



First Year Curriculum

Admission Year 2026-27

**Diploma in Engineering
BioTechnology**

Faculty of Engineering & Technology

Parul University

Vadodara, Gujarat, India

SEMESTER 1

Fundamentals of Biotechnology and Microbiology

a. **Course Name:** Fundamentals of Biotechnology and Microbiology

b. **Course Code:** 03063001PC01

c. **Prerequisite:** Basic idea about biology.

d. **Rationale:** The aim of the course is to teach the students about the emergence of basic biology to biotechnology and to develop an understanding of new biotechnological interventions for novel products, methods and organisms so as to improve human health and society.

e. **Course Learning Objective:**

CLOBJ 1	Understand the emergence of biology, its scope, characteristics of living things and challenges in human health.
CLOBJ 2	Trace the evolution from classical biology to modern biotechnology including its key products and processes.
CLOBJ 3	Learn the history, scope and major milestones of microbiology as a discipline.
CLOBJ 4	Acquire knowledge of microbial nutrition, growth, cultivation media and pure-culture techniques.
CLOBJ 5	Recognise the applications of microbiology in agriculture, health, food, pharmaceuticals and the environment.

f. **Course Learning Outcomes:**

CLO 1	Define and study the evolution of biology.
CLO 2	Explain different aspects from biology to biotechnology.
CLO 3	Discuss the scope of biotechnology and microbiology.
CLO 4	Apply knowledge about microbes for societal benefit.
CLO 5	Relate applications to industry-based requirements.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					Total
L	T	P	C	T	CE	P	Theory	P	
4	0	2	5	20	20	50	60	-	150

L: Lectures; T: Tutorial; P: Practical; C: Credit; CE: Continuous Evaluation; ESE: End Semester Examination

h. Course Content:

Sr. No.	Topics	W (%)	T
1	Emergence of Biology Historical milestones; Use and misuse of biology; Careers in biology; Unified and basic characteristics of organisms; Analysing living things; Energy-transfer devices of life; Metabolism as the sum of all chemical reactions; Homeostasis; Growth, development and reproduction; Adaptation; Death; Challenges in human health.	15	8
2	From Biology to Biotechnology Definition, history, stages of development and establishment of biotechnology; Biotechnology period and policy; Biotechnological processes and products developed in the ancient period; Classical biotechnology and modern biotechnology.	15	8
3	History and Scope of Microbiology Introduction - definition and scope; Spontaneous generation versus biogenesis; History of microbiology; Domain and kingdom concepts; Golden age of microbiology; Role of microorganisms in fermentation; Germ theory of disease; Evolution of microbiological techniques; Scope and application of microbiology in everyday life.	25	15
4	Microbial Nutrition and Growth Nutritional requirements of bacteria; Growth curve; Influence of environmental factors - pH, temperature, oxygen, heavy metals and other compounds; Cultivation of bacteria; Types of growth media (natural, synthetic, complex, enriched, selective - definitions with examples); Pure-culture methods (streak plate, spread plate, pour plate, stab culture, slant culture).	25	15
5	Applications of Microbiology Agriculture - biofertilizers and biopesticides; Human and animal health - antibiotics, antimicrobial peptides; Food and pharmaceutical industries; Environmental applications - biodegradation and bioleaching; Genetically Modified Organisms (GMOs).	20	14
Total:		100	60

h. List of Practicals:

Sr. No.	Practical Title
1	Demonstration of safety and good laboratory practices.
2	Demonstration of principles and operations of autoclave, hot-air oven, incubator, laminar air-flow chamber, filtration unit, colony counter, centrifuge, pH meter, colorimeter and spectrophotometer.
3	Demonstration of microscopy - parts and functions of a compound microscope.
4	Preparation of culture media - solid, semi-solid and liquid.
5	Isolation of bacteria from soil.
6	Isolation of bacteria from water.
7	Pure-culture techniques by streak-plate and spread-plate methods.
8	Biochemical tests for bacterial identification.
9	Microscopic examination of bacteria by Gram's staining.
10	Demonstration of the growth curve of bacteria.

i. Text Book and Reference Book:

1. Biology - Textbook for Class XI, By NCERT.
2. Biology, By Peter H. Raven, George B. Johnson, Kenneth A. Mason, Jonathan Losos & Susan Singer | McGraw Hill Publication.
3. A Textbook of Biotechnology, By R. C. Dubey.

Mathematics - I

a. **Course Name:** Mathematics - I

b. **Course Code:** 03069101BS01

c. **Prerequisite:** Student must have passed the class 10th examination from a recognised board of education and possess a working knowledge of the basic concepts of mathematics studied till the 10th standard.

d. **Rationale:** The goal of this Mathematics course is to give students a strong foundation in fundamental ideas and procedures that are essential for both everyday problem-solving and future education. This course aims to foster logical reasoning and critical thinking skills while covering subjects that are directly relevant to a variety of engineering, technology, business and scientific domains.

e. Course Learning Objective:

CLOBJ 1	Understand the concept of logarithms and the resolution of rational fractions into partial fractions, and apply them in simplifying algebraic and arithmetic computations.
CLOBJ 2	Develop the ability to apply trigonometric ratios, identities and formulae to solve engineering problems.
CLOBJ 3	Learn the algebra and geometric representation of complex numbers and apply De Moivre's theorem to simplify mathematical expressions.
CLOBJ 4	Build foundational concepts of functions and limits required for the study of calculus.
CLOBJ 5	Acquire the techniques of differentiation of standard, composite, implicit and higher-order functions, and apply them in engineering-related problems.

f. Course Learning Outcomes:

CLO 1	Use logarithms and convert rational fractions into sums of partial fractions.
CLO 2	Analyse basic functions used in trigonometry.
CLO 3	Represent complex numbers in various forms like modulus-amplitude (polar) form and exponential (Euler) form and illustrate with examples.
CLO 4	Interpret a function graphically, numerically and analytically.
CLO 5	Solve engineering related problems based on applications of differentiation.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					Total
L	T	P	C	T	CE	P	Theory	P	
3	1	0	4	20	20	-	60	-	100

L: Lectures; T: Tutorial; P: Practical; C: Credit; CE: Continuous Evaluation; ESE: End Semester Examination

h. Course Content:

Sr. No.	Topics	W (%)	T
1	Logarithms and Partial Fractions Logarithms: Definition, Logarithm as a transformation, Antilogarithm, Rules of Logarithms and examples, Use of logarithmic functions for simplifying arithmetic computations. Partial fractions: Definition of partial fractions, Types of partial fractions (denominator containing non-repeated linear factors, repeated linear factors and irreducible non-repeated quadratic factors).	17	8
2	Trigonometry Units of Angles (degree and radian), Trigonometric Functions, Allied & Compound Angles, Multiple and Sub-multiple angles, Graph of Sine and Cosine, Periodic trigonometric functions, Sum and factor formulae.	23	9
3	Complex Numbers Definition of a complex number, Real and imaginary parts of a complex number, Polar and Cartesian representations of complex numbers, Conjugate of a complex number, Geometric representation of complex numbers and their operations, Modulus and Amplitude form, De Moivre's Theorem, Roots of a Complex Number, Use of De Moivre's Theorem to simplify mathematical expressions.	20	9
4	Function and Limit Definition and concept of function, Concept of limits and standard forms of limits, Standard formulae of Limit and related simple examples.	17	8
5	Differentiation Definition of derivative, Differentiation of a standard function by first principle, Rules of Differentiation, Differentiation of algebraic, trigonometric, exponential, logarithmic, implicit and composite functions, Higher-order derivatives.	23	11
Total:		100	45

i. Text Book and Reference Book:

1. Advanced Mathematics for Polytechnic, By N. R. Pandya | Macmillan Publishers India Ltd. | 2012.
2. Mathematics - I, By Deepak Singh | Khanna Book Publishing Co.
3. A Text Book of Engineering Mathematics, By N. P. Bali & Manish Goyal | Laxmi Publications.
4. Polytechnic Mathematics, By S. P. Deshpande | Pune Vidyarthi Gruh Prakashan.
5. Applied Mathematics, By H. K. Das | S. Chand Publication.
6. Calculus and Analytic Geometry, By G. B. Thomas & R. L. Finney | Addison Wesley | 9th Edition.
7. Engineering Mathematics (Third Edition), By Anthony Croft | Pearson Education, New Delhi.
8. Advanced Engineering Mathematics (9th Edition), By Erwin Kreyszig | Wiley India.

Applied Chemistry

a. **Course Name:** Applied Chemistry

b. **Course Code:** 03069501BS01

c. **Prerequisite:** Understanding of basic knowledge of science for application.

d. **Rationale:** This course bridges the gap between theoretical chemistry and real-world industrial applications by providing fundamental knowledge of chemical principles and their relevance in materials science, environmental sustainability, energy production and various engineering processes.

e. Course Learning Objective:

CLOBJ 1	Understand atomic structure, the orbital concept, chemical bonding and the role of catalysis in chemical processes.
CLOBJ 2	Acquire knowledge of electrochemistry including ionisation, pH, electrochemical cells, electrolysis and conductance of solutions.
CLOBJ 3	Learn the causes, types, mechanisms and prevention of corrosion in engineering materials.
CLOBJ 4	Understand water treatment processes used for domestic and industrial purposes.
CLOBJ 5	Get acquainted with the properties and selection of lubricants and fuels, and develop a basic understanding of polymers, elastomers and adhesives used in engineering.

f. Course Learning Outcomes:

CLO 1	Understand the concept of matter and the existence of materials in nature.
CLO 2	Become acquainted with various mechanisms of energy conversion and the applications of electrochemistry.
CLO 3	Interpret the concept of corrosion, its types and mechanisms along with prevention methods.
CLO 4	Develop skills to understand and apply water treatment methods.
CLO 5	Understand the fundamentals of lubricants in industrial applications.
CLO 6	Develop a clear idea of different types of polymers and their properties and applications in engineering fields.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					Total
L	T	P	C	T	CE	P	Theory	P	
3	0	2	4	20	20	50	60	-	150

L: Lectures; T: Tutorial; P: Practical; C: Credit; CE: Continuous Evaluation; ESE: End Semester Examination

h. Course Content:

Sr. No.	Topics	W (%)	T
1	Chemical Bonding and Catalysis Atomic structure and orbital concept; Shapes of s, p and d orbitals; Pauli's exclusion principle; Hund's rule of maximum multiplicity; Aufbau rule; Electronic configuration; Theory of valency; Types of chemical bonds - electrovalent, covalent, coordinate, hydrogen, metallic; Electron sea model; Intermolecular forces (Van der Waals); Structures of solids (ionic, molecular, network, metallic); Catalysis - types, theory, characteristics; Positive, negative, auto-catalyst, catalytic promoter and inhibitor; Industrial applications of catalysts.	10	6
2	Concepts of Electrochemistry Arrhenius theory of ionisation; Degree of ionisation and factors affecting it; pH - definition, pH of acid, base and salt solutions, calculations and importance; Buffer solutions and their applications; Electrolytes and non-electrolytes; Electrodes - inert, working and reference; Construction and working of an electrochemical cell; Standard hydrogen electrode; Nernst equation (concept); Electrochemical and galvanic series; Electrolysis and Faraday's laws; Industrial applications of electrolysis; Conductivity, specific, equivalent and molar conductivity.	20	9
3	Corrosion and its Control Definition and types of corrosion; Dry corrosion - oxidation corrosion mechanism and nature of oxide film; Wet corrosion mechanism; Concentration cell, pitting, waterline, crevice, stress and erosion corrosion; Factors affecting the rate of corrosion - nature of film and environment, pH, area of cathode and anode, temperature, moisture, purity of metal; Methods of prevention - modification of environment and properties of metal, protective coatings, anodic and cathodic protection, design and material selection.	10	5
4	Water Treatment Hard water and soft water; Types of hardness; Salts producing hardness and units of expression; Estimation of total hardness by EDTA method; Effect of hard water in boilers - scale, sludge, priming, foaming, caustic embrittlement; Softening of water - Soda-Lime process, Permutit process, Ion-exchange process, Reverse osmosis; Treatment of drinking water - sedimentation, coagulation, filtration, sterilisation by chlorination, break-point chlorination; Indian standard specifications for drinking water.	20	8
5	Lubricants and Fuels Definition and functions of lubricants; Types of lubrication - fluid film and boundary; Classification - solid, semi-solid, liquid and synthetic; Physical properties - viscosity and viscosity index, flash and fire point, pour and cloud point, oiliness; Chemical properties - saponification value, neutralisation	20	10

	number, emulsification number; Selection criteria for gears, cutting tools and steam turbines; Definition of fuel and combustion; Classification of fuels; Calorific values (HCV, LCV) and Bomb calorimeter; Ultimate and proximate analysis of coal; Liquid fuels (Octane and Cetane number); Biofuels and gaseous fuels.		
6	Polymers, Elastomers and Adhesives Definition of polymer and monomer; Classification of polymers based on molecular structure (linear, branched, cross-linked), monomer type (homo and copolymer) and thermal behaviour (thermoplastic and thermosetting); Types of polymerisation - addition and condensation; Synthesis, properties and applications of polyethylene, polypropylene, PVC, Teflon, polystyrene, phenol- formaldehyde, acrylonitrile and epoxy resin; Elastomers - natural rubber, vulcanisation, synthetic rubbers (Buna-S, Buna-N, Neoprene); Adhesives - definition, characteristics, classification and uses.	20	7
Total:		100	45

h. List of Practicals:

Sr. No.	Practical Title
1	Determine the strength of a given acidic solution using a standard solution of base.
2	Standardise KMnO_4 solution by preparing standard oxalic acid and estimate ferrous ions.
3	Standardise $\text{Na}_2\text{S}_2\text{O}_3$ solution by preparing standard potassium dichromate and estimate the percentage of copper from brass.
4	Determine the viscosity of a given lubricating oil using a Red-wood Viscometer.
5	Determine the pH-values of given samples of solutions using a Universal Indicator and pH-meter.
6	Determine the acid value of a given lubricating oil.
7	Determine the percentage of moisture content in a given coal sample by proximate analysis.
8	Determine the saponification value of a given lubricating oil.
9	Determine the flash and fire point of a given lubricating oil.
10	Study the corrosion of metals in acidic and alkaline media.

i. Text Book and Reference Book:

- Engineering Chemistry, By Jain & Jain | Dhanpat Rai.
- A Text Book of Polytechnic Chemistry, By V. P. Mehta | Jain Brothers.
- Engineering Chemistry, By S. S. Dhara.
- Applied Chemistry, By N. Krishnamurthy (New Edition) | Tata McGraw-Hill.
- Textbook of Environmental Chemistry and Pollution Control, By S. S. Dara.

Fundamentals of Computer Applications and Web Technologies

a. Course Name: Fundamentals of Computer Applications and Web Technologies

b. Course Code: 03062001ES01

c. Prerequisite: Basic computer literacy, logical reasoning and fundamental knowledge of file management and the internet.

d. Rationale: Fundamental computer knowledge and web-development skills are essential for engineering students. This course introduces the basics of computer systems, operating systems, file management and web development using HTML5 and CSS. By understanding these concepts, students can efficiently manage computing tasks and build simple websites, enhancing their technical proficiency in the modern IT landscape.

e. Course Learning Objective:

CLOBJ 1	Understand the fundamental components of a computer system, operating systems and file management.
CLOBJ 2	Acquire basic skills in handling Windows and Linux operating systems and standard system utilities.
CLOBJ 3	Learn the structure of HTML5 documents and build well-formed, semantic web pages.
CLOBJ 4	Develop the ability to add hyperlinks, images, tables, forms and multimedia to web pages.
CLOBJ 5	Apply CSS styling and use HTML5 APIs to design simple, modern and responsive websites.

f. Course Learning Outcomes:

CLO 1	Understand the fundamental concepts of computers, operating systems and file management.
CLO 2	Develop structured web pages using HTML5 elements and formatting techniques.
CLO 3	Implement links, images, tables and forms to create interactive web pages.
CLO 4	Apply CSS styling techniques to enhance the visual presentation of web pages.
CLO 5	Utilise HTML5 APIs and multimedia elements to develop modern, responsive web pages.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					Total
L	T	P	C	T	CE	P	Theory	P	
2	0	4	4	20	20	100	60	-	200

L: Lectures; T: Tutorial; P: Practical; C: Credit; CE: Continuous Evaluation; ESE: End Semester Examination

h. Course Content:

Sr. No.	Topics	W (%)	T
1	Introduction to Computers	15	4

	History and evolution of computers; Basic components of a computer system (hardware and software); Types of computers (supercomputers, mainframes, PCs, embedded systems); Operating system basics (Windows, Linux); Input and output devices.		
2	Operating System and File Management Introduction to operating systems and their functions; Windows OS - file and folder management, Control Panel, Task Manager; Linux OS - basic commands and file handling; System utilities - Disk Cleanup, Task Scheduler, System Restore; Basic troubleshooting techniques.	20	6
3	Introduction to HTML and HTML5 Basics of web development and introduction to HTML; Structure of an HTML document (HTML, Head, Body); HTML elements and attributes; Formatting text (headings, paragraphs, line breaks, bold, italic, underline); HTML lists (ordered, unordered, definition); HTML5 semantic elements (header, footer, article, section, aside, nav).	20	6
4	Working with Links, Images, Tables and Forms Creating hyperlinks (internal, external, e-mail); Adding and formatting images; Image maps and image links; HTML tables (rows, columns, merging cells, borders, styling); Creating forms (text input, radio buttons, checkboxes, drop-downs, validation); HTML5 form elements (placeholder, required, autofocus, date, range, colour); Embedding multimedia (HTML5 audio, video, canvas, SVG).	25	8
5	CSS Basics and HTML5 APIs Introduction to CSS (inline, internal, external); Styling text (font size, colour, alignment); CSS Box Model (margin, padding, border); Introduction to HTML5 APIs (Geolocation API, Local Storage, Web Workers); Mini project - simple portfolio, resume website or personal blog.	20	6
Total:		100	30

h. List of Practicals:

Sr. No.	Practical Title
1	Identify and explain computer hardware components.
2	Perform basic computer operations (booting, using the Start Menu, shortcuts).
3	Install and uninstall software and device drivers.
4	Work with input and output devices (printer, scanner, USB, storage devices).
5	Perform file and folder management in Windows (create, rename, copy, delete).
6	Execute basic Linux commands (ls, cd, mkdir, rm, cp, mv, chmod).
7	Use system utilities such as Disk Cleanup, Task Scheduler and System Restore.

8	Troubleshoot basic system errors and network connectivity issues.
9	Create a basic HTML web page with headings and paragraphs.
10	Use text-formatting tags (bold, italic, underline, subscript, superscript).
11	Create ordered, unordered and definition lists in HTML.
12	Structure a web page using semantic HTML5 elements (header, footer, section).
13	Add comments and special characters in an HTML document.
14	Develop a simple resume web page using HTML.
15	Create hyperlinks (internal, external, e-mail and image links).
16	Add and format images using the tag.
17	Implement an image map using <map> and <area> tags.
18	Design a table using <table>, <tr>, <td>, merging cells and styling.
19	Create a form using text fields, radio buttons, checkboxes and submit / reset buttons.
20	Use HTML5 form elements (placeholder, autofocus, date picker, colour picker).
21	Embed multimedia using <audio> and <video> tags.
22	Develop a simple online registration form using HTML.
23	Apply inline, internal and external CSS to an HTML page.
24	Style text using CSS (font, colour, alignment, text-shadow, line-height).
25	Implement CSS Box Model properties (margin, padding, border, width, height).
26	Demonstrate the use of HTML5 APIs (Local Storage, Session Storage, Geolocation API).
27	Create a simple portfolio website using HTML5 and CSS.

i. Text Book and Reference Book:

1. Computer Fundamentals, By P. K. Sinha | BPB Publications.
2. HTML5: The Missing Manual, By Matthew MacDonald.
3. Operating System Concepts, By Abraham Silberschatz | Wiley | 5th Edition.
4. Pro HTML5 and CSS3 Design Patterns (Expert's Voice in Web Development), By Michael Bowers & Victor Sumner | Kindle Edition.
5. Web Technologies, By Uttam Kumar Roy & Debarshi Kumar Sanyal.

Engineering Workshop

a. **Course Name:** Engineering Workshop

b. **Course Code:** 03061901ES03

c. **Prerequisite:** Engineering Workshop Practice requires basic knowledge of science, mathematics and engineering drawing. Students should also be aware of safety rules and ready to perform hands-on tasks with discipline and teamwork.

d. **Rationale:** The Engineering Workshop Practice course is designed to provide diploma-level students with practical skills essential for their professional development. The hands-on experience gained through this course enables students to understand the operation of various hand tools and perform fundamental mechanical tasks efficiently. By exploring fitting, carpentry, welding and plumbing operations, students build a strong foundation in practical engineering techniques. The course also emphasises the importance of safety and adherence to industry standards, preparing students for real-world challenges in engineering environments.

e. **Course Learning Objective:**

CLOBJ 1	Acquire awareness of workshop safety practices, personal protective equipment and emergency procedures.
CLOBJ 2	Develop hands-on familiarity with hand tools, power tools and basic mechanical measurements.
CLOBJ 3	Perform fundamental fitting, carpentry, sheet-metal, welding and plumbing operations.
CLOBJ 4	Understand piping components, fittings and their use in industrial systems.
CLOBJ 5	Apply codes, standards and good engineering practices while working with materials and tools.

f. **Course Learning Outcomes:**

CLO 1	Apply safety measures and practices while handling tools, machines and materials in various workshop environments to ensure safe operations.
CLO 2	Demonstrate proficiency in using fundamental tools and techniques for mechanical tasks, including measurements, marking and basic engineering operations.
CLO 3	Perform fitting, carpentry, sheet-metal, welding and plumbing operations to fabricate simple components.
CLO 4	Outline piping systems and their industrial applications, including material selection, layout design and component identification.
CLO 5	Interpret codes and standards relevant to mechanical engineering practices.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					Total
L	T	P	C	T	CE	P	Theory	P	
0	0	4	2	-	-	100	-	-	100

h. List of Practicals:

Sr. No.	Practical Title
1	Prepare a workshop layout showing the general specifications of equipment available in various shops.
2	Workshop Safety Practices: demonstration of safety protocols and PPE; interpretation of Industrial Safety Data Sheets (hazard symbols, handling instructions, emergency procedures); demonstration of fire-extinguisher operations and their types and uses.
3	Fundamentals of unit conversions, mechanical measurements, materials and engineering specifications: hands-on practice with Vernier calliper, micrometer, dial indicators and protractor; principles of tolerances, limits and fits; geometric properties (straightness, flatness, squareness, parallelism, perpendicularity, roundness, concentricity); standard sizes and costs of raw materials; specifications of common fasteners; geometric calculations of area, volume, mass and material cost.
4	Demonstration of hand tools and power tools with their general specifications.
5	Fitting Shop: prepare at least one fitting job incorporating marking, punching, filing, chamfering, etc., as per drawing.
6	Carpentry Shop: prepare at least one carpentry job incorporating measuring, marking, cutting, assembly and joint preparation (T-joint, dovetail joint, etc.) as per drawing.
7	Sheet Metal Working: prepare at least one sheet-metal job incorporating cutting, bending, edging, riveting, etc., as per drawing.
8	Welding Shop: demonstration of gas and arc welding setups; practice of arc welding with edge preparation as per drawing; practice of gas welding; demonstration and practice of soldering and brazing.
9	Plumbing: demonstration of plumbing tools and pipe-fitting accessories; preparation of a plumbing layout incorporating elbows, tees, reducers, unions, couplings, crosses, caps, swage nipples, plugs, bushings, adapters, outlets, valves and flanges; overview of industrial piping components and systems (valves, fittings, flanges, joints, connectors); group task - prepare a domestic plumbing model using UPVC / CPVC materials.

i. Text Book and Reference Book:

1. Mechanical Workshop Practice, By K. C. John.
2. A Course in Workshop Technology, By B. S. Raghuwanshi | Dhanpat Rai and Sons, New Delhi | 1982.
3. Workshop Practice Manual, By K. Venkat Reddy | BS Publications.
4. Elements of Workshop Technology - Vol. I, By S. K. Hajra Choudhury | Asia Publishing House.
5. Comprehensive Workshop Technology, By S. K. Garg | Laxmi Publications.

Fundamentals of Communication Skills

a. Course Name: Fundamentals of Communication Skills

b. Course Code: 03060001HM01

c. Prerequisite: Knowledge of English language studied till 10th standard.

d. Rationale: Basic communication skills are essential for all engineers. This course builds foundational competence in speaking, grammar, vocabulary, and written expression so that learners can confidently participate in academic and everyday professional interactions.

e. Course Learning Objectives:

CLOBJ 1	Develop fundamental communication skills required for academic, professional, and social interactions.
CLOBJ 2	Understand and apply basic English grammar concepts including parts of speech, tenses, and active–passive voice in oral and written communication.
CLOBJ 3	Enhance vocabulary through synonyms, antonyms, and one-word substitutions for effective expression.
CLOBJ 4	Improve speaking confidence through role-plays, self-introductions, group activities, and interpersonal communication exercises.
CLOBJ 5	Develop basic reading comprehension and goal-setting abilities applicable to academic and personal contexts.
CLOBJ 6	Build skills in drafting structured written content such as formal and informal applications and short narratives.

f. Course Learning Outcomes:

After learning the course, the student shall be able to:

CLO 1	Confidently participate in basic speaking tasks such as role-plays and peer introductions in social and academic contexts.
CLO 2	Apply key grammar rules such as correct tenses, voice, and parts of speech in both oral and written communication.
CLO 3	Demonstrate improved vocabulary through the use of synonyms, antonyms, and one-word substitutions in context.
CLO 4	Draft well-structured creative and formal content with clarity, coherence, and suitable tone.
CLO 5	Comprehend and analyze reading material using strategic reading techniques and apply goal-setting skills practically.

g. Teaching & Examination Scheme:

Teaching Scheme				Internal Evaluation			ESE		Total
L	T	P	C	MSE	CE	P	Theory	P	
0	0	2	1	-	-	20	-	30	50

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

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1.	Ice Breaker + Introducing your Friend Fun Fact Exchange (e.g., Two Truths and a Lie); Describing Personality and Hobbies; Using Adjectives to Talk About People (Link to Parts of Speech); Structured Self and Peer Introduction (Name, Interests, Goals).	5	2
2.	Parts of Speech Identifying and Using Nouns, Pronouns, and Adjectives; Verbs and Adverbs in Sentence Construction; Prepositions and Conjunctions: Linking Ideas; Interjections and Their Usage in Conversations.	8	2
3.	Story Mason Elements of a Story (Character, Setting, Plot, Conflict, Resolution); Sequencing Events (Beginning, Middle, End); Using Tenses Appropriately in Narratives.	15	4
4.	Tenses Simple Tenses (Present, Past, Future); Continuous Tenses (Present, Past); Perfect Tenses (Present, Past); Perfect Continuous Tense (Present).	10	4
5.	Active – Passive Voice Rules of Active & Passive Voice; Identifying Active vs Passive Constructions; Converting Sentences from Active to Passive and Vice Versa; Tense Changes in Passive Voice.	10	2
6.	Vocabulary Building: One-word Substitution, Synonyms, and Antonyms List and Practice Common One-word Substitutions; Synonym–Antonym Match-Up Games; Use New Words in Sentences/Short Paragraphs.	8	2
7.	Types of Application Formal vs Informal Applications; Structure and Format of an Application (Salutation, Body, Closing); Writing Leave Applications.	10	2
8.	Role Play Generic Situations (Buying, Asking for Directions, At a Doctor etc.); Customer Service and Complaint Handling.	15	6

Sr. No.	Content	Weightage (%)	Teaching Hours
9.	Goal Setting SMART Goals (Specific, Measurable, Achievable, Relevant, Time-bound); Short-term vs Long-term Goals; Overcoming Obstacles to Goals.	7	2
10.	Reading Skills – Basic Level Types of Reading; Strategies of Reading; Reading Comprehension.	12	4
11.	Revision Revision of all topics.	0	2
Total		100%	32

i. Text Book and Reference Book:

Sr. No.	Reference
1.	Word Power Made Easy — Norman Lewis Goyal Publishers, 2014.
2.	Soft Skills: Enhancing Employability and Career Development — M. Ashraf Rizvi McGraw Hill Education, 2010.
3.	High School English Grammar and Composition — Wren & Martin S. Chand Publishing, 2017.
4.	Developing Communication Skills — Krishna Mohan & Meera Banerji Macmillan Publishers India, 2009.
5.	English Grammar in Use — Raymond Murphy Cambridge University Press, 2019.

Environmental Science (Mandatory Course - I)

a. **Course Name:** Environmental Science (Mandatory Course - I)

b. **Course Code:** 03061501MC01

c. **Prerequisite:** Basic knowledge of science (biology, chemistry, physics), environmental awareness, geography, data interpretation and ethical responsibility towards sustainability.

d. **Rationale:** Sustainable development is essential for a nation's progress, making environmental conservation and hazard management crucial for every Indian citizen. The country has endured numerous natural disasters and significant energy wastage remains a challenge. Saving energy is as valuable as producing it. Industrial mismanagement and lack of discipline have led to rising environmental pollution. Embracing renewable energy is a key solution to both the energy crisis and pollution control. This course aims to raise awareness of these pressing issues and inspire students to act responsibly towards a cleaner, more sustainable future.

e. Course Learning Objective:

CLOBJ 1	Understand the structure of ecosystems, their biotic and abiotic components and major biogeochemical cycles.
CLOBJ 2	Learn the sources, types, effects and control measures of air and noise pollution along with relevant regulations.
CLOBJ 3	Acquire knowledge of water and soil pollution, treatment methods and preventive measures.
CLOBJ 4	Explore renewable energy sources, their working principles and applications.
CLOBJ 5	Understand solid waste management and the principles of the 3R, recycling, energy recovery and safe disposal.
CLOBJ 6	Get a basic introduction to seismic engineering and disaster management for natural and man-made hazards.

f. Course Learning Outcomes:

CLO 1	Explain the ecosystem structure, biotic and abiotic components, food chains, food webs and major biogeochemical cycles.
CLO 2	Identify sources, types, effects and control measures of air and noise pollution including relevant regulations.
CLO 3	Analyse water and soil pollution sources, characteristics, treatment methods and preventive measures.
CLO 4	Describe various renewable energy sources, their working principles, applications and environmental impacts.
CLO 5	Classify solid-waste types, sources, characteristics and management techniques including recycling and disposal.
CLO 6	Explain seismic engineering principles and disaster management strategies for natural and human-made hazards.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					Total
L	T	P	C	T	CE	P	Theory	P	
1	0	0	0	20	20	-	-	-	

L: Lectures; T: Tutorial; P: Practical; C: Credit; CE: Continuous Evaluation; ESE: End Semester Examination

h. Course Content:

Sr. No.	Topics	W (%)	T
1	Ecosystem Structure of ecosystem; Biotic and abiotic components; Food chain and food web; Carbon, nitrogen, sulphur and phosphorus cycles.	10	2
2	Air and Noise Pollution Definition of pollution and pollutant; Natural and man-made sources of air pollution (refrigerants, I.C. engines, boilers); Types of air pollutants; Particulate pollutants - effects and control (bag filter, cyclone separator, electrostatic precipitator); Gaseous pollution control - absorber, catalytic converter; Effects of air pollution; Noise pollution - sources, measurement of pollution level, effects; Noise Pollution (Regulation and Control) Rules, 2000.	25	3
3	Water and Soil Pollution Sources of water pollution; Types of water pollutants and their characteristics - turbidity, pH, total suspended solids, total solids, BOD and COD (definition and calculation); Waste-water treatment - primary methods (sedimentation, froth flotation), secondary methods (activated sludge treatment, trickling filter, bioreactor), tertiary methods (membrane separation, reverse osmosis); Soil pollution - causes (excessive use of fertilizers, pesticides and insecticides, irrigation, e-waste), effects and preventive measures.	25	3
4	Renewable Sources of Energy Solar energy - basics, flat-plate collector (liquid and air), theory of flat-plate collector, importance of coating, advanced collectors, solar pond, solar water heater, solar dryer, solar still; Biomass - overview as energy source, thermal characteristics, anaerobic digestion, biogas production mechanism, utilisation and storage of biogas; Wind energy - current status, future prospects, wind energy in India, environmental benefits and problems; New energy sources - need and types (hydrogen energy, ocean energy, tidal energy, geothermal energy - concept, origin and power plants).	25	3
5	Solid Waste Management Solid-waste generation - sources and characteristics of municipal solid waste, e-waste, biomedical waste; Metallic and non-metallic wastes (lubricants, plastics,	10	2

	rubber) from industries; Collection and disposal of MSW - 3R principles, energy recovery, sanitary landfill; Hazardous waste.		
6	Seismic Engineering and Disaster Management Introduction to seismic engineering and its application in civil engineering designs; Features of disasters - floods, earthquakes, fires, epidemics, gas / radioactive leaks; Management and mitigation of the above disasters.	5	2
Total:		100	15

i. Text Book and Reference Book:

1. Basics of Environmental Studies, By U. K. Khare | Tata McGraw Hill.
2. Environmental Sciences, By Daniel B. Botkin & Edward A. Keller | John Wiley & Sons.
3. Environmental Pollution Control Engineering, By C. S. Rao | New Age International.
4. Environmental Studies, By Dr. Suresh K. Dhameja | S. K. Kataria & Sons, New Delhi.
5. Air Pollution, By M. N. Rao & H. V. N. Rao | Tata McGraw-Hill Publishing Company.
6. Solid Waste Treatment and Disposal, By G. Tchobanoglous | McGraw Hill Pub.

Pollution Prevention and Control Techniques (MOPEC - I)

a. Course Name: Pollution Prevention and Control Techniques (MOPEC - I)

b. Course Code: 03061501UE01

c. Prerequisite: Student must have passed the class 10th examination from a UGC-recognised board of education.

d. Rationale: The study of environmental pollution related to industry is essential to understand various types of pollution and their preventive and control measures. The study of this course helps engineers in operating diverse pollution-control equipment for controlling gaseous, water and land pollution. The course has been designed to develop this competency and its associated cognitive and affective domain learning outcomes.

e. Course Learning Objective:

CLOBJ 1	Understand the basic concepts and classification of environmental pollution.
CLOBJ 2	Acquire knowledge of air pollutants, their monitoring and major air-pollution control technologies.
CLOBJ 3	Learn about water and noise pollution and the various stages of waste-water treatment used in industry.
CLOBJ 4	Understand the management of solid waste including collection, recycling, composting, incineration and landfilling.
CLOBJ 5	Recognise the role of environmental laws, ISO 14001 and industrial sustainability initiatives.

f. Course Learning Outcomes:

CLO 1	Understand the basic concepts and types of environmental pollution.
CLO 2	Analyse the causes, effects and control measures of air pollution.
CLO 3	Identify the sources and effects of water and noise pollution and recommend suitable control strategies.
CLO 4	Understand the methods and practices involved in solid-waste management.
CLO 5	Interpret key environmental regulations and understand the concept of sustainability in environmental engineering.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					Total
L	T	P	C	T	CE	P	Theory	P	
3	0	0	3	20	20	-	60	-	100

L: Lectures; T: Tutorial; P: Practical; C: Credit; CE: Continuous Evaluation; ESE: End Semester Examination

h. Course Content:

Sr. No.	Topics	W (%)	T
1	Introduction to Pollution Definition of pollution and pollutants; Classification - air, water and solid pollution; Sources and effects of pollution.	10	6
2	Air Pollution and Control Major air pollutants and their impact; Sampling and monitoring of air pollutants; Air pollution control techniques - filtration, electrostatic precipitators, scrubbers.	25	10
3	Water and Noise Pollution: Sources, Impacts and Control Measures Water pollutants and their effects; Waste-water treatment processes - primary, secondary and tertiary treatment; Effluent Treatment Plant (ETP), Sewage Treatment Plant (STP) - process and parameters; Water standards; Noise pollution - effects and control measures.	25	10
4	Solid Waste Management Types of solid waste - municipal, industrial, hazardous; Collection, disposal and recycling methods; Composting, incineration and landfilling.	20	10
5	Environmental Regulations and Sustainability Environmental laws and policies (Air and Water Pollution Acts); ISO 14001 and environmental management systems; Role of industries in pollution control and sustainability initiatives.	20	9
Total:		100	45

i. Text Book and Reference Book:

1. Environmental Pollution Control Engineering, By C. S. Rao | New Age International.
2. Text Book of Environmental Pollution and Control, By Dr. H. S. Bhatia | Galgotia Publication, New Delhi | 1st Edition.
3. Pollution Control in Process Industries, By S. P. Mahajan | Tata McGraw-Hill, New Delhi | 21st reprint, 2008.
4. Environmental Engineering, By G. N. Pandey & G. C. Carney | Tata McGraw-Hill, New Delhi.

SEMESTER 2

Cell and Molecular Biology

a. **Course Name:** Cell and Molecular Biology

b. **Course Code:** 03063002PC01

c. **Prerequisite:** Basic Biology; concept of cell structure, biomolecules and chemistry.

d. **Rationale:** The course transforms foundational knowledge into actionable skills, empowers students to engage with modern technologies and prepares them to contribute meaningfully to scientific and industrial advancements. By aligning with industry needs, academic progression and global challenges, the course ensures students are work-ready, innovative and ethically conscious professionals.

e. **Course Learning Objective:**

CLOBJ 1	Understand the structure and function of prokaryotic and eukaryotic cells and their organelles.
CLOBJ 2	Acquire knowledge of biomolecules, enzymes and basic metabolic pathways operating in cells.
CLOBJ 3	Learn the central dogma of molecular biology, gene expression and its regulation in prokaryotes and eukaryotes.
CLOBJ 4	Understand the cell cycle, cell division, apoptosis and basic cell-signalling mechanisms.
CLOBJ 5	Appreciate the applications of molecular and cell biology in biotechnology, cancer research and regenerative medicine.

f. **Course Learning Outcomes:**

CLO 1	Differentiate between prokaryotic and eukaryotic cells, describe the functions of various cell organelles, and apply knowledge of microscopy for cell observation.
CLO 2	Describe the structure and function of carbohydrates, proteins, lipids and nucleic acids, along with their involvement in key metabolic pathways, and distinguish metabolite-production strategies and recent developments in genetic engineering.
CLO 3	Build insights into the central dogma of molecular biology, mechanisms of genetic-code expression, and regulatory aspects of prokaryotic and eukaryotic gene expression.
CLO 4	Explain different phases of the cell cycle and cell communication, and explore the potential applications of molecular biology in biotechnology, cancer research and regenerative medicine.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					Total
L	T	P	C	T	CE	P	Theory	P	
4	0	2	5	20	20	50	60	-	

h. Course Content:

Sr. No.	Topics	W (%)	T
1	Introduction to Cell Biology Basics of cell structure and function; Definition of cell and cell theory; Prokaryotic versus eukaryotic cells; Cell size and shape - structure and functions; Microscopy - light and electron microscopy; Cell organelles and their functions; Plasma membrane - structure and transport mechanisms; Nucleus - structure and function; Mitochondria and energy production; Endoplasmic reticulum, Golgi apparatus, lysosomes, peroxisomes; Cytoskeleton - microtubules, microfilaments and intermediate filaments.	25	15
2	Biomolecules and Molecular Components of Cells Biomolecules in cells; Carbohydrates - structure and function; Proteins - structure and function; Lipids and membrane function; Nucleic acids - DNA and RNA structure; Enzymes - structure, function and kinetics; Enzyme regulation and inhibition; ATP and energy metabolism; Overview of Glycolysis, TCA Cycle and Electron Transport Chain.	25	15
3	Molecular Biology and Genetic Mechanisms DNA replication, transcription and translation; Central dogma of molecular biology; DNA replication - enzymes and mechanism; Transcription process in prokaryotes and eukaryotes; Translation process and the genetic code; Gene expression and regulation; Operon model - Lac and Trp operons; Gene regulation in eukaryotes; Mutations - types and consequences; Recombinant DNA technology - basics and applications.	30	18
4	Cell Division, Cell Communication and Applications Cell cycle and cell division; Phases of the cell cycle; Mitosis and meiosis - process and significance; Apoptosis and programmed cell death; Cell signalling and biotechnology applications; Cell communication - signal-transduction pathways; Types of cell signalling (autocrine, paracrine, endocrine); Stem cells and their applications; Basics of cancer biology.	20	12
Total:		100	60

h. List of Practicals:

Sr. No.	Practical Title
1	Microscopy and cell structure observation.
2	Staining techniques for cell identification.
3	Demonstration of cell fractionation and organelle isolation.

4	Quantitative estimation of carbohydrates.
5	Quantitative estimation of proteins.
6	Isolation of plasmid DNA from bacterial cells.
7	Quantification of plasmid DNA from bacterial cells.
8	Agarose gel electrophoresis for DNA separation.
9	Demonstration of mitosis and meiosis using prepared slides.
10	Demonstration of cell viability and apoptosis assay.

i. Text Book and Reference Book:

1. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, By P. S. Verma & V. K. Agarwal | S. Chand & Co. Ltd., India | 1st Edition.
2. Cell Biology: A Short Course, By Stephen R. Bolsover, Andrea Townsend-Nicholson, Greg FitzHarris, Elizabeth A. Shephard & Jeremy S. Hyams | Wiley | 4th Edition, 2022.
3. Karp's Cell and Molecular Biology: Concepts and Experiments, By Gerald Karp, Janet Iwasa & Wallace Marshall | Wiley | 9th Edition, 2019.
4. Biochemistry, Cell and Molecular Biology, and Genetics: An Integrated Textbook, By Zeynep Gromley & Adam Gromley | Thieme | 1st Edition, 2021.

Mathematics - II

a. **Course Name:** Mathematics - II

b. **Course Code:** 03069102BS01

c. **Prerequisite:** Knowledge of the basic concepts of mathematics studied in the first semester (Mathematics - I).

d. **Rationale:** This course is an extension of Mathematics - I of the first semester. Using the methods of differentiation, integration, differential equations, matrix theory, geometry and differential equations, the course aims to instil applications in pertinent engineering and technological fields.

e. Course Learning Objective:

CLOBJ 1	Develop the ability to manipulate determinants and matrices and solve systems of linear equations using matrix methods and Cramer's rule.
CLOBJ 2	Acquire knowledge of vector algebra and apply it to engineering problems related to work, moment and angular velocity.
CLOBJ 3	Build basic concepts of coordinate geometry of straight lines and circles required for engineering analysis.
CLOBJ 4	Master techniques of integration including substitution, by parts and partial fractions, and apply them to compute areas and volumes.
CLOBJ 5	Develop the ability to formulate and solve first-order, first-degree ordinary differential equations arising in engineering and technology.

f. Course Learning Outcomes:

CLO 1	Solve engineering related problems based on matrices.
CLO 2	Analyse engineering related problems based on the concepts of vectors.
CLO 3	Understand basic engineering problems under given conditions of straight lines and circles.
CLO 4	Apply integral calculus to engineering related problems.
CLO 5	Obtain the solution of differential equations for significant applied problems.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					Total
L	T	P	C	T	CE	P	Theory	P	
3	1	0	4	20	20	-	60	-	100

L: Lectures; T: Tutorial; P: Practical; C: Credit; CE: Continuous Evaluation; ESE: End Semester Examination

h. Course Content:

Sr. No.	Topics	W (%)	T
1	Determinants and Matrices	23	10

	Elementary properties of determinants up to 3rd order; Consistency of equations; Cramer's rule; Algebra of matrices; Inverse of a matrix; Matrix inversion method to solve a system of linear equations in three variables.		
2	Vector Algebra Definition, notation and rectangular resolution of a vector; Addition and subtraction of vectors; Scalar and vector products of two vectors; Simple problems related to work, moment and angular velocity.	20	9
3	Co-ordinate Geometry Straight line - inclination and slope of a line, different forms of equations of a line (slope-intercept, point-slope, two-point, intercept), general equation of a straight line, family of lines, conditions for concurrency of lines; Circle - definition, equation with given centre and radius, general form, equation when intercepts are given, circle passing through three points, equation of chord, equations of tangent and normal at a point.	17	8
4	Integral Calculus Integration as the inverse operation of differentiation; Integration of simple functions; Integration by substitution, by parts and by partial fractions (linear factors only); Definite integral - definition, properties, odd and even functions, use of formulae; Applications of integration: evaluation of area bounded by a curve and the axes, calculation of volume of a solid formed by revolution of an area about an axis (simple problems).	23	10
5	Differential Equations Solution of first-order and first-degree differential equations by variable separation method (simple problems); Exact differential equations (simple problems); Linear differential equations (simple problems); MATLAB - simple introduction.	17	8
Total:		100	45

i. Text Book and Reference Book:

1. Polytechnic Mathematics, By S. P. Deshpande | Pune Vidyarthi Gruh Prakashan.
2. Mathematics - I, By Deepak Singh | Khanna Book Publishing Co.
3. Mathematics II, By Garima Singh | Khanna Book Publishing Co.
4. Elementary Engineering Mathematics, By Dr. B. S. Grewal | Khanna Publishers | 15th Edition.
5. Calculus and Analytic Geometry, By G. B. Thomas & R. L. Finney | Addison Wesley | 9th Edition.
6. Higher Engineering Mathematics, By B. S. Grewal | Khanna Publications.
7. Engineering Mathematics (Third Edition), By Anthony Croft | Pearson Education, New Delhi, 2014.
8. Calculus and Its Applications, By Marvin L. Bittinger, David J. Ellenbogen & Scott A. Sargent | Addison-Wesley | 10th Edition.
9. Advanced Engineering Mathematics (9th Edition), By Erwin Kreyszig | Wiley India.

Organic Chemistry

a. **Course Name:** Organic Chemistry

b. **Course Code:** 03069502BS01

c. **Prerequisite:** Understanding and recognising the organic compounds that will be studied in organic chemistry chapters.

d. **Rationale:** Organic chemistry is a fundamental branch of chemistry focusing on the structure, properties, composition, reactions and synthesis of carbon-containing compounds. It plays a crucial role in various scientific and technological advancements relevant to biotechnology, pharmaceuticals and industry.

e. **Course Learning Objective:**

CLOBJ 1	Understand the fundamental concepts of organic chemistry including hydrocarbons, functional-group classification, IUPAC nomenclature and isomerism.
CLOBJ 2	Acquire techniques for the purification of organic compounds such as crystallisation, sublimation and various forms of distillation.
CLOBJ 3	Develop the ability to detect and quantitatively estimate elements present in organic compounds.
CLOBJ 4	Learn the preparation, properties and uses of important aliphatic and aromatic organic compounds.
CLOBJ 5	Understand the chemistry of carbohydrates, soaps, detergents and dyes used in industry.

f. **Course Learning Outcomes:**

CLO 1	Understand the fundamental concepts of organic chemistry.
CLO 2	Master techniques for the purification of organic compounds.
CLO 3	Demonstrate proficiency in the detection and estimation of elements in organic compounds.
CLO 4	Acquire knowledge of aliphatic compounds and aromatic compounds.
CLO 5	Understand the chemistry of carbohydrates, soaps, detergents and dyes.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					Total
L	T	P	C	T	CE	P	Theory	P	
3	0	2	4	20	20	50	60	-	150

L: Lectures; T: Tutorial; P: Practical; C: Credit; CE: Continuous Evaluation; ESE: End Semester Examination

h. **Course Content:**

Sr. No.	Topics	W (%)	T
1	Concept of Organic Chemistry	10	6

	Introduction; Classification of hydrocarbons; Functional-group classification of organic compounds; IUPAC system of nomenclature; Structural isomerism - position, chain, metamerism and functional isomerism; Stereo-isomerism - optical and geometrical isomerism.		
2	Purification of Organic Compounds Crystallisation; Sublimation; Distillation - simple distillation, fractional distillation, distillation under reduced pressure, steam distillation; Tests of purification - melting point and boiling point of organic compounds.	10	5
3	Detection and Estimation of Elements Detection of C, H, N, halogens, S and P; Lassaigne's test for detection of N, Cl, Br, I and S; Estimation of C and H; Estimation of nitrogen by Duma's method and Kjeldahl's method; Estimation of halogens, sulphur and phosphorus by Carius method; Problems based on methods of estimation.	15	6
4	Study of Aliphatic Compounds Preparation, properties (physical and chemical) and uses of: Alcohols, Aldehydes and Ketones (methanol, ethanol, acetaldehyde, acetone); Carboxylic acids (acetic acid, oxalic acid); Esters and ethers (methyl acetate, ethyl acetate, diethyl ether); Amines (methylamine, ethylamine).	20	8
5	Study of Aromatic Compounds Preparation, properties (physical and chemical) and uses of: Benzene & Toluene; Nitrobenzene & Aniline; Phenol & Benzaldehyde; Benzoic acid & Salicylic acid; Styrene & Naphthalene; Anthracene; Urea & Benzamide.	20	8
6	Carbohydrates, Soaps and Detergents Introduction to carbohydrates and their classification with suitable examples; Functions of carbohydrates; Soaps and detergents - definition, classification with examples of each class; Mechanism of cleansing action.	10	4
7	Chemistry of Dyes Definition and theories of colour; Chromogen, chromophore and auxochrome; Introduction to natural and synthetic dyes; Classification of dyes based on structure and method of application; Azo dyes, Mordant dyes, Anthraquinone (VAT) dyes, Indigoid dyes; Reactive and disperse dyes - introduction, classification and applications.	15	8
Total:		100	45

h. List of Practicals:

Sr. No.	Practical Title
1	Identification of organic acid, base, phenol and neutral compounds (physical state, structural formula and solubility).

2	Purification of a given organic compound by crystallisation.
3	Purification of a given organic compound by the solvent-treatment method.
4	Determination of melting point of some organic solids by Thiele's method.
5	Determination of boiling point of some organic liquids by Thiele's method.
6	Organic separations - I: Acid + Phenol + Base.
7	Preparation of nitrobenzene from benzene.
8	Purification of organic compounds by sublimation method.
9	Detection of inorganic elements by Lassaigne's test.
10	Organic spotting: (i) Acetic acid & Benzoic acid (ii) Aniline & Nitrobenzene (iii) Benzene & Acetone (iv) Chloroform & Phenol.

i. Text Book and Reference Book:

1. A Text Book of Organic Chemistry, By Arun Bahl & B. S. Bahl | Sultan Chand & Sons, New Delhi.
2. Text Book of Organic Chemistry, By P. L. Soni | Sultan Chand & Sons, New Delhi.
3. Organic Chemistry (Volumes I & II), By I. L. Finar | Longmans.
4. Organic Chemistry, By Morrison and Boyd | Pearson Education.

Basic Physics

a. **Course Name:** Basic Physics

b. **Course Code:** 03069202BS01

c. **Prerequisite:** High school level Physics.

d. **Rationale:** Applied Physics aims to give an understanding of this world both by observation and by prediction of the way in which objects behave. Concrete use of physical principles and analysis in various fields of engineering and technology are given prominence in the course content. The course will help diploma engineers to apply basic concepts and principles to solve broad-based engineering problems and to understand different technology-based applications.

e. **Course Learning Objective:**

CLOBJ 1	Understand units, dimensions and the principles of measurement and error analysis applied to engineering.
CLOBJ 2	Acquire fundamental knowledge of electrostatics, current electricity, capacitors and resistors.
CLOBJ 3	Learn the principles of electromagnetism, magnetic materials and electromagnetic induction.
CLOBJ 4	Build foundational knowledge of semiconductor physics, junction diodes, transistors and photovoltaic devices.
CLOBJ 5	Get an introductory exposure to modern physics including lasers, optical fibres and nanotechnology.

f. **Course Learning Outcomes:**

CLO 1	Apply concepts of units, measurements and error analysis to perform accurate physical measurements and validate results using dimensional analysis.
CLO 2	Analyse basic electric and magnetic phenomena including electrostatics, current electricity and electromagnetic induction, and solve related numerical problems.
CLO 3	Interpret the characteristics and functioning of semiconductor devices such as diodes and transistors, and apply them in basic electronic circuits.
CLO 4	Explain the working principles and applications of modern physics tools including lasers, optical fibres and nanotechnology-based devices.
CLO 5	Demonstrate the ability to relate theoretical physics concepts to practical engineering applications across electrical, electronics and communication fields.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					Total
L	T	P	C	T	CE	P	Theory	P	
3	0	2	4	20	20	50	60	-	150

L: Lectures; T: Tutorial; P: Practical; C: Credit; CE: Continuous Evaluation; ESE: End Semester Examination

h. **Course Content:**

Sr. No.	Topics	W (%)	T
1	<p>Physical World, Units and Measurements</p> <p>Physical quantities - fundamental and derived; Units and systems of units (FPS, CGS, SI); Dimensions and dimensional formulae; Principle of homogeneity; Dimensional equations and their applications (unit conversion, checking equations, deriving simple equations); Limitations of dimensional analysis; Measurements - need, measuring instruments, least count, types of measurement (direct and indirect); Errors in measurements (systematic and random); Absolute error, relative error, error propagation, error estimation and significant figures.</p>	15	8
2	<p>Electrostatics and Current Electricity</p> <p>Coulomb's law; Unit of charge; Electric field, electric lines of force and their properties; Electric flux; Electric potential and potential difference; Gauss's law; Capacitor and its working; Types of capacitors; Capacitance and its units; Capacitance of a parallel-plate capacitor; Series and parallel combination of capacitors (numericals); Dielectric and its effect on capacitance, dielectric breakdown; Electric current and its units; DC and AC; Resistance and specific resistance, conductance and specific conductance; Series and parallel combination of resistances; Factors affecting resistance; Carbon resistances and colour coding; Ohm's law and its verification; Kirchhoff's laws; Wheatstone bridge and its applications (slide-wire bridge); Terminal potential difference and EMF; Heating effect of current; Electric power and electric energy (numericals); Advantages of electrical energy over other forms.</p>	25	10
3	<p>Electromagnetism and Magnetic Materials</p> <p>Types of magnetic materials - diamagnetic, paramagnetic and ferromagnetic with their properties; Magnetic field and its units, magnetic intensity, magnetic lines of force, magnetic flux and units, magnetisation; Concept of electromagnetic induction; Faraday's laws; Lorentz force (force on a moving charge in a magnetic field); Force on a current-carrying conductor; Force on a rectangular coil placed in a magnetic field; Moving coil galvanometer - principle, construction and working; Conversion of a galvanometer into ammeter and voltmeter.</p>	20	8
4	<p>Semiconductor Physics</p> <p>Energy bands in solids; Types of materials (insulator, semiconductor, conductor); Intrinsic and extrinsic semiconductors; p-n junction; Junction diode and V-I characteristics; Types of junction diodes; Diode as a rectifier - half-wave and full-wave rectifier (centre-tapped); Transistor - description and three terminals; Types - pnp and npn; Electronic applications (list only); Photocells and solar cells - working principle and engineering applications.</p>	20	10
5	<p>Modern Physics</p>	20	9

	Lasers: Energy levels, ionisation and excitation potentials; Spontaneous and stimulated emission; Population inversion, pumping methods, optical feedback; Types of lasers - Ruby, He-Ne and semiconductor; Laser characteristics; Engineering and medical applications of lasers. Fibre Optics: Introduction to optical fibres; Light propagation; Acceptance angle and numerical aperture; Fibre types; Applications in telecommunication, medicine and sensors. Nanoscience and Nanotechnology: Introduction; Nanoparticles and nanomaterials; Properties at the nanoscale; Nanotechnology and nanotechnology-based devices and applications.		
Total:		100	45

h. List of Practicals:

Sr. No.	Practical Title
1	To measure the length and radius of a given cylinder, test tube and beaker using a Vernier callipers and find the volume of each object.
2	To determine the diameter of a wire, a solid ball and the thickness of cardboard using a screw gauge.
3	To verify Ohm's law by plotting a graph between current and potential difference.
4	To verify the laws of resistances in series and parallel combination.
5	To draw the V-I characteristics of a semiconductor diode (Ge, Si) and determine its knee voltage.
6	To verify Kirchhoff's laws using electric circuits.
7	To determine A.C. frequency with the help of a sonometer.
8	To calculate the SA/V ratio of simple objects to understand nanotechnology.

i. Text Book and Reference Book:

1. Comprehensive Practical Physics - Volumes I and II, By I. N. Jaiswal | Laxmi Publishers.
2. Text Book of Physics for Class XI & XII (Part-I, Part-II), By N.C.E.R.T., Delhi.

Verbal Ability

a. Course Name: Verbal Ability

b. Course Code: 03060002HM01

c. Prerequisite: Basic knowledge of grammar and communication.

d. Rationale: Practical language proficiency and essential soft skills are necessary for academic and professional success. This course strengthens listening, speaking, reading, and writing competence along with logical reasoning and self-assessment skills that learners can apply across diverse professional contexts.

e. Course Learning Objectives:

CLOBJ 1	Develop effective listening, speaking, reading, and writing skills required for academic and professional communication.
CLOBJ 2	Enhance vocabulary and language proficiency through the study of homophones, homonyms, homographs, phrasal verbs, and idioms.
CLOBJ 3	Understand and apply grammatical concepts such as subject–verb agreement and direct–indirect speech in communication.
CLOBJ 4	Improve interpersonal and presentation skills through activities such as product presentations, public speaking, and storytelling.
CLOBJ 5	Develop professional communication skills including formal letter writing and email writing.
CLOBJ 6	Build personality-development, analytical-thinking, and self-assessment skills through SWOT analysis and logical-reasoning activities.

f. Course Learning Outcomes:

After learning the course, the student shall be able to:

CLO 1	Identify and explain the fundamentals of listening skills, vocabulary elements, and basic grammar concepts used in English communication.
CLO 2	Demonstrate effective listening and speaking skills in academic and everyday communication situations.
CLO 3	Apply appropriate vocabulary (homonyms, idioms, phrasal verbs) and grammar rules (subject–verb agreement, direct–indirect speech) in spoken and written communication.
CLO 4	Analyze situations using logical reasoning and SWOT analysis for personal and professional decision-making.
CLO 5	Create structured written and spoken content such as letters, emails, stories, presentations, and short speeches with clarity and appropriate tone.

g. Teaching & Examination Scheme:

Teaching Scheme				Internal Evaluation			ESE		Total
L	T	P	C	MSE	CE	P	Theory	P	
1	0	2	2	40	-	20	60	30	150

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

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1.	Listening Skills – Basic Level Introduction and importance of good listening; Difference between listening and hearing; Types of listening; Barriers to effective listening; Traits of a good listener.	10	1
2.	Crazy Scientist Invent a product; Presentation of a product.	8	1
3.	Advanced Vocabulary Building: Homophones, Homonyms, Homographs, Phrasal Verbs & Idioms Homophones and Their Confusing Pairs; Homographs and Contextual Meaning; Homonyms: Words with Multiple Meanings; Common Phrasal Verbs in Conversation; Popular Idioms and Their Real-life Application.	10	2
4.	Subject–Verb Agreement Basic Rules and Exceptions; Spot the Error & Correction Exercises.	8	2
5.	SWOT Analysis Introduction to SWOT; Creating a Personal SWOT Chart; Applying SWOT for Goal Setting.	10	1
6.	Letter Writing & E-mail Writing Formal vs Informal Letter Format; Structure of a Professional Email (Subject, Greeting, Body, Sign-off); Tone and Language Appropriateness; Common Mistakes in Letters/Emails.	13	2
7.	Direct–Indirect Speech Rules for Changing Tenses, Pronouns, and Time Expressions; Reporting Statements, Questions, Commands, and Requests; Reporting Modal Verbs (can → could, will → would); Conversion Exercises.	8	2
8.	Blood Relations & Alphabetical Series Introduction to Family Tree Terms; Types of Blood Relation Questions; Introduction to Alphabetical Series; Common Patterns in Alphabetical Series.	8	1

Sr. No.	Content	Weightage (%)	Teaching Hours
9.	Story Writing Using Hints Elements of a Story (Characters, Setting, Plot, Conflict, Resolution); Types of Stories (Narrative, descriptive, imaginative, moral-based, fables).	10	1
10.	Speaking Skill Building – Introduction Overcoming Stage Fear and Speaking Anxiety; Voice Modulation and Pronunciation Tips; Organizing Thoughts Before Speaking; Basic Public Speaking Formats (Self-intro, Small Speeches).	15	2
Total		100%	15

i. Text Book and Reference Book:

Sr. No.	Reference
1.	English Grammar in Use — Raymond Murphy Cambridge University Press, 2019.
2.	Word Power Made Easy — Norman Lewis Goyal Publishers, 2014.
3.	A Modern Approach to Logical Reasoning — R. S. Aggarwal S. Chand Publishing, 2018.
4.	Developing the Leader Within You — John C. Maxwell Thomas Nelson, 2013.
5.	Cambridge Listening and Speaking Skills Series — Cambridge University Press, 2017.
6.	The 7 Habits of Highly Effective People — Stephen R. Covey Simon & Schuster, 2020.

Universal Human Values (Mandatory Course - II)

a. Course Name: Universal Human Values

b. Course Code: 03060002MC01

c. Prerequisite: Basic communication and interpersonal skills.

d. Rationale: The Universal Human Values (UHV) course aims to develop a holistic understanding of life, fostering ethical behaviour, responsible decision-making, and harmonious living. It helps students align their personal and professional actions with core human values, ensuring happiness, well-being, and sustainable development in society.

e. Course Learning Objectives:

CLOBJ 1	Understand the concept and importance of value education for holistic human development and continuous happiness.
CLOBJ 2	Develop self-awareness and self-exploration to identify the relationship between human values, behaviour, and ethical living.

CLOBJ 3	Understand harmony within the individual, family, society, and nature for peaceful and sustainable coexistence.
CLOBJ 4	Analyze the role of trust, respect, justice, and responsibility in maintaining healthy human relationships and social harmony.
CLOBJ 5	Develop awareness regarding environmental balance, coexistence, and mutual fulfilment among all forms of nature.
CLOBJ 6	Apply universal human values and professional ethics in personal life, education, workplace, and society.

f. Course Learning Outcomes:

After learning the course, the student shall be able to:

CLO 1	Demonstrate an understanding of the need for human values and value-based education to achieve happiness and prosperity.
CLO 2	Analyze the harmony within the human being, in the family, society, and nature, and apply the concepts for self-regulation and well-being.
CLO 3	Exhibit the ability to identify the role of ethical conduct and trust in human relationships and professional life.
CLO 4	Develop a holistic perspective on sustainable living and social responsibility through self-exploration and real-life applications.
CLO 5	Apply principles of Universal Human Values to make responsible decisions in day-to-day life and professional settings.

g. Teaching & Examination Scheme:

Teaching Scheme				Internal Evaluation			ESE		Total
L	T	P	C	MSE	CE	P	Theory	P	
1	0	0	0	20	20	-	-	-	40

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

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1.	Introduction to Value Education Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education); Understanding Value Education; Self-exploration as the Process for Value Education; Continuous Happiness and Prosperity – the Basic Human Aspirations; Happiness and Prosperity – Current Scenario; Method to Fulfil the Basic Human Aspirations.	20	3

Sr. No.	Content	Weightage (%)	Teaching Hours
2.	Harmony in the Human Being Understanding Human Being as the Co-existence of the Self and the Body; Distinguishing between the Needs of the Self and the Body; The Body as an Instrument of the Self; Understanding Harmony in the Self; Harmony of the Self with the Body; Programme to Ensure Self-regulation and Health.	20	3
3.	Harmony in the Family and Society Harmony in the Family – the Basic Unit of Human Interaction; ‘Trust’ – the Foundational Value in Relationship; ‘Respect’ – as the Right Evaluation; Other Feelings; Justice in Human-to-Human Relationship; Understanding Harmony in the Society; Vision for the Universal Human Order.	20	3
4.	Harmony in the Nature / Existence Understanding Harmony in the Nature; Interconnectedness, Self-regulation and Mutual Fulfilment among the Four Orders of Nature; Realizing Existence as Co-existence at All Levels; The Holistic Perception of Harmony in Existence.	20	3
5.	Implications of the Holistic Understanding – A Look at Professional Ethics Natural Acceptance of Human Values; Definitiveness of (Ethical) Human Conduct; A Basis for Humanistic Education; Humanistic Constitution and Universal Human Order; Competence in Professional Ethics; Holistic Technologies, Production Systems and Management Models – Typical Case Studies; Strategies for Transition towards Value-based Life and Profession.	20	3
Total		100%	15

i. Text Book and Reference Book:

Sr. No.	Reference
1.	Jeevan Vidya – Ek Parichay — A. Nagraj Divya Path Sansthan, Amarkantak, 1998.
2.	Human Values — A. N. Tripathy New Age International Publishers, 2003.
3.	The Story of My Experiments with Truth — M. K. Gandhi.
4.	Small is Beautiful — E. F. Schumacher.

Disaster Management (MOPEC - II)

a. **Course Name:** Disaster Management (MOPEC - II)

b. **Course Code:** 03061502UE01

c. **Prerequisite:** High School Science.

d. **Rationale:** Disaster management is an essential subject for equipping students with the knowledge and skills needed to prevent, prepare for, respond to and recover from disasters efficiently. It contributes to building safer communities and sustainable development.

e. Course Learning Objective:

CLOBJ 1	Understand the basic concepts of hazard, vulnerability, risk and capacity, and the role of disaster management.
CLOBJ 2	Recognise the types, causes and consequences of geological, hydro-meteorological, biological, technological and man-made disasters.
CLOBJ 3	Learn the disaster management cycle including prevention, preparedness, response and recovery phases.
CLOBJ 4	Understand the institutional and policy framework for disaster management in India including the Disaster Management Act 2005.
CLOBJ 5	Appreciate the role of science and technology - RS, GIS, GPS and early-warning systems - in disaster mitigation and response.

f. Course Learning Outcomes:

CLO 1	Define and explain key concepts related to disasters, including hazards, vulnerabilities, risks and disaster management frameworks.
CLO 2	Identify various types of natural, technological and man-made disasters, their causes, impacts and control measures.
CLO 3	Describe and implement disaster management cycles, including risk assessment, preparedness, response and recovery.
CLO 4	Explain the legal and institutional frameworks in India, including the Disaster Management Act, policies and the role of government and non-government agencies.
CLO 5	Apply GIS, remote sensing, early-warning systems and structural mitigation techniques to enhance disaster preparedness and response.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					Total
L	T	P	C	T	CE	P	Theory	P	
3	0	0	3	20	20	-	60	-	100

L: Lectures; T: Tutorial; P: Practical; C: Credit; CE: Continuous Evaluation; ESE: End Semester Examination

h. Course Content:

Sr. No.	Topics	W (%)	T
1	Introduction and Basic Principles of Disaster Management Understanding the concepts and definitions of disaster, hazard, vulnerability, risk and capacity; Disaster and development; Disaster management - concept and scope.	10	3
2	Types, Trends, Causes, Consequences and Control of Disasters Geological disasters (earthquakes, landslides, tsunamis, mining); Hydro-meteorological disasters (floods, cyclones, lightning, thunderstorms, hail storms, avalanches, droughts, cold and heat waves); Biological disasters (epidemics, pest attacks, forest fire); Technological disasters (chemical, industrial, radiological, nuclear); Man-made disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemical and biological disasters); Global disaster trends; Emerging risks - climate change and urban disasters.	20	10
3	Disaster Management Cycle and Framework Basics of the disaster management cycle; Paradigm shift in disaster management; Understanding risk; Prevention and reduction of disaster impact; Early-warning systems; Awareness and capacity building; Search and rescue operations in disaster situations; Relief and rehabilitation after a disaster; Assessing damage and restoring infrastructure; Reconstruction and redevelopment.	30	12
4	Disaster Management in India Disaster profile of India; Mega disasters of India and lessons learnt; Disaster Management Act 2005; Institutional and financial mechanism; National policy on disaster management; National guidelines and plans; Role of government (local, state, national), non-government and inter-governmental agencies.	20	10
5	Applications of Science and Technology for Disaster Management Geo-informatics in disaster management (RS, GIS, GPS); Disaster communication system - early warning and its dissemination; Land-use planning and development regulations; Disaster-safe designs and constructions; Structural and non-structural mitigation of disasters; S&T institutions for disaster management in India.	20	10
Total:		100	45

i. Text Book and Reference Book:

1. Disaster Management Guidelines, By GOI-UNDP Disaster Risk Reduction Programme (2009-2012).
2. Environment Engineering and Disaster Management, By Sanjay K. Sharma | Laxmi Publications, New Delhi.
3. Handbook of Disaster Management: Techniques and Guidelines, By B. K. Singh.
4. Disaster Management, By G. K. Ghosh.