthographic and isometric projections of 3D objects using basic principles of projection.
CLO 6	Draft 2D and 3D engineering drawings with aid of basic AutoCAD.

g. Mapping of Course Learning Outcomes and Bloom's Taxonomy:

Course Learning Outcomes		Bloom's Level
CLO 1	Understand electrical current, potential difference, power and energy, sources of electrical energy and elements of electrical circuit.	2
CLO 2	Solve basic electrical circuit problems using various laws and theorems	3
CLO 3	Understand the role of resistor, capacitor and inductor and their performance characteristics for series and parallel connections.	3
CLO 4	Discuss three phase-balanced circuits.	3
CLO 5	Understanding the basic concepts and working principles of transformers, DC machines and AC machines.	3
CLO 6	Acquire knowledge about electrical installations	3

h. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	4	4	20	20	20	60	30	150

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

i. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Introduction Scope of Engineering Drawing in all Branches of Engineering, Uses of Drawing Instruments and Accessories, Introduction to Drawing Standards BIS- SP-46, Representative Fraction, Engineering Scales,	10%	5

	Dimensioning Terms and Notations, Types of Lines used in Engineering. Practice recommended by BIS.		
2	Engineering Curves Classification of Engineering Curves, Application of Engineering Curves, Constructions of Engineering Curves - Conics, Spirals, Involutives and Cycloids with Tangents and Normals.	15%	10
3	Principles of Projections Types of Projection, Parallel Projection, One-point Perspective projection. Introduction to principal planes of projections, Projections of the points: Projections of the points located in same quadrant and different quadrants. Projections of line: Projections of line with its inclination to one reference plane and with two reference planes. True length and inclination with the reference planes. Projections of planes: Projections of planes (polygons, circle and ellipse) with its inclination to one reference plane and with two reference planes, Concept of auxiliary plane method for projections of the plane.	20%	0
4	Projections and Development of Solids Projections of Solids: Classifications of basic Solids, Projections of Solids - Right Regular Prism, Pyramid, Cone, Cylinder, Tetrahedron and Cube; Sectional Views. Development of Surfaces: Methods of Development of Lateral Surfaces of Right Regular Solids, Parallel Line Development and Radial Line Development, Applications of Development of Surfaces.	20%	10
5	Orthographic and Isometric Projections Orthographic Projections: Principle of orthographic projections, Conversion of pictorial views into orthographic projections including sectional orthographic projections. Isometric Projections: Conversion of orthographic views into isometric projections/views.	20%	5
6	Computer Aided Drafting Basic User Interface of Drafting Software, Demonstration of basic modeling	15%	0

	commands, Preparation of 2D and 3D models using Drafting Software.		
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j. Text Book and Reference Book:

1. A Text Book of Engineering Graphics, By P. J. Shah, S. Chand & Company Ltd., New Delhi, 1st Edition, 2021.
2. Engineering Drawing, By N. D. Bhatt, Charotar Publishing House, 55th Edition, 2010.
3. A Text Book of Engineering Drawing, By P. S. Gill, S. K. Kataria & Sons, 2013 Edition.
4. Engineering Graphics with AutoCAD, By James D. Bethune, Pearson Education, 2020 Edition

- a. **Course Name:** Principles of Communication Skills
- b. **Course Code:** 03010001HM01
- c. **Prerequisite:** Knowledge of English Language studied till 12th standard
- d. **Rationale:** Basic Communication Skills are essential for all Engineers
- e. **Course Learning Objective:**

CLOBJ 1	Students will demonstrate the ability to communicate ideas clearly and effectively.
CLOBJ 2	Students will develop strategies for building positive interpersonal relationships, fostering effective collaboration and teamwork.
CLOBJ 3	Students will develop active reading skills, including the ability to comprehend, interpret, and respond appropriately to written messages.
CLOBJ 4	Students will exhibit proficiency in written communication, crafting clear, concise, and well-organized messages across various formats (Ex: Book review, Picture Description, Picture Connectors).
CLOBJ 5	Students will develop and deliver professional presentations, incorporating effective visual aids, engaging content, and confident delivery.
CLOBJ 6	Students will be able to understand and analyse the common grammatical errors.

f. Course Learning Outcomes:

CLO 1	Enable students to apply essential grammar rules for accurate and effective communication.
CLO 2	Develop ability to construct clear and coherent sentences and paragraphs using varied sentence structures.
CLO 3	Enhance reading and listening comprehension through identification of main ideas, details, and contextual meanings.
CLO 4	Build s confidence in everyday communication using appropriate greetings, expressions, and speaking skills.
CLO 5	Encourage creative and logical thinking through picture perception and extempore activities.
CLO 6	Help students set and track realistic personal and academic goals for continuous self-improvement.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	-	2	1	-	-	20	-	30	50

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr No.	Topics	Weightage (%)	Teaching Hours
1	Parts of Speech, Punctuation Overview of 8 parts of speech, Basic punctuation marks and their usage Importance of grammar in writing	10	4
2	Tenses Types: Present, Past, Future Forms and correct usage, Common tense errors	8	2
3	Phrase and Clauses; Types of Sentences (Structure Wise) Difference between phrases and clauses Classification of Simple, Compound & Complex Interchange of Simple to Compound, Simple to Complex, Compound to Complex	10	4
4	Picture Perception: Observing and interpreting images Building a short story or description Improving vocabulary and creativity	15	4
5	Paragraph Development Structure: topic sentence, development, conclusion	8	2
6	Meeting and Greeting (Initiating a conversation) Basic conversation skills Formal and informal greetings Common phrases for starting interactions	7	2
7	Reading Comprehension (Basic Level) Types - Skimming & Scanning Reading short passages Identifying main ideas and details Answering basic questions	12	4
8	Listening Comprehension (Basic Level) Listening to short audios/Conversation Understanding and responding to key information	8	2
9	Extempore Speech Speaking on random topics Organizing thoughts quickly Improving fluency and confidence	15	4
10	Goal Setting and Tracking Setting SMART goals Planning and tracking progress Self-assessment and reflection	7	2
	Total	100	30

i. Text Book and Reference Book:

1. English Grammar in Use, By Murphy, Raymond | Cambridge University Press, Pub. Year 2019
2. A Practical English Grammar, By Thomson & Martinet | Oxford University Press, Pub. Year 1986
3. The St. Martin's Guide to Writing, By Rise B. Axelrod & Charles R. | Cooper, Bedford/St. Martin's, Pub. Year 2021
4. Tactics for Listening (Basic), By Jack C. Richards | Oxford University Press, Pub. Year 2011
5. Active Skills for Reading: Book 1, By Neil J. Anderson | Cengage Learning, Pub. Year 2013
6. Speak with Impact, By Allison Shapira | HarperCollins Leadership, Pub. Year 2018

Sr No.	Experiment List
1	Identify and use the eight parts of speech correctly, and apply basic punctuation marks appropriately in sentences.
2	Practice the correct use of present, past, and future tenses, and identify common tense errors.
3	Distinguish between phrases and clauses, and classify sentences as simple, compound, or complex.
4	Transform sentences from simple to compound, simple to complex, and compound to complex forms.
5	Observe pictures carefully and develop short descriptions or meaningful stories based on visual interpretation.
6	Write well-structured paragraphs using a topic sentence, supporting details, and a concluding sentence.
7	Practice formal and informal greetings, and initiate simple conversations using appropriate expressions.
8	Read short passages using skimming and scanning techniques, and identify main ideas, supporting details, and contextual meaning.
9	Listen to short conversations or audio clips, understand key information, and respond to basic questions.
10	Deliver short extempore speeches on random topics to improve fluency, confidence, and organization of thoughts.

- a. **Course Name:** Student Induction Program with Essence of Indian Knowledge System
b. **Course Code:** 03010001MC01
c. **Prerequisite:** Basic awareness about higher education, social values, ethics, and Indian culture will be beneficial for understanding the course effectively.
d. **Rationale:** This course helps students adapt to the academic environment, develop confidence, communication skills, ethical values, and understand the essence of Indian Knowledge System for holistic personal and professional growth.
e. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
15	-	-	0	-	50	-	-	-	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

f. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	Activities in Mathematics Exploring 3D Shapes (Cylinder, Cone, Cube, Cuboid), The Geometry of Conic Sections: Properties and Applications, Measuring the Height of a Tree or Building Using Trigonometry, Techniques for Measuring Top and Bottom Angle Reflections, Fundamental Elements of Set Theory, Set Theory Tools for Probability Analysis, Key Concepts in Combinatorial Mathematics, Probability Fundamentals: Key Ideas and Concepts Foundations of Statistical Theory: Key Concepts Explained, Principles of Geometric Progressions and Series, Matrix Application in Cryptography, An experimental approach to measure velocity and acceleration, Analysing Rate of Change and Optimisation, Utilising Integration for Problem Solving, A B C of Tangram	25%	12
2	Activities in Communication Skills Phase-1: Part of Speech, Articles, Tenses, Basic Sentence Formation Phase-2: Verb, Subject Verb Agreement, Active Passive Voice, Idioms and Phrases Phase-3: Introduction to IKS, Indian ways of Speaking and Listening, Healthy Daily Life: The Indian Way, Indian Achievers and Innovations.	25%	12

3	<p>Activities in Computer Science, Computer Basic Architecture: Introduction to Computer Systems, Von Neumann Architecture, Components of a Computer: CPU, Memory, I/O devices, Data Representation and Number Systems, Registers, ALU, Control Unit, Memory Hierarchy: Cache, RAM, ROM, Secondary Storage Indian Knowledge System in Context of Computing: Historical Contributions of Indian Scholars to Mathematics and Computing, Algorithms in Ancient Indian Texts, Concept of Zero and Decimal Number System, Indian Logic and Computation Models, Sanskrit Computational Models and Grammar, Traditional Indian Computing Tools and Techniques, Integration of Traditional Knowledge with Modern Computing Emerging Technologies in Computer</p> <p>Engineering: Introduction to Artificial Intelligence and Machine Learning, Internet of Things (IoT), Blockchain Technology, Quantum Computing Basics, Edge Computing and Cloud Computing Advances, Cybersecurity Trends and Challenges, 5G and Networking Innovations, Bioinformatics and Computational Biology, Robotics and Automation in Computing.</p>	25%	12
4	<p>Activities of Physics Measurement, Electrostatics, Electromegnetics, Optics, Leaser and Fiber Optics, Vedic Physics and Cosmology</p>	25%	12

Semester 2

- a. **Course Name:** Material & Energy Balance Computation
- b. **Course Code:** 03010302PC01
- c. **Prerequisite:** Knowledge of basic mathematics, physics and chemistry is mandatory.
- d. **Rationale:** The course will serve as a basis for all further chemical engineering courses that are part of the curriculum.
- e. **Course Learning Objective:**

CLOBJ 1	To enable the students to understand different systems of units and unit conversions from one system to another.
CLOBJ 2	To make the students perform basic calculations related to reactive and non-reactive chemical engineering processes.
CLOBJ 3	To make the student to apply material and energy balances on reactive and non-reactive chemical engineering systems, and also involving recycle, bypass, and purge operations
CLOBJ 4	To enable the students to estimate properties of gases, liquids, mixtures, and solutions including phase transition from ideal gas and solution laws
CLOBJ 5	To make the students to perform calculation of heat capacity, standard heat of reaction from energy balances, and humidity calculations using psychrometric charts.
CLOBJ 6	To enable the student to understand fuel and combustion concepts with basic calculations.

f. Course Learning Outcomes:

CLO 1	Understand different systems of units and unit conversions from one system to another.
CLO 2	Perform basic calculations related to reactive and non-reactive chemical engineering processes.
CLO 3	Apply material and energy balances on reactive and non-reactive chemical engineering systems, and also involving recycle, bypass, and purge operations
CLO 4	Estimate properties of gases, liquids, mixtures, and solutions including phase transition from ideal gas and solution laws
CLO 5	Perform heat capacity, standard heat of reaction from energy balances, and humidity calculations using psychrometric charts.
CLO 6	Understand fuel and combustion concepts with basic calculations.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr.	Topics	Weightage (%)	Teaching hours
1	Dimensions and Units; Basic Calculations in Chemical Engineering Fundamental and derived quantities, dimensions and system of units, dimensional analysis, unit conversions; atomic, Molecular and equivalent weight, compositions – mass and mole percentages, concentration of solids, liquids, gases, and solutions – normality, molarity, molality, ppm, specific gravity, extent of reaction	20	9
2	Material Balance without Chemical Reactions Operations without chemical reactions-evaporation, distillation, absorption, adsorption, liquid-liquid extraction, crystallization; open, closed, and isolated systems, batch versus continuous processes, solving material balance problems without chemical reaction – mixer, dryer, evaporation, distillation, extraction, absorption, crystallization	25	10
3	Material Balance with Chemical Reactions, Recycle, Bypass, and Purge Operations Reaction stoichiometry, Limiting and Excess reactants, percentage conversion, yield and selectivity, material balances involving chemical reactions, material balances for systems with recycle, bypass and purge operations	25	10
4	Ideal Gas, Vapors, and Solutions; Humidity and Saturation Ideal gas laws and their applications, ideal solutions, Raoult's law, Henry's law, Amagat's Law & Dalton's law; properties of vapor-gas mixtures, psychrometric chart and its applications	15	8
5	Energy balances; Fuels & Combustion Heat capacity calculations for gases, liquids, solids and mixtures, enthalpy changes accompanied with chemical reactions, standard heat of reaction; types of fuels, calorific value of fuels Proximate and ultimate analysis, combustion calculations	15	8
Total		100%	45

i. Text Book and Reference Book:

1. "Elementary Principles of Chemical Processes", By Felder, R. M.; Rousseau, R. W. | Third Edition, John Wiley & Sons, 2000
2. "Chemical Process Principles, Part-I Material & Energy Balances", By Hougen, O. A., Watson, K. M., Ragatz, R. A. | Second Edition, CBS Publishers & Distributors, 2004
3. "Chemical Process Calculations", By Sikdar, D. C., | Prentice Hall of India.
4. "Process Calculations" By Venkataramani, V., Anantharaman, N., Begum, K. M. Meera Sheriffa | Second Edition, Prentice Hall of India.
5. Basic Principles & Calculations in Chemical Engineering By David M. Himmelblau, James .B. | PHI Learning Pvt. Ltd.
6. Stoichiometry By B.I. Bhatt, Thakor | McGraw Hill Publishing Company Limited | 20

- a. **Course Name:** Differential Equations and Vector Calculus
 b. **Course Code:** 03019102BS02
 c. **Prerequisite:** Differential Calculus, Integral Calculus, Vector Algebra, Differential Equations
 d. **Course Learning Objective**

CLOBJ 1	Understand second and higher-order ordinary differential equations and their solution techniques.
CLOBJ 2	Apply Laplace transform methods and inverse transforms for solving differential equations arising in engineering applications.
CLOBJ 3	Analyze periodic functions using Fourier series and half-range expansions.
CLOBJ 4	Develop understanding of vector differentiation concepts including gradient, divergence, curl, and Laplacian operators.
CLOBJ 5	Apply vector integration techniques such as line integrals and Green's theorem in mathematical and physical problems.
CLOBJ 6	Formulate and solve engineering and scientific problems using differential equations and vector calculus methods.

e. **Course Learning Outcomes:**

CLO 1	Solve Second and Higher-Order Ordinary Differential Equations
CLO 2	Apply Laplace Transform to Solve Differential Equations.
CLO 3	Apply Fourier series techniques to approximate periodic functions in mathematical and engineering contexts.
CLO 4	Compute and interpret vector differentiation concepts.
CLO 5	Evaluate vector integrals.

f. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

g. **Course Content:**

Sr.	Topics	Weightage %	Teaching hours
1	Second and Higher-Order Ordinary Differential Equations Homogeneous Linear ODE, Homogeneous constant coefficient linear ODE, non-homogeneous linear constant coefficient linear ODE, Undetermined coefficient and Variation of Parameter, Applications of higher order linear differential equations in Free oscillations, forced oscillations, Damped oscillations, RLC circuit	25%	15
2	Laplace Transformations and Its Applications: Definition and Laplace transformation of elementary functions, Properties of Laplace Transformations - linearity property, First-Shifting Theorem, Derivative of Laplace transformation, Integration of Laplace transformation, Laplace transformation of Integral, Laplace transformation of derivatives, Inverse Laplace Transformation, Convolution theorem and Application of Laplace Transformation to solve ODE.	30%	18
3	Fourier Series Fourier Series of periodic functions with arbitrary period, Even and Odd functions, Half-Range Fourier Series	15%	9

4	Vector Calculus: Vector Differentiation: Vector-valued functions, smooth curve, vector differentiation, scalar-valued function, Gradient of scalar valued function, Divergence and curl of vector-valued functions, Laplacian operator, Scalar potential function, Vector Integration: Line integral of scalar functions, Line integral of vector valued function, conservative vector field and independent of path, Green's theorem.	30%	18
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h. Text Books:

1. Advanced Engineering Mathematics (TextBook) By Erwin Kreyszig | Willey India Education
2. D.A. Murray, Introductory Course in Differential Equations. Orient Longman (India).
3. Fourier Series and Boundary Value Problems, By James Brown and Ruel Churchill, | McGraw Hill
4. Elementary Differential Equations and Boundary Value Problems, By William E Boyce and Richard C. D'Prima | Willey India Edition
5. Advanced Engineering Mathematics, By K. A. Stroud and Dexter Booth, | Macmillan Publication

- a. **Course Name:** Basic Electrical Engineering
- b. **Course Code:** 03010601ES01
- c. **Prerequisite:** Standard 12th science.
- d. **Rationale:** Basic Electrical Engineering provides fundamental knowledge of electrical principles, components, and systems that form the backbone of all engineering disciplines. Understanding concepts such as DC and AC circuit analysis, electrical machines, measurement techniques, and safety practices equips students with the skills to interpret, design, and troubleshoot basic electrical systems. This course bridges theoretical understanding with practical applications, enabling learners to apply electrical engineering concepts in multidisciplinary contexts, industrial environments, and further specialized studies.
- e. **Course Learning Objective:**

CLOBJ 1	Apply fundamental laws and network theorems to calculate voltage, current, and power in resistive DC networks.
CLOBJ 2	Analyze the steady-state behavior of RLC elements in single-phase and three-phase circuits using phasor diagrams.
CLOBJ 3	Solve efficiency and voltage regulation problems by applying magnetic circuit principles and transformer equivalent models.
CLOBJ 4	Evaluate the performance and construction of various electrical motors and generators for specific industrial applications.
CLOBJ 5	Explain the function of low-voltage components and battery systems to ensure safety and reliability in electrical installations.

f. Course Learning Outcomes:

CLO 1	Identify basic electrical circuit elements and fundamental laws to determine voltage and current in DC circuits.
CLO 2	Describe the behavior of R, L, and C elements in sinusoidal steady-state conditions for single-phase and three phase AC circuits.
CLO 3	Apply magnetic circuit principles and transformer equivalent models to solve practical efficiency and regulation problems
CLO 4	Analyze the construction and performance characteristics of electrical machines to assess suitability for industrial applications
CLO 5	Explain the role of key components in low-voltage electrical installations and battery systems in ensuring safety and reliability in residential and commercial environments.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	2	4	20	20	20	60	30	150

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation,

CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr .	Topic	Weightage	Teaching Hrs.
1	DC Circuits Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff current and voltage laws, Mesh and Node analysis, Simplifications of networks using series and parallel combinations and star-delta conversions. Superposition, Thevenin and Norton Theorems.	22	10
2	AC Circuits Sinusoidal voltages and currents, their mathematical and graphical representation, Concept of instantaneous, peak (maximum), average and R.M.S. values, frequency, cycle, period, peak factor and form factor, phase difference, lagging, leading and in phase quantities and phasor representation. Rectangular and polar representation of phasors, examples based on theory. Study of A.C. circuits consisting of pure resistance, pure inductance, pure capacitance and corresponding voltage-current phasor diagrams and waveforms. Development of concept of reactance, study of series R-L, R-C, R-L-C circuit and resonance, study of parallel R-L, R-C and RLC circuit, concept of impedance, admittance, conductance and susceptance in case of above combinations and relevant voltage-current phasor diagrams, concept of active, reactive and apparent power and power factor, examples based on theory. Concept of three phase supply and phase sequence. Voltages, currents and power relations in three-phase balanced star-connected loads and delta connected loads along with phasor diagrams.	33	15
3	Transformers Magnetic effect of an electric current, right hand thumb rule, Concept of m.m.f., flux, flux density, reluctance, permeability and field strength, their units and relationships, comparison between electrical and magnetic parameters. Flemings left hand rule. Self and mutual inductance, Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency.	20	9
4	Electrical Machines Construction, working and application of DC Motor and Generator. Generation of 3 phase rotating magnetic fields, Construction and working of a three-phase and Single phase induction motor and its types. Construction and working of Synchronous generator.	15	7
5	Electrical Installations Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries.	10	4

*Continuous Evaluation:

It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.

i. Reference Books:

1. Electrical Technology (Vol-II) (TextBook) By B L Theraja & A K Theraja | S Chand
2. Basic Electrical Engineering By D. P. Kothari and I. J. Nagrath, | Tata McGraw Hill | 3, Pub. Year 2010
3. Basic Electrical Engineering By D. C. Kulshreshtha | McGraw Hill | 1, Pub. Year 2009
4. Fundamentals of Electrical Engineering By Leonard S. Bobrow | Oxford University Press | 2, Pub. Year 1996
5. Electrical and Electronics Technology By E. Hughes | Pearson | 10, Pub. Year 2010
6. Electrical Engineering Fundamentals By Vincent Del Toro | PHI

i. List of Experiments:

Sr. No.	Experiment List
1	To Study about Various Electrical and Electronics Symbols and demonstrate various measuring instruments used in Basic electrical Engineering laboratory.
2	To Perform and Solve Electrical Networks with Series and Parallel Combinations of Resistors Using Kirchhoff's Laws.
3	Verification of superposition theorem with DC source.
4	Verification of Thevenin's theorem with DC source.
5	Verification of Norton's theorems in DC circuits.
6	To Obtain Inductance, Power and Power Factor of the Series RL Circuit With AC Supply Using Phasor Diagram.
7	To Obtain Capacitance, Power and Power Factor of the Series RC Circuit With AC Supply Using Phasor Diagram.
8	To Obtain Inductance, Capacitance, Power and Power Factor of the Series R-L-C Circuit With AC Supply Using Phasor.
9	Verification of Current and Voltage Relations in Three Phase Balanced Star and Delta Connected Loads.
10	Find out the Efficiency and Voltage Regulation of Single Phase Transformer by Direct Load Test.

- a. **Course Name:** Chemistry-I
- b. **Course Code:** 03019501BS01
- c. **Prerequisite:** This subject requires the basic Knowledge of chemistry in Engineering field.
- d. **Rationale:** Engineering Chemistry bridges the gap between fundamental chemical sciences and engineering applications. This subject provides a strong foundation in chemical principles, reaction mechanisms, and material properties, enabling engineering students to understand and apply chemistry in various technological advancements and industrial processes.
- e. **Course Learning Objective:**

CLOBJ 1	Understand the principles of water chemistry including hardness, softening methods, and treatment processes, and apply these concepts to solve numerical problems related to water quality.
CLOBJ 2	Apply electrochemical principles to analyze electrode potentials using the Nernst equation, understand reference electrodes, and evaluate various energy storage and conversion systems including batteries and hydrogen fuel cells.
CLOBJ 3	Classify and characterize engineering materials including polymers, elastomers, paints, varnishes, refractories, and glasses in terms of their composition, properties, and industrial applications.
CLOBJ 4	Explain nuclear chemistry concepts including radioactivity, nuclear reactions, and the working of nuclear reactors, and identify the applications of radioisotopes in diverse scientific and industrial fields.
CLOBJ 5	Analyze metallic alloys and apply the phase rule to one- and two-component systems to predict phase equilibria and understand material behavior in engineering contexts.

f. Course Learning Outcomes:

CLO 1	Understand fundamental water chemistry concepts, such as hardness and treatment techniques, and solve related numerical problems.
CLO 2	Gain knowledge on Principles of electrochemistry and its applications and understand working of Fuel Cell and Batteries.
CLO 3	Demonstrate knowledge of engineering materials, including polymers and refractories, focusing on their properties and industrial uses.
CLO 4	Explain nuclear chemistry concepts like radioactivity and the applications of radioisotopes in science and industry.
CLO 5	Evaluate metallurgy processes, alloy properties, and phase rule applications in material science relevant to engineering.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme		
L	T	P	C	Internal Evaluation		ESE
				MSE	CE	Total
3	-	2	4	20	20	150

L-Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	Unit 1 Water Chemistry and Corrosion Water chemistry: Hardness of water-types, degree of hardness, Effects, causes and prevention methods; numerical problems on hardness of water. Softening of water – Ion exchange, Soda-Lime method, Zeolite/Permutit method, Treatment of water –Breakpoint of chlorination. Drinking water specification, COD, BOD Dissolve Oxygen content Corrosion and its prevention: Introduction, Electrochemical theory of corrosion, Factors affecting the rate of corrosion: ratio of anodic to cathodic areas, nature of corrosion product, nature of medium – pH, conductivity and temperature. Types of corrosion - Differential metal and differential aeration (pitting and water line). Corrosion control: Anodizing – Anodizing of aluminum, Cathodic protection - sacrificial anode and impressed current methods, Different Metal coatings methods.	20%	10
2	Unit – II Electrochemistry and energy storage systems Electrochemistry: Introduction, Potential, EMF of cell, Free Energy, Single electrode potential-Derivation of Nernst equation, Numerical problems based on Nernst Equation (E, Eo & Ecell). Reference Electrodes: construction, working and applications of SHE, calomel electrode, ion selective electrodes: Introduction, construction, working and applications of Glass electrode, Energy storage Systems: Introduction, Classification of batteries (primary, secondary and reserved batteries). Applications of Electrochemistry- Li-ion batteries. Brief introduction of Na-ion battery. Green fuel: Hydrogen-production and applications in hydrogen fuel cells (Construction, working and applications)	25%	10
3	Unit – III Engineering Materials Definition, Classification of Polymers (Natural and Synthetic) Types of Polymerization, Polymerization Techniques Plastics –Thermosetting and	25%	10

	Thermoplastic (Difference) and Properties and uses of Important commercial Plastics– PE,PS, Polypropylene, PVC,PTFE, Epoxy resin,). Single used Plastics, Biodegradable polymers: Introduction and their requirements, Properties and applications, Inorganic Polymers and its Industrial Importance. Elastomers –Natural and Synthetic, disadvantages of natural rubber, Compounding of rubber, Ingredients and their functions – Vulcanization, properties and uses of Butyl Rubber, Neoprene, SBR, Silicone, NBR. Paint – definition, Components and properties of paints. Varnish – definition, properties and examples. Refractories – Definition, Classification, properties and applications. Glass and Refractories- Definition and General Properties of Glass, Types of Glasses and their Applications, Refractories: Definition and Characteristics of Refractory, Classification of refractories: Acid, Basic and Neutral refractories.		
4	Unit – IV Nuclear Chemistry Introduction, radioactivity, type of radiations, type of radioactive decay, Radioactivity and Radioactive laws, Fission & Fusion reactions, Nuclear reactor, Chain Reaction, nuclear waste disposal. Detection and measurement of radioactivity by Cloud chamber, Geiger-Muller counter, scintillation counter, ionization chamber. Applications of Radioisotopes in Physicochemical investigation, Agriculture field, Biology, healthcare.	15%	7
5	Unit – V Metallurgy and Phase rule Metal and Alloys- Introduction, Physical and chemical properties of metals, purpose of making alloys, Ferrous and Non-Ferrous alloys and its industrial applications. Phase Rule- Introduction, Phase, Components, Degree of freedom, Derivation of Gibb's Phase, One component system like water, sulphur systems, two component system, Eutectic systems like silver-lead, zinc-cadmium system	15%	8
Total:		100%	45

i. Text Book and Reference Book:

1. Engineering Chemistry, By Jain and Jain, Dhanpat Rai Publication
2. Engineering Chemistry, By O.G. Palanna, McGraw Hill Education
3. Engineering Chemistry, By Shashi Chawla, Dhanpat Rai & Co.
4. A Textbook of Engineering Chemistry, By S.S. Dara, S. Chand Publication
5. Engineering Chemistry, By K.Sesha Maheswaramma & Mridula Chugh, Pearson Publication

- a. **Course Name:** Advanced Communication and Interpersonal Skills
- b. **Course Code:** 03010002HM01
- c. **Prerequisite:** Basic Communication Skills are essential for all Engineers.
- d. **Rationale:** Strengthen core language and soft skills through applied grammar, communication tasks, and vocabulary building.

e. Course Learning Objective:

CLOBJ 1	Enable students to understand and apply essential rules of English grammar including subject-verb agreement, reported speech, active and passive voice for accurate written and spoken communication.
CLOBJ 2	Build students' vocabulary through systematic learning of word meanings, synonyms, antonyms, homonyms, homophones, homographs, and idioms for effective language use.
CLOBJ 3	Develop students' reading and listening comprehension skills at an intermediate level to identify main ideas, tone, purpose, and supporting details from written and spoken texts.
CLOBJ 4	Strengthen students' writing skills by training them to structure and compose well-organized essays using appropriate language, logical sequencing, and formal tone.
CLOBJ 5	Foster personality development, professional grooming, and self-awareness through SWOT analysis, self-introduction, confident body language, and professional etiquette.
CLOBJ 6	Improve students' time management and interpersonal skills by developing prioritization habits, scheduling techniques, and awareness of effective communication in professional contexts.

f. Course Learning Outcomes:

CLO 1	Remember and apply essential rules of English grammar — subject-verb agreement, reported speech, and active/passive voice — in written and spoken communication tasks.
CLO 2	Use vocabulary knowledge including synonyms, antonyms, homonyms, homophones, and idioms accurately in everyday and professional communication contexts.
CLO 3	Understand spoken and written texts at an intermediate level by identifying main ideas, supporting details, tone, and purpose, and responding appropriately.
CLO 4	Apply structured writing skills to compose well-organized essays with a clear introduction, body, and conclusion using appropriate language and tone.
CLO 5	Analyze personal strengths, weaknesses, opportunities, and threats through SWOT analysis and deliver a confident self-introduction demonstrating professional grooming and body language.
CLO 6	Analyze personal communication habits and time use patterns to develop effective time management strategies and improve professional and interpersonal effectiveness.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Marks			External Marks		Total
				T	CE	P	T	P	
1	–	2	2	40	–	20	60	30	150

L – Lectures; T – Tutorial; P – Practical; C – Credit; CE – Continuous Evaluation; SEE – Semester End Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	Subject Verb Agreement Rules of subject-verb matching Singular vs plural forms Common agreement errors	10%	1
2	Reported Speech Direct and indirect speech Changing tenses, pronouns, and time expressions Reporting statements, questions, and commands	10%	1
3	Active and Passive Voice Difference between Active and Passive Rules for converting sentences Usage in real-life contexts	10%	1
4	Building Vocabulary Word meanings and usage Synonyms and antonyms Homonyms, Homophones, Homographs, Idioms	10%	2
5	Grooming and Personality Development Importance of dressing and professional etiquette Building confidence and positive body language	10%	2
6	SWOT Analysis with Self Introduction Identifying strengths, weaknesses, opportunities, threats Preparing and delivering a confident self-introduction Developing self-awareness and a growth mindset	10%	2
7	Reading Comprehension (Intermediate Level) Understanding written texts Finding main ideas and supporting details Answering questions accurately	10%	2
8	Listening Comprehension (Intermediate Level) Listening for specific information Identifying tone and purpose Responding appropriately	10%	1
9	Essay Writing Structure of an essay: introduction, body, conclusion Organizing ideas logically Using appropriate language and tone	10%	2
10	Time Management Importance of managing time Prioritization Creating schedules	10%	1
Total:		100%	15

i. Text Book and Reference Book:

1. Technical Communication: Principles And Practice, By Sangeetha Sharma, Meenakshi Raman | Oxford University Press | 2nd Edition
2. Personality Development and Soft Skills, By Barun K Mitra | Oxford, 2011
3. High School English Grammar and Composition, By Wren & Martin | S. Chand Publishing, Pub. Year 2017
4. English Grammar in Use, By Raymond Murphy | Cambridge University Press, Pub. Year 2019
5. Communication Skills and Soft Skills, By Suresh Kumar | Pearson Publication, 2010

j. List of Practicals:

S.No.	Name of experiments
1.	Subject Verb Agreement: a. Fill-in-the-blank exercises b. Sentence correction tasks c. Group quiz competition d. Role-play using correct subject-verb forms
2.	Reported Speech: a. Dialogue conversion practice b. Pair work: narrate a conversation c. Reporting classroom news d. Role-play followed by reporting
3.	Active and Passive Voice: a. Transform active sentences to passive and vice versa b. Rewrite instructions in passive voice c. Classroom narration using passive structures d. Group activity: change story voice
4.	Building Vocabulary: a. Daily word journal b. Vocabulary flashcards and games c. Synonym-antonym match-up d. Word building through storytelling
5.	Grooming and Personality Development: a. Personal grooming checklist task b. Group discussion on personality traits c. Mock social interaction d. Confidence-building exercises
6.	SWOT Analysis with Self Introduction: a. SWOT worksheet filling b. Self-introduction in pairs or groups c. Strength-sharing circle d. Feedback on introductions
7.	Reading Comprehension (Intermediate Level): a. Reading passage followed by Q&A b. Find-the-theme activity c. Vocabulary hunt from the passage d. Summarizing a short text
8.	Listening Comprehension (Intermediate Level):

	<ul style="list-style-type: none"> a. Listen and answer exercises b. Listening and completing notes c. Audio-based MCQs d. Paraphrasing what was heard
9.	<p>Essay Writing:</p> <ul style="list-style-type: none"> a. Brainstorming and outline creation b. Writing on guided topics c. Peer feedback session d. Editing and final draft submission
10.	<p>Time Management and Team Building:</p> <ul style="list-style-type: none"> a. Create a weekly schedule b. Prioritization task (urgent vs important) c. Reflection on time use habits

- a. Course Name:** Environmental Science
b. Course Code: 03010002MC01
c. Prerequisite: Knowledge of Physics, Chemistry and Mathematics up to 12th science level and Biology up to 10th science level
d. Rationale: Basic knowledge of the environment is essential for all human beings for a good life and sustainable existence
e. Course Learning Objective:

CLOBJ 1	Apply systems thinking to analyze the city as a system, demonstrating application
CLOBJ 2	Evaluate the role of smart citizens and approaches for citizen engagement
CLOBJ 3	Identify sources and stressors of water resources, demonstrating understanding
CLOBJ 4	Analyze the causes, effects, and control measures of population explosion

f. Course Learning Outcomes:

CLO 1	Understand the interrelation and interdependency of organisms and their interactions with the environment
CLO 2	Identify eco-friendly measures in engineering projects
CLO 3	Understand preventive steps for environmental protection.
CLO 4	Act as a responsible individual who is aware of efficient usage of resources and securing sustainable development

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	0	0	Audit Course	-	50	-	-	-	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weighage (%)	Teaching Hours
1	Environmental Health Ecology and Quality of Life Environmental education: Objective and scope, Impact of technology on the environment, Environmental disasters: Case studies,	25%	7

	Global environmental awareness to mitigate stress on the environment, Structure and function of an ecosystem, Ecological pyramids, Pyramid of number, Pyramid of energy and pyramid of biomass.		
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2	<p>Pollution Prevention Air & Noise pollution -Sources & their Effects, Case studies of Major Catastrophes, Structure and composition of the atmosphere, Water, Soil, Marine, Thermal & Marine Pollution: The story of fluoride contamination, Eutrophication of lakes, control measures, Measuring water quality: Water quality index, Waste water treatment (general) primary, secondary and tertiary stages, Municipal Solid waste management: Sources and effects of municipal waste, Biomedical waste, Hazardous waste</p>	20%	6
3	<p>Pollution Growth Global Environmental Challenges & Latest Developments Population Explosion - Causes, Effects and Control, an International initiative in population-related issues, Urbanization, Growth of the world's large cities, Water resources: Sources of water, Stress on water resources, Climate Change, Global Warming and Green House Effect, Acid Rain, Depletion of Ozone layer, Variation in concentrations of GHG gases in ambient air during last millennium, Role of Environmental Information System (ENVIS) in India and similar programs run by EPA(USA), Role of soft tools like Quantum GIS, Autodesk Building Information Modelling (BIM) and City Finance Approach to Climate-Stabilizing Targets (C- FACT), Life Cycle Assessment, Bioinformatics and Optimization tools for sustainable development.</p>	25%	7
4	<p>Smart Cities Introduction to smart cities - about smart cities, what is a smart city, world urbanization, case studies of Songdo, Rio De Janeiro, what makes cities smart. City as a system of systems – Introduction, systems thinking, Milton Keynes Future Challenges, Rich picture as city challenges, Wicked problems, Development of smart city approach – core elements, open data, sustainability, privacy and ethics, development processes. Smart Citizens – their role, engaging citizens,</p>	30%	10

	<p>IES Cities, Energy systems, Approaches for Citizen Engagement, co-creating smart cities, cities unlocked, living labs, city problems, crowdsourcing ideas, redesigning cities for citizens, all age-friendly cities, mobility on demand, motion maps.</p> <p>Infrastructure, Technology and Data – urban infrastructure and its technology, future of lighting, IoT, connected objects, sensing the city, NOx eating paints and air quality sensors, safest, smart citizen kit, sensing your city, Sensored City, Cyber security for data power, open, shared and closed data, satellite data, open data revolution, Smart City Project Data.</p> <p>Innovation – smart innovations, smart city ecosystem, data-driven innovations for smart cities</p> <p>Standards and Capacity Building – the role of Standard, BSI smart city Standards, Hyper Cat, ITU Smart Sustainable cities, Smart City Readiness, Lessons Learnt from Amsterdam</p> <p>Smart Measurements - metrics and indicators, city indicators, WCCD data portal, value proposition, integrated reporting, smart city learning and education, urban data school.</p>		
Total:		100%	

i. Text Book and Reference Book:

1. Environmental Studies for Undergraduate Courses” (Textbook) | By Dr Erach Bharucha | Orient Black Swan | Second Edition, Pub. Year 2013.
2. Basics of Environmental Studies | By U K Khare, Tata McGraw Hill
3. Environmental Studies” By Anindita Basak, Drling Kindersley (India) Pvt. Ltd Pearson
4. Environmental Sciences”, By Daniel B Botkin & Edward A Keller, John Wiley & Sons
5. “Air Pollution”, By M N Rao, H. V N Rao, McGraw Hill Publishing Company Limited, New Delhi

- a. **Course Name:** Design, Technology and Innovation
- b. **Course Code:** 03M10002UE02
- c. **Prerequisite:** Zeal to learn the subject
- d. **Rationale:** Design, Technology, and Innovation (DT&I) subject's lies in equipping students with the skills to be creative problem solvers and innovators in a rapidly evolving world. These subjects foster critical thinking, creative exploration, and the ability to translate ideas into tangible solutions, preparing students for future careers and societal challenges.
- e. **Course Learning Objective:**

CLOBJ 1	To enable the students to apply design thinking methodologies to identify and solve user-centered problems
CLOBJ 2	To make the students to demonstrate creative thinking and effective ideation strategies.
CLOBJ 3	To enable the students to develop low-fidelity and high-fidelity prototypes and understand fabrication challenges
CLOBJ 4	To enhance the students to incorporate engineering principles into design and innovation.
CLOBJ 5	To motivate the students to communicate ideas visually through sketching and graphical tools
CLOBJ 6	To make the students to understand the fundamentals of entrepreneurship and the startup process.

f. Course Learning Outcomes:

CLO 1	Apply design thinking methodologies to identify and solve user-centered problems
CLO 2	Demonstrate creative thinking and effective ideation strategies.
CLO 3	Develop low-fidelity and high-fidelity prototypes and understand fabrication challenges
CLO 4	Incorporate engineering principles into design and innovation.
CLO 5	Communicate ideas visually through sketching and graphical tools
CLO 6	Understand the fundamentals of entrepreneurship and the startup process.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	-	3	20	20	-	60		100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination.

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching (hr)
1	Basics of Thermodynamics	10%	5
	Prime Movers - Meaning and Classification; Concept of Force, Pressure, Energy, Work, Power, System, Heat, Temperature, Specific heat capacity, Internal Energy, Enthalpy, Specific Volume; Thermodynamics – Definition: Change of State, Path, Process, Cycle, Thermodynamic systems, Statement of Zeroth Law, First Law and Second Law of Thermodynamics and its Applications.		
2	Properties of Gases Gas Laws, Boyle's law, Charles law, Combined gas law; Gas Constant, Relation between Cp and Cv Constant Volume Process; Constant Pressure Process; Isothermal Process; Adiabatic Process; Poly-tropic Process. Examples based on above topics.	15%	7
3	Properties of Steam Types of Steam and Steam formation; Specific Enthalpy; Specific Volume; Dryness Fraction of Steam; Measurement of Dryness Fraction; Steam Table. Examples based on above topics.	15%	7
4	Heat Engines Definition of Heat Engine; Classification of Heat Engine; Carnot Cycle, Rankine Cycle, Otto Cycle and Diesel Cycle. Internal Combustion Engines: Two Stroke Petrol and Diesel Engine; Four Stroke Petrol and Diesel Engine; Measurement of Indicated Power and Brake Power: Numerical on calculation of Mechanical, Thermal and Volumetric Efficiency. Examples based on above topics.	20%	10
5	Energy Conversion Devices Steam Generators: Definition and Classification; Cochran, Lancashire, Locomotive, Babcock and Wilcox Boiler: Construction and Working; Boiler Mounting and Accessories. Refrigeration and Air Conditioning: Meaning of Refrigeration; Vapor Compression Refrigeration Cycle; Vapor Absorption Refrigeration Cycle; Air conditioning; Window Air Conditioning and Split Air Conditioning.	20%	5

6	Pumps And Air Compressors Pumps Definition, Classification and Application of Pumps; Types and Operation of Rotary pump, Reciprocating Pump, Centrifugal Pump. Air Compressors Definition, Classification and Application of Compressors; Types and Operation of Rotary and Reciprocating Air Compressor.	10%	5
7	Motion And Power Transmission Devices Shaft and Axle; Belt Drive; Chain Drive; Friction Drive; Gear Drive; Clutch, Coupling and Brake.	5%	3
8	Conventional And Non-Conventional Energy Sources Introduction and Classification of Energy Sources; Conventional Energy Sources E.g. Solid, Liquid, Gaseous and Nuclear fuels; Calorific Value of Fuels; Non- Conventional Energy Sources E.g. Solar Energy, Wind Energy, Hydro Power, Biomass and Biomass Energy; Comparison of Conventional & Non-Conventional Energy Sources.	5%	3
Total		100%	45

i. Text Book and Reference Book:

1. "Elements of Mechanical Engineering", By S.B. Mathur, S. Domkundwar, Dhanpat Rai & Sons Publications.
2. "Thermal Engineering, By R.K Rajput", Laxmi Publications.
3. "Thermal Science and Engineering", By Dr. D. S. Kumar, S. K. Kataria and sons Publishers.
4. "Basic Mechanical Engineering", By T. S. Rajan, Wiley Eastern Ltd
5. "Fundamental of Mechanical Engineering", By G. S. Sawhney, PHI Publication New Delhi.