JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

(Established by Andhra Pradesh Act No.30 of 2008)

Kakinada – 533 003, Andhra Pradesh (India)

JNT University, Kakinada
B.Tech., Civil Engineering

B.Tech. – I Year I Semester

S.No.	Course Category	Course Code	Title	L	T	P	Credits
1	HSM		English for Technical Communication	3	0	0	3
2	BSC		Linear Algebra and Calculus	3	0	0	3
3	BSC		Chemistry for Civil Engineers	3	0	0	3
4	ESC		Computational Thinking and Problem Solving with Python	3	0	0	3
5	ESC		Design Thinking and Innovation	0	1	3	2.5
6	HSM		English for Technical Communications and MOODLES Laboratory	0	0	3	1.5
7	BSC		Chemistry for Civil Engineers Lab	0	0	3	1.5
8	ESC		Computational Thinking and Problem Solving with Python Lab	0	0	3	1.5
9	ESC		Workshop Practice	0	0	3	1.5
10	MNC		NSS/NCC	0	0	2	0
		Total		**12**	**1**	**17**	**20.5**

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

S.No.	Course Category	Course Code	Title	L	T	P	Credits
1	BSC		Differential Equations and Vector Calculus	3	0	0	3
2	BSC		Physics for Civil Engineers	3	0	0	3
3	ESC		Fundamentals of Quantum computing	3	0	0	3
4	ESC		Basic Electrical and Electronics Engineering	3	0	0	3
5	ESC		Engineering Geology	2	0	0	2
6	ESC		AI Tools and Applications	0	1	3	2.5
7	ESC		Engineering graphics Lab	0	1	3	2.5
8	ESC		Engineering Geology Lab	0	0	2	1
9	BSC		Physics for Civil Engineers Lab	0	0	3	1.5
10	MNC		Environmental Science for Engineers	2	0	0	0
		Total		**16**	**2**	**11**	**21.5**

I year B.Tech. I Semester

Course Code	English for Technical Communications	Category HSM	L-T-P-C 3-0-0-3

Pre-requisites: NIL

Course Objectives:

- Listen the authentic texts to comprehend and respond appropriately as both audience and conversant;
- Communicate in academic and social (formal) contexts with reasonable fluency and accuracy (neutral accent, social and grammatical appropriateness);
- Comprehend the texts of various types for academic, technical and career purposes;
- Write for academic and professional purposes;
- Communicate across cultures that requires a blend of cognitive, interpersonal, and linguistic skills

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

CO1: Comprehend specific information, context, and central ideas from social, academic, or workplace conversations and audio-visual material. (K2)

CO2: Apply appropriate social norms to bridge the gaps and collaborate effectively across diverse cultural backgrounds (K3)

CO3: Examine discourse features and speech strategies to participate effectively in group discussions, informal exchanges, and short presentations on technical and general topics. (K4)

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

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

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

UNIT –I

Effective Communication: Exploring Channels and Methods

Vocabulary: Roots, Prefixes, and Suffixes Homonyms

Grammar: Articles, Prepositions, Tenses.

Reading: Definition and Importance, Skills and Sub-Skills of Reading

Writing: Cohesion and Coherence, Paragraph Writing.

Listening: Listening for main ideas and supporting details, Note-taking

Speaking: Introducing self and others, Describing people and objects, JAM.

UNIT-II

Eco-Consciousness: Negotiating for a Sustainable Future

Vocabulary: Contractions, Phrasal Verbs, Idioms & Phrases

Grammar: Subject-Verb Agreement, Conditional Sentences

Reading: Reading for Inference, Point of View, Tone and Perspective.

Writing: Note making, Summarizing, Paraphrasing.

Listening: Listening to various texts and comprehension
Speaking: Role-plays, Extempore.

UNIT-III

Disruptive Technologies: Ethical Implications and Future Prospects
Vocabulary: One-Word Substitutes, Commonly Confused Words
Grammar: Degrees of Comparison, Active and Passive Voice, Question Tags.
Reading: Reading the extracts/articles/ essays of the News Papers, Journals and literary texts.
Writing: Paraphrasing, Letter Writing
Listening: Listening to stories, news, documentaries and discussions.
Speaking: Debate, Group Discussions

UNIT-IV

Entrepreneurship and Start-Up Culture: Emerging Trends
Vocabulary: Business/ Profession/ Career/ Job-related Vocabulary.
Grammar: Sentence Synthesis, Simple, Compound and Complex Sentences.
Reading: Reading various texts for global understanding
Writing: Email Writing, Data Interpretation, Report Wrtiting
Listening: Listening to debates and discussions.
Speaking: Power Point Presentations by Individuals and Teams.

UNIT-V

Ethical Leadership: Integrating Social Responsibility and Core Values
Vocabulary: Advanced Vocabulary for GRE/TOEFL/ IELTS/CAT etc.
Grammar: Sentence Synthesis, Para Jumbles.
Reading: Reading texts for global comprehension.
Writing: Book/Film Reviews, Social Media Etiquette
Listening: Listening to the talks/speeches by the eminent personalities
Speaking: Team Discussions and Presentations

Learning Resources:

Textbook:

1. Chekuri, T., & Perumalla, R. K. (2026). NextGen English for engineers: A course book for technical English communication. Cengage.
2. Coelho, P. (2020). The alchemist. HarperCollins. (Non-Detailed Text)

Reference Books:

1. Technical Communication (2nd Ed.) by M. Raman & S. Sharma. Oxford University Press, 2012.
2. Effective Technical Communication by M.A. Rizvi, Tata McGraw-Hill, 2005.
3. English for Engineers and Technologists, Orient Blackswan 2010 (Combined edition, Vol.1 &2).
4. The Oxford Guide to Writing and Speaking by John Seely, Oxford University Press, 2004.

Web Resources:

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

Course Code	LINEAR ALGEBRA AND CALCULUS	Category BSC	L-T-P-C 3-0-0-3

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

Course Objectives:

- The main objective of this course is to provide the learner with variety of linear algebra techniques to solve linear systems, orthogonal representation of the quadratic surfaces and apply its knowledge in optimization problems.
- It aims further to calculate areas, surfaces and volumes in various coordinate systems.

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

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

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

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

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

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

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

UNIT-I

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

UNIT-II

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

UNIT-III

Calculus: Mean Value Theorems: Rolle's Theorem, Lagrange's mean value theorem with their geometrical interpretation, Cauchy's mean value theorem, Taylor's and Maclaurin theorems with remainders (without proof), Problems and applications on the above theorems. Taylor's and Maclaurin series.

UNIT-IV

Partial Differentiation and Applications (Multi Variable Calculus): Functions of several variables: Continuity and Differentiability, Partial derivatives, Total derivatives, Chain rule, Euler's Theorem, Taylor's and Maclaurin's series

expansion of functions of two variables. Jacobians, Functional dependence, Maxima and Minima of functions of two variables without constraints and with Constraints-Method of Lagrange multipliers.

UNIT-V

Multiple Integrals: Double integrals, Change of order of integration, Triple integrals, Change of variables from Cartesian to polar, Cylindrical and Spherical coordinates. Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

Learning Resources:

Text Books:

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

Reference Books:

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

Web Resources:

1. https://en.wikipedia.org/wiki/System_of_linear_equations
2. https://en.wikipedia.org/wiki/Eigenvalues_and_eigenvectors
3. https://www.math.hmc.edu/calculus/tutorials/eigenstuff/
4. https://en.wikipedia.org/wiki/Quadratic_form
5. https://en.wikipedia.org/wiki/Calculus
6. https://en.wikipedia.org/wiki/Partial_derivative
7. https://www.whitman.edu/mathematics/calculus_online/section14.03.html
8. https://en.wikipedia.org/wiki/Multiple_integral
9. http://tutorial.math.lamar.edu/Classes/CalcIII/MultipleIntegralsIntro.aspx

Course Code	Chemistry for Civil Engineers	Category ESC	L-T-P-C 3-0-0-3

Pre-requisite: NIL

Course Objectives

- To understand water chemistry parameters relevant to civil engineering applications and to design and evaluate water and wastewater treatment processes.
- To understand electrochemical principles governing corrosion in civil engineering structures and to evaluate corrosion-prevention and protection methods for infrastructure.
- To understand the chemical composition and hydration reactions of cement and concrete and to analyze the role of admixtures and their effects on concrete properties.
- To understand the chemistry, properties, and applications of polymers in civil engineering and to analyze composite materials used in modern construction.
- To understand principles of green chemistry for sustainable civil engineering practice and to evaluate impacts of construction materials and processes.

Course Outcomes (COs)

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

CO1: Analyze important water quality parameters and explain principles of water, boiler feed water and wastewater treatment methods relevant to civil engineering applications. (K2, K3)

CO2: Analyze electrochemical principles governing corrosion and evaluate corrosion-control methods, including cathodic protection, protective coating and corrosion inhibitors for civil engineering structures. (K3, K4)

CO3: Explain composition and hydration chemistry of Portland cement and analyze the role of aggregates, admixtures and special cement and heat treatment process of engineering steels. (K3, K4)

CO4: Classify polymers and explain polymerization mechanisms, properties and applications of engineering polymers, elastomers, and fibre-reinforced polymer composites in civil engineering. (K4, K5)

CO5: Apply green chemistry principles to assess the environmental impacts of construction materials and processes, evaluate sustainable alternatives for reducing pollution and carbon emission in civil engineering projects. (K5, K6)

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

UNIT 1: Water Chemistry and Treatment: 10hrs

Water chemistry: Hardness of water (temporary and permanent), units, estimation of hardness by EDTA method, Boiler troubles (scale and sludge formation, boiler corrosion, caustic embrittlement; priming and foaming)

Internal treatment of boiler feed water (phosphate conditioning, calgon conditioning and treatment with sodium aluminate), External treatment [Lime soda process, zeolite process, ion-exchange (demineralization)], Desalination process (Electrodialysis, reverse osmosis)

Specifications for drinking water: [Bureau of Indian Standards (BIS) and World health organization (WHO) standards, Domestic water treatment [screening, sedimentation, coagulation-flocculation (alum, ferric chloride, polyelectrolytes), filtration, disinfection (chlorination, breakpoint chlorination, ozonation, UV treatment)].
Wastewater treatment: Primary, secondary (activated sludge, trickling filters) and tertiary treatment.

UNIT II: Chemistry of Construction Materials: 9hrs

Chemistry of cement: Portland cement composition (C_3S, C_2S, C_3A, C_4AF), Setting and hardening mechanism, Special types of cement (high-alumina cement, high-early-strength cement, silicate cement, Sorel cement).
Chemistry of concrete: Role of aggregates, water–cement ratio, workability.
Chemical admixtures: Plasticizers, retarders, accelerators, air-entraining agents; chemistry of lime, gypsum and clay materials.
Steel chemistry: Composition and applications, alloying elements; heat treatment — annealing, normalizing, hardening, tempering, age hardening.

UNIT III: Electrochemistry and Corrosion: 9hrs

Electrochemical Principles: Electrode potential, Electrochemical series, Nernst equation, Conductance and conductometric titrations.
Batteries: Li-ion, sodium-ion batteries, Fuel cell: Hydrogen-oxygen fuel cell
Types of corrosion: Chemical corrosion and Pilling–Bedworth rule; electrochemical corrosion; concentration-cell corrosion; pitting, galvanic and stress corrosion, Galvanic series, Factors affecting the rate of corrosion.
Corrosion-prevention methods: Cathodic protection (sacrificial anode and impressed-current), anodic protection, protective coatings (galvanizing, electroplating, electroless plating, tinning, metal cladding); corrosion inhibitors.

UNIT IV: Engineering Polymers and Composite Materials: 10hrs

Polymer Chemistry: Polymerization mechanisms (addition, condensation); classification (thermoplastics, thermosets), engineering polymers: HDPE, PVC, polypropylene, epoxy resins, polyurethane, and their construction applications.
Elastomers: Natural rubber, vulcanization, synthetic rubbers (BUNA-S and BUNA-N) and their applications in civil engineering (bearings, joints, waterproofing).
Composite Materials: Matrix and reinforcement; types (polymer-matrix, metal-matrix, ceramic-matrix composites).
Fibre-reinforced Polymers (FRP): Glass fiber, carbon fiber, aramid fiber; applications in structural strengthening and rebar replacement.

UNIT V: Green Chemistry: Principles of green chemistry and their applications in construction.
Sustainable Construction Materials: geopolymer concrete; Carbon capture in cement industry (definition, advantages, challenges); Industrial waste utilization (common industrial wastes (fly ash, GGBS, Steel slag), applications, benefits, challenges); Construction and demolition waste recycling (common C& D waste, Recycling process, applications, advantages); Recycled aggregates (definition, types, applications, advantages, limitations); Plastic waste in roads (definition, types of plastics used, process, advantages, limitations); Low-carbon concrete (definition, methods, advantages, challenges); Net-zero buildings (features, benefits, challenges)

Textbooks

1. Jain, P. C., & Jain, M. (2020). Engineering Chemistry (17th ed.). Dhanpat Rai Publishing Company.
2. Shikha, A., & Sharma, R. K. (2019). Engineering Chemistry. Krishna Prakashan Media.

Reference Books

1. Davis, M. L. (2020). Water and Wastewater Engineering: Design principles and practice (2nd ed.). McGraw-Hill Education.
2. Dara, S. S., & Umare, S. S. (2018). Engineering Chemistry (15th ed.). S. Chand Publishing.

Web Resources

- American Concrete Institute. (2021). ACI 222R-01: Protection of metals in concrete against corrosion. https://www.concrete.org
- Bureau of Indian Standards. (2012). IS 456:2000 — Plain and reinforced concrete — Code of practice. https://www.services.bis.gov.in
- U.S. Environmental Protection Agency. (2023). Green chemistry. https://www.epa.gov/greenchemistry
- World Health Organization. (2022). Guidelines for drinking-water quality (4th ed.). https://www.who.int/publications/i/item/9789241549950
- Indian Green Building Council. (2023). LEED India rating systems. https://igbc.in/igbc

Course Code	Computational Thinking and Problem Solving Using Python	Category ESC	L-T-P-C 3-0-0-3

Pre-requisite: NIL

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

- Establish computational thinking , decomposition, pattern recognition, abstraction, and algorithmic reasoning as the foundation for problem-solving, with strong grounding in algorithm design and flowchart construction.
- Develop proficiency in Python control structures while explicitly linking conditionals to abstraction and loops to pattern recognition.
- Build competence in selecting Python data structures (strings, lists, tuples, dictionaries) as an exercise in abstraction and pattern-based organization of information.
- Train students to decompose problems into functions and recursive sub-problems, reason informally about algorithmic efficiency, and use AI coding assistants responsibly.
- Equip students with file handling, exception handling, and basic data analysis/visualization skills framed as decomposing a larger data workflow into manageable, robust steps and to integrate these skills in a capstone mini-project.

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

CO1: Explain the principles of computational thinking and interpret algorithms and flowcharts that represent problem-solving logic.(K2)

CO2: Apply pattern recognition and abstraction, via Python control structures, to implement step-by-step algorithmic solutions (K3)

CO3: Analyze problems to select and manipulate appropriate data structures (strings, lists, tuples, dictionaries) as an abstraction and organization exercise (K4)

CO4: Evaluate the correctness and efficiency of decomposed, modular algorithms and Python programs through tracing, testing, debugging, and exception handling (K5)

CO5: Create modular, well-structured Python programs by decomposing problems into functions, recursion, file handling, and data analysis, culminating in an integrative capstone project (K6)

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

UNIT – 1: Computational Thinking, Algorithm Design & Flowcharting

Computational thinking pillars - decomposition, pattern recognition, abstraction, algorithmic thinking, and the problem-solving process. Algorithm design - characteristics of a good algorithm, stepwise refinement, pseudocode. Flowcharts - standard symbols, construction rules, and manual tracing for verification.

Translating algorithms and flowcharts into Python code - variables, data types, operators, and input/output.

Introduction to good coding practice - docstrings, inline comments, and print-based debugging, threaded through every unit from here on

UNIT – 2: Control Structures

Conditional statements - as abstraction over multiple cases.

Loops (for, while) - as pattern recognition of repetition.

Nested loops and loop control (break, continue, pass) - as decomposition of complex repetitive logic.

UNIT – 3: Data Structures — Strings, Lists, Tuples & Dictionaries

Strings - pattern matching and abstraction of text as a sequence.
Lists - abstraction of ordered, mutable collections.
Tuples and dictionaries - abstraction of fixed and key-based data
UNIT – 4: Functions & Modular Programming
Functions - decomposition of a program into independent, reusable sub-problems.
Recursion - algorithmic thinking applied to self-similar sub-problems.
Basic algorithmic efficiency - informal comparison of iterative vs. recursive approaches and their time trade-offs.
Modules and built-in libraries, including responsible AI-assisted coding practices.
UNIT – 5: File Handling, Exception Handling, Data Analysis & Capstone Project
File handling - decomposition of a data workflow into read/process/write stages.
Exception handling - abstraction of error cases into predictable, manageable patterns.
Introduction to data analysis and visualization (NumPy/Pandas/Matplotlib basics) - pattern recognition in real datasets.
Capstone integration - combining all prior units into one end-to-end project.

Learning Resources:
Text Books:

1. Downey, A. B. (2015). Think Python: How to think like a computer scientist (2nd ed.). O'Reilly Media.
2. Guttag, J. V. (2021). Introduction to computation and programming using Python: With application to computational modeling and understanding data (3rd ed.). MIT Press.

Reference Books:

1. Sweigart, A. (2025). Automate the boring stuff with Python: Practical programming for total beginners (3rd ed.). No Starch Press.
2. McKinney, W. (2022). Python for data analysis: Data wrangling with pandas, NumPy, and Jupyter (3rd ed.). O'Reilly Media.
3. Wing, J. M. (2006). Computational thinking. Communications of the ACM, 49(3), 33–35. https://doi.org/10.1145/1118178.1118215

Web References:

1. Python Software Foundation. (n.d.). The Python tutorial. https://docs.python.org/3/tutorial/
2. W3Schools. (n.d.). Python tutorial. https://www.w3schools.com/python/
3. NPTEL. (n.d.). Programming, data structures and algorithms using Python. https://nptel.ac.in

Course Code	Design Thinking and Innovation	Category ESC	L-T-P-C 0-1-3-2.5

Pre-requisites: NIL

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

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

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

CO1: Explain the principles, processes and mindset of Design Thinking for engineering problem-solving and innovation (K2)

CO2: Apply empathy, observation and problem-framing techniques to identify user needs and define engineering problems (K3)

CO3: Apply creative and systematic ideation techniques to generate and select innovative solution concepts (K3)

CO4: Analyze solution concepts and prototypes using user feedback and appropriate design criteria for iterative improvement (K4)

CO5: Analyze the innovation potential of solutions considering value proposition, feasibility, sustainability, societal impact and basic IPR aspects (K4)

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

UNIT I — Design Thinking Foundations & Empathy

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

Practical Activities

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

Unit Outcome

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

UNIT II — Problem Definition, Analysis & Opportunity Identification

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

Practical Activities

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

Unit Outcome

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

UNIT III — Creativity, Ideation & Concept Development

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

Practical Activities

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

Unit Outcome

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

UNIT IV — Prototyping, Experimentation & Validation

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

Practical Activities

- Develop a low-fidelity prototype
- Prepare a storyboard
- Build a physical/digital prototype
- Conduct user testing
- Collect structured feedback

- Modify the prototype
- Prepare an iteration log

UNIT V — Innovation, Value Creation & Communication

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

Practical Activities

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

Learning Resources:

Textbook:

1. Chandan Adhikari, Prabir Kumar Das & Tanay Pramanik, Textbook of Design Thinking and Innovation, S. Chand Publishing, 2026.
2. Shalini Rahul Tiwari & Rohit Rajendra Swarup, Design Thinking: A Comprehensive Textbook, Wiley India, 2024

Reference Books:

1. Soni, Pavan, Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-Solving, Penguin Random House India.
2. Jauhari, Vinnie & Sudhanshu Bhushan, Innovation Management, Oxford University Press India.

Web Resources:

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

Course Code	English for Technical Communications and MOODLES Laboratory	Category HSM	L-T-P-C 0-0-3-1.5

Part – A

Course Objectives:

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

Course Outcomes:

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

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

CO2: Apply appropriate reading strategies to interpret content/material related to engineering and technology domain.

CO3: Participate in discussions and presentations on general and technical topics.

CO4: Possess an ability to write clearly on topics related to technology and workplace communication.

CO5: Choose functional language, cohesive devices and skills of organization to express clearly in speaking.

CO6: Demonstrate proficiency in using Moodle LMS and digital learning tools to access learning resources, manage academic activities, submit assignments, participate in quizzes and discussions, and organize learning effectively.

CO7: Apply digital communication, academic, research, and presentation skills while demonstrating academic integrity, responsible use of AI and digital technologies, and professional online behaviour.

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

List of Experiments for the subject English for Technical Communication Lab

(Any 10 experiments in Part A)

1. Phonetics & Accent Neutralisation

- Sound Lab Drills — Students record minimal pairs (/p/–/b/, /t/–/d/) and compare waveforms using free apps like Voice Recorder.
- Pronunciation Clinics — Peer-correction circles where each student reads a short passage focusing on stress and intonation.
- IPA Treasure Hunt — Give IPA transcriptions; students identify the words and pronounce them.
- Shadowing Practice — Students mimic short clips (newsreader, documentary narrator) to reduce mother-tongue influence.

2. Introducing Self and Others
   - Speed Networking — Students rotate every 2 minutes and introduce themselves to a new partner.
   - Identity Cards — Each student prepares a "professional identity card" and introduces another student using it.
   - Role-based Introductions — Introduce yourself as a student, intern, job applicant, club member, etc.

3. Brief Talk in Formal/Informal Contexts, JAM/Extempore
   - JAM Box — A box with random topics; students pick one and speak for 60 seconds.
   - Context Switch — Students speak on the same topic twice: once formally (seminar), once informally (friends).
   - Prompt Cards — Situational prompts: "Convince your friend to join a club", "Address a class meeting".

4. Listening Comprehension
   - Audio Quizzes — Play short clips (announcements, interviews) and ask MCQs.
   - Gap-fill Listening — Provide partially blank transcripts; students fill missing words.
   - Error Spotting — Students listen to a narration and identify factual inconsistencies.

5. Audio-based Note Taking & Narrating Events
   - Event Reconstruction — Play an audio describing an incident; students reconstruct the event in 5–6 bullet points.
   - Timeline Creation — Students listen to a process or story and create a chronological timeline.
   - Peer Narration — One student listens to an audio; narrates it to a partner who writes notes.

6. Process Description & Paragraph Writing (Technical Lab Context)
   - Lab-to-Paragraph — After a lab experiment, students write a process description using sequence markers.
   - Flowchart to Paragraph — Provide a technical flowchart; students convert it into a coherent paragraph.
   - Reverse Engineering — Give a paragraph; students convert it back into steps and check accuracy.

7. Group Discussions & Deliberations – Coming to Consensus
   - Consensus Challenge — Groups must agree on one solution to a problem (e.g., "Best way to reduce campus waste").
   - Fishbowl GD — Inner circle discusses; outer circle observes and gives feedback.
   - Ranking Task — Groups rank items (e.g., skills for employability) and justify their consensus.

8. Micro Presentations (2–5 minutes)
   - One-Slide Presentation — Students prepare a single slide and speak for 3 minutes.
   - Teach a Concept — Students explain a simple technical idea (e.g., "How Wi-Fi works").
   - Object Talk — Students bring an object and present its use, history, or mechanism.

9. Explaining Concepts – Technical Text-based
   - Concept Simplification — Students take a technical paragraph and rewrite it for a layperson.

- Peer Teaching — Each student teaches a concept from their discipline to a partner from another discipline.
- Diagram Explanation — Provide a technical diagram; students explain it verbally.

10. Presenting Logical Arguments – Debates
    - Two-Minute Debates — Quick debates with timed arguments and rebuttals.
    - Evidence Hunt — Students gather data or examples to support their stance before debating.
    - Role-based Debates — Students debate from assigned roles (environmentalist, policymaker, student).

11. Talking About Social Issues & Data Interpretation
    - Data Talk — Provide charts/graphs (literacy rates, pollution levels); students interpret and present insights.
    - Issue Circles — Groups discuss a social issue and propose one actionable solution.
    - Poster-to-Speech — Students convert an infographic into a 2-minute talk.

12. Interviews – Formal & Semi-formal
    - Mock Interview Panels — Students face a panel of peers acting as interviewers.
    - Resume-based Q&A — Students ask each other questions based on their resumes.
    - Situational Interviews — Semi-formal scenarios: club membership, internship, volunteer role.

Lab Manual

- Propel: A Course Book for Technical English Communication. Cengage Publishers, 2026.

Reference Books:

1. Raman Meenakshi,Sangeeta-Sharma.TechnicalCommunication.OxfordPress.2018.
2. Taylor Grant: English Conversation Practice,Tata McGraw Hill Education India,2016.
3. Hewing's, Martin. Cambridge Academic English (B2).CUP, 2012.
4. J.Sethi & P.V.Dhamija. A Course in Phonetics and Spoken English, (2ndEd), Kindle, 2013
5. Richards, Jack C., Jonathan Hull, and Susan Proctor. Interchange Level 3 Student's Book with Self-study DVD-ROM. Vol. 3. Cambridge University Press, 2012.

Web Resources:

1. www.esl-lab.com
2. www.englishmedialab.com
3. www.englishinteractive.net
4. https://www.britishcouncil.in/english/online
5. http://www.letstalkpodcast.com
6. https://www.youtube.com/c/mmmEnglish_Emma/featured
7. https://www.youtube.com/c/ArnelsEverydayEnglish/featured
8. https://www.youtube.com/c/engvidAdam/featured
9. https://www.youtube.com/c/EnglishClass101/featured
10. https://www.youtube.com/c/SpeakEnglishWithTiffani/playlists
11. https://www.youtube.com/channel/UCV1h_cBE0Drdx19qkTM0WNw
12. https://www.youtube.com/user/letstalkaccent/videos
13. https://www.youtube.com/c/EngLanguageClub/featured
14. https://www.youtube.com/channel/UC_OskgZBoS4dAnVUgJVexc

15. https://www.youtube.com/channel/UCNfm92h83W2i2ijc5Xwp_IA

Part B

(Any 4 Experiments in Part B)

Moodle Learning Management System: Digital learning an Academic Skills

Course Objectives

- To become familiar with model LMS and on-line learning
- To develop basic Digital and Academic Skills needed for Engineering students
- To learn effective on-line communication and collaboration
- To develop skills in Assignments, Quizzes, Presentation and Refreshing
- To practice Academic Integrity and Responsible use of Digital Technology

Moodle Learning Management System: Digital learning to enhance Academic Skills. Students familiarize with model LMS and on-line learning, communication and collaboration. They develop skills in Assignments, Quizzes, Presentation and online interviews. They exercise academic Integrity and responsible use of Digital Technology. They adopt the usage of Grammarly, ChatGPT, CultureWizard, Quizlet AI and Google Speech – to-text to enhance their respective skills.

List of Experiments

1. **Introduction to Moodle LMS**
   - Introduction to Moodle
   - Student login and profile management
   - Moodle dashboard and course navigation
   - Accessing announcements and course materials
   - Notifications and calendars

2. Learning Through Moodle

- Accessing PDFs, videos, web resources, and lecture materials
- Downloading and organizing study materials
- Moodle lessons and learning activities
- Tracking course completion
- Managing deadlines and study schedules

3. Assignments, Quizzes and Assessments

- Understanding assignment instructions
- Creating and uploading assignments
- File formats and file naming
- Online quizzes and question types
- Viewing marks and teacher feedback
- Resubmission and revision

4. Digital Communication and Collaboration

- Moodle forums and discussions
- Academic email etiquette

- Online communication and netiquette
- Group activities and peer learning
- Collaborative learning tools
- Digital presentation skills

5. Academic Skills for Engineering Students

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

6. Academic honesty

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

7. Students can complete activities such as:

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

Course Code	Chemistry for Civil Engineers Laboratory	Category BSC	L-T-P-C 0-0-3-1.5

Pre-requisite: NIL

Course Objectives:

- To impart practical knowledge of volumetric and instrumental methods for analyzing water quality parameters (hardness, alkalinity, dissolved oxygen, BOD, conductivity, pH).
- To familiarize students with electroanalytical techniques (conductometry, potentiometry) for acid-base and redox titrations.
- To introduce synthesis of industrially important polymers and photocatalytic methods for environmental remediation.
- To train students in testing and characterizing construction materials (cement), synthesizing industrially important polymers and photocatalytic methods for environmental remediation.

Course Outcomes (COs)

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

CO1: Determine water quality parameters — hardness, alkalinity, dissolved oxygen, and BOD — using standard titrimetric and volumetric methods. (K3)

CO2: Measure conductivity and pH of water/soil samples and perform conductometric and potentiometric titrations to determine acid-base and redox characteristics. (K3)

CO3: Apply photocatalytic degradation techniques for dye removal, demonstrating a chemistry-based approach to wastewater treatment. (K4)

CO4: Assess the quality of cement through iron content estimation, fineness (sieve analysis), and setting time (Vicat apparatus) tests.(K3)

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

LIST OF EXPERIMENTS

(Any **TEN** of the following listed experiments)

(Out of which any **TWO** experiments may be conducted in virtual mode)

1. Determination of total hardness of a water sample by the EDTA titrimetric method.
2. Determination of alkalinity of a water sample by acid titration.
3. Determination of dissolved oxygen (DO) in a water sample by Winkler's method.
4. Determination of conductivity of water and soil samples using conductivity meter.
5. Conductometric titration of a strong acid against a strong base.
6. Determination of the corrosion rate of a mild-steel specimen by the weight-loss method.
7. Study of galvanic corrosion using a zinc–iron electrochemical couple.
8. Determination of percentage of iron in cement sample by colorimeter.
9. Preparation and study of a urea-formaldehyde/phenol-formaldehyde resin sample.
10. Determination of the thickness of an electroplated coating (copper/nickel) using Faraday's law.
11. Determination of the fineness of cement by sieve analysis.
12. Determination of the setting time (initial and final) of cement using a Vicat apparatus.
13. Potentiometric titration of a strong acid against a strong base.
14. Determination of strength of an acid in Pb-Acid battery.

15. Photocatalytic degradation of dye.
16. Redox titration using potentiometer.
17. Determination of pH of water and soil samples using a pH meter.
18. Determination of the Biochemical Oxygen Demand (BOD) of a wastewater sample.

References:

1. Vogel, A. I. (2012). Vogel's textbook of quantitative chemical analysis (6th ed.). Pearson Education.
2. Ahluwalia, V. K., & Dhingra, S. (2017). Comprehensive practical organic chemistry. Universities Press.
3. Virtual Labs, Ministry of Education, Government of India. https://vlab.co.in

Course Code	Computational Thinking and Problem Solving Using Python Laboratory	Category ESC	L-T-P-C 0-0-3-1.5

Pre-requisite: NIL

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

- Establish computational thinking, decomposition, pattern recognition, abstraction, and algorithmic reasoning as the foundation for problem-solving, with strong grounding in algorithm design and flowchart construction.
- Develop proficiency in Python control structures while explicitly linking conditionals to abstraction and loops to pattern recognition.
- Build competence in selecting Python data structures (strings, lists, tuples, dictionaries) as an exercise in abstraction and pattern-based organization of information.
- Train students to decompose problems into functions and recursive sub-problems, reason informally about algorithmic efficiency, and use AI coding assistants responsibly.
- Equip students with file handling, exception handling, and basic data analysis/visualization skills framed as decomposing a larger data workflow into manageable, robust steps and to integrate these skills in a capstone mini-project.

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

CO1: Explain the principles of computational thinking and interpret algorithms and flowcharts that represent problem-solving logic (K2)

CO2: Apply pattern recognition and abstraction, via Python control structures, to implement step-by-step algorithmic solutions (K3)

CO3: Analyze problems to select and manipulate appropriate data structures (strings, lists, tuples, dictionaries) as an abstraction and organization exercise (K4)

CO4: Evaluate the correctness and efficiency of decomposed, modular algorithms and Python programs through tracing, testing, debugging, and exception handling (K5)

CO5: Create modular, well-structured Python programs by decomposing problems into functions, recursion, file handling, and data analysis, culminating in an integrative capstone project (K6)

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

Week 1 (Unit 1):

(1) Find the largest of three numbers.

(2) Check whether a given year is a leap year.

Week 2 (Unit 1):

(1) Compute simple interest given principal, rate, and time.

(2) Compute the area and perimeter of a rectangle from user input.

(3) Swap two numbers without using a third variable.

Week 3 (Unit 2):

(1) Determine whether a number is positive, negative, or zero.

(2) Check if a given number is prime

(3) Convert temperature between Celsius and Fahrenheit based on user choice

(4) Determine BMI category (underweight/normal/overweight/obese) using elif.
(5) Classify a triangle as equilateral, isosceles, or scalene.

Week 4 (Unit 2):

(1) Print all Armstrong numbers between 1 and 1000.
(2) Generate the Fibonacci series up to n terms using a loop
(3) Find the GCD and LCM of two numbers using a while loop
(4) Simulate a simple ATM PIN-entry system allowing a maximum of 3 attempts.
(5) Find the first n prime numbers using nested loops with break.

Week 5 (Unit 3):

(1) Encrypt a message using a Caesar cipher.
(2) Check if two given strings are anagrams of each other.
(3) Check whether a given string is a palindrome using slicing and string methods
(4) Count vowels, consonants, digits, and spaces in a given string

Week 6 (Unit 3):

(1) Find the second-largest element in a list of exam scores.
(2) Merge two sorted lists of student roll numbers into a single sorted list.
(3) Generate squares of all even numbers from 1 to 50 using list comprehension.
(4) Store and retrieve student records using a dictionary (roll number as key, tuple of name/marks as value)

Week 7 (Unit 3):

(1) Store coordinates (x, y) as tuples in a list and compute the distance between consecutive points.
(2) Count the frequency of each word in a paragraph using a dictionary
(3) Maintain an inventory system (item name as key, tuple of price and quantity as value) that updates stock after each transaction.

Week 8 (Unit 4):

(1) Using a function, check if a number is "perfect," and list all perfect numbers up to 10,000.
(2) Using *args, compute the total resistance of resistors in series or parallel.
(3) Define a function with default/keyword arguments to compute the area of different shapes based on shape type and use it.
(4) Write a function that returns the mean, median, and mode of a list of numbers

Week 9 (Unit 4):

(1) Compute the GCD of two numbers recursively using the Euclidean algorithm.
(2) Compute factorial using recursion
(3) Solve the Tower of Hanoi problem for n disks recursively and count the number of moves.
(4) Compute the range and maximum height of a projectile given initial velocity and angle, using the math module.

Week 10 (Unit 5):

(1) Count the words, lines, and characters in a given text file.
(2) Read a log file of sensor readings and append a new set of readings with a timestamp.
(3) Read a text file of daily temperature readings and write the maximum, minimum, and average to an output file

Week 11 (Unit 5):

(1) Build a simple calculator that gracefully handles ZeroDivisionError, ValueError, and invalid operators.

(2) Safely compute the roots of a quadratic equation using try-except-finally, abstracting invalid input and division-by-zero into predictable, handled error patterns.
(3) Read a CSV of student marks and write the names of students scoring above 75% to a new file
(4) Validate user input for a unit-conversion tool and raise a custom exception for out-of-range values.
(5) Using Pandas, read a CSV of daily electricity consumption and plot a line graph over a month, recognizing weekday/weekend consumption patterns.

Week 12 (Unit 5):

(1) Capstone Mini-Project: "Dataset Health-Check & Insights Tool" — decompose the workflow into read → validate → clean → analyze → visualize → report stages, using exception handling and NumPy/Pandas/Matplotlib, submitted with a one-page reflection.

Learning Resources:

Text Books:

3. Downey, A. B. (2015). Think Python: How to think like a computer scientist (2nd ed.). O'Reilly Media.
4. Guttag, J. V. (2021). Introduction to computation and programming using Python: With application to computational modeling and understanding data (3rd ed.). MIT Press.

Reference Books:

4. Sweigart, A. (2025). Automate the boring stuff with Python: Practical programming for total beginners (3rd ed.). No Starch Press.
5. McKinney, W. (2022). Python for data analysis: Data wrangling with pandas, NumPy, and Jupyter (3rd ed.). O'Reilly Media.
6. Wing, J. M. (2006). Computational thinking. Communications of the ACM, 49(3), 33–35. https://doi.org/10.1145/1118178.1118215

Web References:

1. Python Software Foundation. (n.d.). The Python tutorial. https://docs.python.org/3/tutorial/
2. W3Schools. (n.d.). Python tutorial. https://www.w3schools.com/python/
3. NPTEL. (n.d.). Programming, data structures and algorithms using Python. https://nptel.ac.in

Course Code	WORKSHOP PRACTICE	Category ESC	L-T-P-C 0-0-3-1.5

Pre-requisites: NIL

Course Objectives:

- Familiarize students with workshop tools, equipment, materials, and safety practices used in basic engineering activities.
- Develop hands-on skills in wood working, sheet metal working, fitting, foundry, welding, and plumbing operations.
- Provide practical experience in basic electrical wiring, soldering, and electrical circuit connections.
- Introduce students to basic tinkering, sensors, actuators, microcontrollers, and IoT applications.
- Develop students' practical problem-solving, fabrication, assembly, maintenance, and troubleshooting skills through hands-on activities.

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

CO1: Apply safety practices and identify appropriate workshop tools, equipment, materials, and measuring instruments for basic engineering activities.

CO2: Perform basic fabrication and manufacturing operations using carpentry, sheet metal, fitting, foundry, welding, and plumbing techniques.

CO3: Apply workshop practices for the assembly, disassembly, maintenance, and repair of simple engineering components and systems.

CO4: perform basic electrical wiring, circuit connections, soldering, and testing using appropriate electrical practices.

CO5: Develop simple sensors, actuator, microcontroller, and IoT-based applications through hands-on tinkering and experimentation.

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

SYLLABUS

1. **Demonstration**: Safety practices and precautions to be observed in workshop.

2. **Wood Working:** Familiarity with different types of wood and tools used in wood working and make following joints.
   a)Half – Lap joint b) Mortise and Tenon joint c) Corner Dovetail joint or Bridle joint

3. **Sheet Metal Working**: Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets.
   a)Tapered tray b) Conical funnel c) Elbow pipe d) Brazing

4. **Fitting:** Familiarity with different types of tools used in fitting and do the following fitting exercises.
   a) V-fit b) Dovetail fit c) Semi-circular fit

5. **Electrical Wiring**: Familiarity with different types of basic electrical circuits and make the following connections.

a) Parallel and series b) Two-way switch c) Godown lighting
d) Soldering of wires.

6. **Foundry Trade:** Demonstration and practice on Moulding tools and processes, Preparation of Green Sand Moulds for given Patterns.

7. **Welding Shop**: Demonstration and practice on GTAW. Preparation of Lap joint and Butt joint.

8. **Plumbing:** Demonstration and practice of Plumbing tools, Preparation of Pipe joints with coupling for same diameter and with reducer for different diameters.

9. **Assembly and dis assembly of Two-wheeler electric vehicle.**

10. **Tinkering Lab experiments:**
    a) Build and demonstrate automatic street light using LDR.
    b) Simulate the AURDINO LED blinking activity in Tinkercad
    c) Interface a basic sensor and actuator with a microcontroller.

Textbooks:

1. Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published,2019. Workshop Processes, Practices and Materials; Bruce J. Black, Routledge publishers, 5th Edn. 2015.
2. A Course in Workshop Technology Vol I. & II, B.S. Raghuwanshi, Dhanpath Rai & Co., 2015 & 2017.

Reference Books:

1. Elements of Workshop Technology, Vol. I by S. K. Hajra Choudhury & Others, Media Promoters and Publishers, Mumbai. 2007, 14th edition
2. Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.
3. Wiring Estimating, Costing and Contracting; Soni P.M. & Upadhyay P.A.; Atul Prakashan, 2021-22.
4. https://aim.gov.in/pdf/equipment-manual-pdf.pdf - For Tinkering Lab

Course Code	NSS / NCC	Category MNC	L-T-P-C 0-0-2-0

Course Objectives:

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

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

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

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

CO3: Explore human relationships by analyzing social problems.

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

CO5: Develop leadership skills and civic responsibilities.

UNIT I Orientation

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

Activities:

i Conducting –ice breaking sessions-expectations from the course-knowing personal talents and skills

ii Conducting orientations programs for the students –future plans-activities-releasing road map etc.

iii Displaying success stories-motivational biopics- award winning movies on societal issues etc.

iv Conducting talent show in singing patriotic songs-paintings- any other contribution.

UNIT II Nature & Care

Activities:

i Best out of waste competition.

ii Poster and signs making competition to spread environmental awareness.

iii Recycling and environmental pollution article writing competition.

iv Organising Zero-waste day.

v Digital Environmental awareness activity via various social media platforms.

vi Virtual demonstration of different eco-friendly approaches for sustainable living.

vii Write a summary on any book related to environmental issues.

UNIT III Community Service

Activities:

i Conducting One Day Special Camp in a village contacting village-area leaders- Survey in the village, identification of problems- helping them to solve via media- authorities-experts-etc.

i Conducting awareness programs on Health-related issues such as General Health, Mental health, Spiritual Health, HIV/AIDS,

ii Conducting consumer Awareness. Explaining various legal provisions etc.

iii Women Empowerment Programmes- Sexual Abuse, Adolescent Health and Population Education.

iv Any other programmes in collaboration with local charities, NGOs etc.

Reference Books:

1. Nirmalya Kumar Sinha & Surajit Majumder, *A Text Book of National Service Scheme* Vol; I, Vidya Kutir Publication, 2021 (ISBN 978-81-952368-8-6)
2. *Red Book - National Cadet Corps* – Standing Instructions Vol I & II, Directorate General of NCC, Ministry of Defence, New Delhi

3. Davis M. L. and Cornwell D. A., “Introduction to Environmental Engineering”, McGraw Hill, New York 4/e 2008
4. Masters G. M., Joseph K. and Nagendran R. “Introduction to Environmental Engineering and Science”, Pearson Education, New Delhi. 2/e 2007
5. Ram Ahuja. *Social Problems in India*, Rawat Publications, New Delhi.

General Guidelines:

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

Evaluation Guidelines:

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

I year II Semester

Course Code	DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS	Category BSC	L-T-P-C 3-0-0-3

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

Course Objectives:

- This course is aimed to provide the learner with several methods for solving differential equations and partial differential equations.
- To prepare the student to calculate gradient, surface and volume integrals by applying standard theorems.

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

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

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

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

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

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

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

UNIT-I

Differential Equations of First Order and First Degree: Exact equations and equations reducible to exact form (integrating factor), Linear differential equations – Bernoulli's equations. Orthogonal Trajectories, Applications: Newton's Law of cooling – Law of natural growth and decay- Electrical circuits.

UNIT-II

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

UNIT-III

Partial Differential Equations: Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, Solutions of first order linear equations using Lagrange's method, Non-linear partial differential equations using Charpit's Method. Homogeneous Linear Partial differential equations with constant coefficients.

UNIT-IV

Vector Differentiation: Scalar and Vector point functions, Vector operator Del, Gradient and applications, Directional derivative, Divergence-Solenoidal and Curl-Irrotational Field - Scalar Potential, Vector identities.

UNIT-V

Vector Integration: Line integral – Circulation – Work done by the force, Surface integral-flux, Green's theorem in a plane (without proof), Stoke's theorem (without proof), Volume integral, Divergence theorem (without proof) and their applications.

Learning Resources:

Text Books:

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

Reference Books:

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

Web Resources:

1. https://mathworld.wolfram.com/First-OrderOrdinaryDifferentialEquation.html
2. https://en.wikipedia.org/wiki/Differential_equation
3. https://en.wikipedia.org/wiki/Partial_differential_equation
4. https://en.wikipedia.org/wiki/Vector_calculus
5. https://en.wikipedia.org/wiki/Vector_calculus

Course Code	Physics for Civil Engineers (For Civil Engineering)	Category BSC	L-T-P-C 3-0-0-3

Course Objectives

- To help students understand interference, diffraction, and polarization and apply them to optical measurement and surveying problems in civil engineering.
- To introduce crystallography and X-ray diffraction methods for characterizing construction materials and studying crystal structures.
- To provide a working knowledge of quantum mechanics and elementary quantum computing concepts relevant to sensing and secure monitoring systems.
- To familiarize students with oscillations, vibration control, and building acoustics as applied to earthquake-resistant and smart structures.
- To impart knowledge of ultrasonics and non-destructive testing methods used for quality inspection and defect detection in civil structures.

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

CO1: Analyse the principles of interference, diffraction, and polarization and apply basic optical measurement techniques for civil engineering applications (K3–K4).

CO2: Examine crystal structures and material characterization by using x-ray diffraction method (K4)

CO3: Apply the concepts of quantum mechanics and elementary quantum computing to explain quantized systems and quantum-based communication ideas. (K3)

CO4: Analyze oscillatory systems, vibration-control mechanisms, and architectural acoustics relevant to earthquake-resistant and acoustically optimized structures. (K4)

CO5: Evaluate ultrasonic and non-destructive testing techniques for identifying defects and assessing the quality of structural materials.(K5)

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

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

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

Diffraction: Fresnel and Fraunhofer diffraction – Fraunhofer's diffraction due to single slit, double slit & N-slits (qualitative) – Diffraction Grating and grating spectrum – Dispersive and Resolving power of a grating.

Polarization: types of polarization – Nicol's prism – Half-wave and Quarter-wave plates.

UNIT – II: CRYSTALLOGRAPHY & MATERIAL CHARACTERIZATION **9**Hrs

Crystallography: Space lattice – Basis – Unit cell – Lattice Parameters – Crystal systems and Bravais lattices, Coordination Number and Packing Fraction of SC, BCC and FCC structures.

Material Characterization: Miller indices – Inter-planar spacing between successive (h k l) planes – Bragg's law – X-ray Diffractometer – Crystal structure determination by Laue's method.

UNIT - III: INTRODUCTION TO QUANTUM MECHANICS & QUANTUM COMPUTING **10**Hrs

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

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

UNIT – IV: OSCILLATIONS & ACOUSTICS OF BUILDINGS **10**Hrs

Oscillations: Oscillations of springs – Series and parallel combination of springs (quantitative) – Stiffness factor and its significance – Damping and resonance: over-, under- and critical damping (qualitative) – Forced oscillations and resonance – Sharpness of resonance – Quality factor (Q).

Acoustics of Buildings: Introduction – Requirements of acoustically good auditorium – Reverberation – Reverberation time – Sabine's formula (qualitative) – Absorption coefficient and its determination – Factors affecting acoustics of buildings and their remedial measures.

UNIT – V: ULTRASONICS & NON-DESTRUCTIVE TESTING **9**Hrs

Ultrasonics: Introduction – Characteristics of ultrasonic waves – Production of ultrasonic waves by magnetostriction and piezoelectric methods – Detection - Acoustic grating – Applications.

Non-Destructive Testing (NDT): Introduction - pulse echo system through transmission and reflection modes – Applications.

Textbooks:

1. Avadhanulu, M.N., Kshirsagar, P.G., & Murthy, T.V.S.A., A textbook of engineering physics, S. Chand Publishing (2019)
2. P.K. Palanisamy, Engineering physics. Scitech Publications (2015)

Reference Books:

1. Pandey, B. K., & Chaturvedi, S., Engineering physics, Cengage Learning (2021)
2. Bhattacharya, D. K., & Tandon, P., Engineering physics, Oxford University Press (2015)

Learning Resources

1. NPTEL. (n.d.). National Programme on Technology Enhanced Learning. https://nptel.ac.in
2. MIT OpenCourseWare. (n.d.). Physics courses. https://ocw.mit.edu
3. Georgia State University. (n.d.). HyperPhysics. http://hyperphysics.phy-astr.gsu.edu
4. PhET Interactive Simulations. (n.d.). University of Colorado Boulder. https://phet.colorado.edu
5. American Concrete Institute. (2021). ACI 228.2R: Nondestructive test methods for evaluation of concrete in structures. https://www.concrete.org

Course Code	Fundamentals of Quantum Technologies	Category ESC	L-T-P-C 3-0-0-3

Pre-requisites: NIL

Course Objectives: *The course aims to*:

- Introduce the fundamental concepts of classical and quantum mechanics, including Hamiltonian mechanics, phase space, quantum postulates, operators, state vectors, and time evolution.
- Develop an understanding of quantum phenomena such as superposition, entanglement, spin, angular momentum, quantum statistics, and their applications to fundamental physical systems.
- Familiarize students with statistical physics, quantum information concepts, entropy, decoherence, noise, and basic quantum information formalisms.
- Introduce the principles of computational complexity and quantum computing complexity classes, with an overview of their relevance to quantum information and post-quantum cryptography.

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

CO1. Explain the principles of Hamiltonian mechanics and the historical development, postulates, and mathematical foundations of quantum mechanics. (K2)

CO2. Apply quantum mechanical operators, state-vector formalism, and time-evolution principles to analyze fundamental systems such as the particle in a box, harmonic oscillator, and hydrogen atom. (K3)

CO3. Analyze quantum phenomena including superposition, entanglement, spin, angular momentum, coherent states, and quantum statistics of bosons and fermions. (K4)

CO4. Analyze the principles of statistical physics and quantum information, including Gibbs principle, Shannon entropy, decoherence, noise, and density-operator formalism. (K4)

CO5. Evaluate basic computational complexity concepts and quantum complexity classes, and relate them to quantum information processing and post-quantum cryptography. (K5)

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

UNIT-I:

Brief overview of classical physics (*This segment is meant for the student to understand what a Hamiltonian is, which will feature later in quantum mechanics*) : Hamiltonian function and Hamilton's equations, Phase-space description of a system, Connection and Equivalence with Newton's laws for simple systems – free particle, particle moving in a conservative potential, examples of Harmonic oscillator, hydrogen atom

Historical evolution of quantum mechanics: Planck's quantum hypothesis, Photo electric effect, Atomic spectra, Bohr's quantisation principle, De Broglie's Wave particle duality

UNIT-II

Postulates of Quantum Mechanics: State vectors and Hilbert Space, Dirac Bra-Ket notation, Measurables and Hermitian Operators, Unitary Transformations, Schrodinger Equation and Time evolution of quantum states, Measurement Postulate, Schrodinger, Heisenberg and Interaction pictures, Eigen values, Expectation values and Matrix elements, Heisenberg's Uncertainty principle

UNIT-III:

○ Density operator formalism of quantum mechanics – pure and mixed states; Superposition and Entanglement in quantum mechanics; No cloning theorem; Applications of postulates –Particle in a box, Hydrogen atom, Harmonic Oscillator

○ Number states, ladder operators and Coherent states of a harmonic oscillator; Spin and Angular momentum – spin half particles; Rabi problem of a spin-half particle in a rotating magnetic field; Bosons and Fermions

UNIT-IV:

Statistical Physics: Quick review of first and second laws of thermodynamics, Thermal Equilibrium and Gibbs principle, Applying Gibbs principle to Classical and Quantum harmonic oscillators, Bosons and Fermions and Quantum statistics – Fermi-Dirac and Bose-Einstein distributions

UNIT - V:

Information Science:

Digital communication and information: Quantifying information in terms of Shannon entropy; Basic ideas of quantum information; Decoherence and noise; Introductory ideas of Kraus operators

Brief overview of Computational Complexity: Qualitative ideas of a Turing machine: Types of Turing machines; Time and Space complexity – P vs NP, PSPACE; Quantum complexity classes – Q, EQP, BQP, BPP, QMA; Post Quantum Cryptography (PQC)

Course References:

1. Introduction to Quantum Mechanics, Griffiths D. J., 3rd Edition, Cambridge University Press (2024)
2. Introduction to Electrodynamics, Griffiths D. J., 4th edition, Cambridge University Press (2020)
3. Principles of Quantum Mechanics, Shankar, R., 2nd edition, Springer (2014)
4. Quantum Information Science – Manenti R., Motta M., 1st Edition, Oxford University Press (2023)
5. Quantum computation and quantum information – Nielsen M. A., and Chuang I. L., 10^{th} Anniversary edition, Cambridge University Press (2010)
6. A Pathak, Elements of Quantum Computation and Quantum Communication, Boca Raton, CRC Press (2015)
7. Information Theory, Robert B. Ash, Dover Publications (2003)
8. Introduction to the Theory of Computation, Michael Sipser, 3rd edition, Cengage India Pvt. Ltd. (2014)
9. Statistical Mechanics, Pathria R. K., Paul D. Beale, 4th edition, Academic Press, (2021)

Course Code	Basic Electrical & Electronics Engineering (CE, ME and Pharmaceutical Engineering Only)	Category ESC	L-T-P-C 3-0-0-3

Pre-requisite: NIL

Course Objectives:

- To introduce the fundamental laws, circuit elements, and network theorems used in the analysis of DC electrical circuits.
- To develop an understanding of single-phase AC circuits using phasor concepts, impedance, and power calculations, and the basic concepts of three-phase systems.
- To explain the construction, operating principles, basic equations, characteristics, and applications of DC and AC machines.
- To familiarize students with semiconductor devices and basic electronic circuits, including diodes, rectifiers, Zener regulators, BJTs, and operational amplifiers.
- To introduce the fundamentals of digital electronics and electricity billing, and electrical safety measures including fuse, MCB, and electric shock protection.

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

CO1: apply Ohm's law, Kirchhoff's laws, and network theorems to analyze and simplify DC electrical circuits. (K3)

CO2: analyze single-phase AC circuits using phasor concepts, impedance, and power calculations, and the basic concepts of three-phase systems. **(K4)**

CO3: understand the construction, operating principles, basic equations, speed-control methods, and applications of DC and AC machines. **(K2)**

CO4: apply the operating principles of semiconductor devices, rectifiers, Zener regulators, BJTs, and operational amplifiers in basic electronic circuits. (K3)

CO5: analyze basic digital logic circuits, electricity billing, and electrical safety measures including fuse, MCB, and electric shock protection. (K4)

COs / Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	H	-	L	M	-	-	-	-	-	-			
CO2	H	H	-	L	M	-	-	-	-	-	-			
CO3	H	2	-	-	L	-	-	-	-	-	-			
CO4	H	H	-	L	M	-	-	-	-	-	-			
CO 5	H	H	-	L	H	-	-	-	-	-	-			

UNIT-I

DC Circuits and Network Theorems: Electrical circuit elements and terminology; Ohm's law; Kirchhoff's Current Law (KCL) and Voltage Law (KVL); series-parallel DC circuits; mesh and nodal analysis; Thevenin's theorem, Norton's theorem, Superposition theorem.

UNIT-II

AC Circuits: Generation of alternating EMF; peak, average, RMS values, form factor and peak factor; Voltage and current relationship with phasor diagrams in R, L, and C series circuits only, concept of reactance and impedance, concept of power factor, active power, reactive power and apparent power Introduction to three-phase systems; star and delta connections (line and phase relations only).

UNIT-III

Electrical Machines: DC machines: Principle of operation of DC Generator; Principle of operation of DC Motor, Torque Equation, types of DC motors and applications, speed control using flux control & armature voltage control methods; Transformers: working principle, EMF equation, losses, and efficiency; Three-phase induction motor: principle of operation and applications; Principle of operation of Stepper Motor and DC Servo motor.

UNIT-IV

Semiconductor Devices and Electronic Circuits: Semiconductor basics: intrinsic and extrinsic semiconductors; PN junction diode and its V-I characteristics; Operation of half-wave and full-wave bridge rectifiers without filters; Zener diode and voltage regulation; Operation of PNP and NPN junction transistors, CE Configuration - input and output characteristics; Operational amplifiers: inverting and non-inverting amplifiers

UNIT-V

Digital Electronics, Electricity Billing & Safety : Overview of Number Systems, Logic gates including Universal Gates, BCD codes, Boolean Algebra, Basic Theorems and properties of Boolean Algebra, Truth Tables and Functionality of Logic Gates: NOT,OR,AND,NOR,NAND,XOR and XNOR; Electricity Bill: Power rating of household appliances including air conditioners, PCs, Laptops, Printers, etc. Types of Tariff, Calculation of electricity bill for domestic consumers; Equipment Safety Measures**:** Working principle of Fuse and Miniature Circuit Breaker (MCB), Electric Shock, Safety Precautions to avoid shock.

Learning Resources:

Textbooks

1. Ed Hughes. (2016). Electrical & Electronic Technology (12th edition). Pearson Education.
2. Vincent Del Toro. (2015). Electrical Engineering Fundamentals (2nd edition). Pearson Education.

Reference Books

1. Mehta, V. K., & Mehta, R. (2008). Principles of electrical engineering and electronics. S. Chand Publishing.
2. Charles K. Alexander and Mathew N.O. Sadiku. (2017). Fundamentals of Electrical Circuits (6th edition). Mc Graw-Hill Education, India.
3. V. K. Mehta, Rohit Mehta, (2022). Principles of Power Systems. S. Chand Publishing.

Web Resources

1. https://nptel.ac.in/courses/108105112
2. https://nptel.ac.in/courses/108101091
3. https://nptel.ac.in/courses/108105113

Course Code	Engineering Geology	Category ESC	L-T-P-C 2-0-0-2

Pre-requisite: NIL

Course Objectives:

- To know the importance of Engineering Geology to the Civil Engineering.
- To enable the students, understand what minerals and rocks are and their formationand identification.
- To highlight significance/ importance/ role of Engineering Geology in constructionof Civil Engineering structures.
- To enable the student, realize its importance and applications of Engineering Geologyin Civil Engineering constructions.
- concepts of Groundwater and its geophysical methods.

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

CO1: Understand the significance of geological agents on Earth surface and its significancein Civil Engineering. (K2)

CO2: Identify and understand the properties of Minerals and Rocks. (K2)

CO3: Understand the concepts of Groundwater and its geophysical methods. (K3)

CO4: Classify and measure the Earthquake prone areas, Landslides and subsidence topractice the hazard zonation. (K4)

CO5: Investigate the project site for mega/mini civil engineering projects and site selectionfor mega engineering projects like Dams, Reservoirs and Tunnels. (K5)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO.1	H	-	-	-	-	-	-	-	-	-	L	M	-
CO.2	M	L	-	-	-	-	-	-	-	-	-	L	-
CO.3	H	M	-	-	-	-	-	-	-	-	-	L	-
CO.4	H	H	H	M	H	-	M	-	-	-	M	M	M
CO.5	H	H	M	M	H	-	M	-	-	-	M	M	M

SYLLABUS:

UNIT-I:

Introduction: Branches of Geology, Importance of Geology in Civil Engineering with case studies, Weathering of rocks, Geological agents, weathering process of Rock, Rivers andgeological work of rivers.

UNIT-II

Mineralogy And Petrology: Definitions of mineral and rock-Different methods of study of mineral and rock. Physical properties of minerals and rocks for megascopic study for the following minerals and rocks. Common rock forming minerals: Feldspar, Quartz Group, Olivine, Augite, Hornblende, Mica Group, Asbestos, Talc, Chlorite, Kyanite, Garnet, Calcite and ore forming minerals are Pyrite, Hematite, Magnetite, Chlorite, Galena, Pyrolusite, Graphite, Chromite, Magnetite and Bauxite. Classification, structures ,textures and forms of Igneous rocks, Sedimentary rocks, Metamorphic rocks, and their megascopic study of granite varieties, (pink, gray, green). Pegmatite, Dolerite, Basalt etc., Shale, Sand Stone, Lime Stone, Laterite, Quartzite, Gneiss, Schist, Marble, Khondalite and Slate.

UNIT-III

Structural Geology: Strike , Dip and Outcrop study of common geological structures associating with the rocks such as Folds, Faults, Joints and Unconformities- parts, types,mechanism and their importance in Civil Engineering.

UNIT-IV

Ground Water: Water table, Cone of depression, Geological controls of Ground Water Movement, Ground Water Exploration Techniques.

Earthquakes and Land Slides: Terminology, Classification, causes and effects, Shield areas and Seismic bells, Richter scale intensity, Precautions of building constructions in seismic areas. Classification of Landslides, Causes and Effects, measures to be taken prevent their occurrence at Landslides.

Geophysics: Importance of Geophysical methods, Classification, Principles of Geophysical study by Gravity method, Magnetic method, Electrical methods, Seismic methods, Radiometric method and Electrical resistivity, Seismic refraction methods and Engineering properties of rocks.

UNIT-V

Geology of Dams, Reservoirs and Tunnels: Types and purpose of Dams, Geological considerations in the selection of a Dam site. Geology consideration for successful constructions of reservoirs, Life of Reservoirs. Purpose of Tunnelling, effects, Lining of Tunnels. Influence of Geology for successful Tunnelling.

Learning Resources:

Textbooks

1. Chenna Kesavulu, N. (2014). *Textbook of Engineering Geology* (2nd ed.). Laxmi Publications.
2. Singh, P. (2023). *Engineering and general geology* (8th ed.). S. K. Kataria & Sons (Katson Educational Series).

Reference Books

1. Gangopadhyay, S. (2012). *Engineering geology*. Oxford University Press.
2. Kehew, A. E. (2013). *Geology for engineers and environmental scientists* (3rd ed.). Pearson.
3. Valdiya, K. S. (2013). *Environmental geology* (2nd ed.). McGraw-Hill Education.
4. Venkat Reddy, D. (2017). *Engineering geology* (2nd ed.). Vikas Publishing House

Web Resources

1. http://nptel.iitm.ac.in/video.php?subjectId=105105106
2. http://nptel.iitm.ac.in/video.php?courseId=1055&p=1
3. http://nptel.iitm.ac.in/video.php?courseId=1055&p=3
4. http://nptel.iitm.ac.in/video.php?courseId=1055&p=4

Course Code	AI Tools and Applications	Category ESC	L-T-P-C 0-1-3-2.5

Pre-requisite: NIL

Course Objectives: To familiarize students with the landscape of AI tools and their underlying working principles.

- To develop competence in prompt engineering for effective interaction with generative AI systems.
- To enable students to apply AI tools for data analysis, visualization, and interpretation.
- To train students in using AI-assisted tools for coding, writing, and productivity tasks.
- To instill awareness of ethical, legal, and societal considerations in AI tool usage.

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

1. Recall the categories, capabilities, and limitations of major AI tools (text, image, code, data). (K1)
2. Explain the principles of prompt engineering and how generative AI models process instructions. (K2)
3. Apply AI tools to solve first-year engineering problems in analysis, writing, and coding tasks. (K3)
4. Analyze AI-generated outputs for accuracy, bias, and reliability before use. (K4)
5. Evaluate the ethical, academic-integrity, and societal implications of AI tool use, justifying appropriate usage choices. (K5)

CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	M	–	–	–	H	L	L	–	–	–	L			
CO2	M	M	–	–	H	L	–	L	–	M	L			
CO3	H	H	M	M	H	L	L	–	L	M	M			
CO4	M	H	M	H	H	M	M	H	L	M	M			
CO5	L	M	M	M	M	H	H	H	M	H	M			

UNIT1

Introduction to AI and the AI Tools Landscape:

What is AI, Machine Learning, and Generative AI — basic definitions and how they relate to one another.

Core categories of AI tools: conversational/text, code assistants, data-analysis tools, image-generation tools, and writing/productivity tools.

How large language models process and generate responses (conceptual, non-mathematical overview).

Criteria for selecting the right AI tool for a given task — accuracy needs, cost, data sensitivity, and output format.

Setting up accounts and workspaces; understanding free-tier versus paid-tier capabilities and limitations.

Widely Used AI Tools by Application (for classroom coverage):

Category	Example Tools	Typical Application
Conversational / General-Purpose AI	ChatGPT, Claude, Gemini, Perplexity	Writing, research, coding help, file/data analysis, cited web search
AI Coding Assistants	GitHub Copilot, Cursor, Claude Code	In-IDE code completion, AI-native editing, multi-file agentic coding

Data Analysis Tools	ChatGPT (Advanced Data Analysis), Microsoft Copilot in Excel, Julius AI	Upload a dataset, generate statistics/charts, spreadsheet formulas via natural language
Image Generation	Midjourney, DALL·E 3, Stable Diffusion / Flux	Illustrations, concept art, design mockups
Writing & Productivity	Grammarly, Gamma, Fathom, Notion AI	Grammar/style checking, slide generation, meeting summaries, task automation
Audio, Video & Presentation (optional)	ElevenLabs, Runway/Sora, Synthesia	Text-to-speech, AI video generation, script-to-video presentations

Teacher Practical Examples (for classroom demonstration):

1. Live comparison of the same general engineering query (e.g., "explain the engineering design process") answered by two different AI chatbots, highlighting differences in response style and accuracy.
2. Walkthrough of an AI tool's interface — settings, conversation history, file upload, and model selection — using a common platform.

Student Exercise Problems (for practice):

1. Create accounts on two AI platforms and compare their responses to a simple engineering question (e.g., "explain the difference between analysis and design").
2. Prepare a one-page comparison chart of five AI tools by category and primary use case.
3. Write a short reflection identifying one task in your daily academic life where an AI tool could help.

UNIT2

Prompt Engineering and Generative AI Tools

Anatomy of a good prompt — context, clear instruction, desired format, and constraints.
Zero-shot, few-shot, and chain-of-thought prompting techniques and when to use each.
Role-based and context-setting prompts (e.g., asking the AI to respond as a reviewer, tutor, or domain expert).
Iterative prompt refinement — diagnosing a poor AI response and rewriting the prompt to fix it.
Using generative AI for brainstorming, summarizing, and drafting technical content.

Teacher Practical Examples (for classroom demonstration):

1. Refine a vague prompt (e.g., "explain project scheduling") into a precise one step-by-step, showing output improvement at each stage.
2. Demonstrate few-shot prompting by providing examples to guide the AI toward a specific output format (e.g., a formatted comparison table).

Student Exercise Problems (for practice):

1. Write three versions of a prompt (basic, detailed, role-based) for the same task and compare outputs.
2. Use an AI tool to summarize a one-page technical article and verify the summary against the original.
3. Draft a chain-of-thought prompt to solve a multi-step numerical/logical problem (e.g., a unit-conversion or estimation problem) and check the reasoning.

UNIT3

AI Tools for Data Analysis and Visualization

AI-assisted spreadsheet and dataset analysis using natural-language commands.
Natural-language querying of datasets to extract summary statistics and insights.
AI tools for generating charts, graphs, and visual summaries from tabular data.

Interpreting AI-generated statistical summaries correctly and recognizing their limitations.
Identifying and correcting errors or misinterpretations in AI-generated data analysis.

Teacher Practical Examples (for classroom demonstration):

1. Upload a small dataset (e.g., class attendance or survey data) to an AI tool and generate a summary-statistics report and chart using natural-language commands.
2. Show an example where an AI tool misinterprets data (e.g., treats a numeric code as text), and demonstrate how to verify and correct it.

Student Exercise Problems (for practice):

1. Use an AI tool to clean and summarize a small sample dataset (e.g., class attendance or marks data).
2. Generate three different chart types from the same dataset using AI prompts and justify which is most appropriate.
3. Cross-check one AI-generated statistical claim manually and report any discrepancy found.

UNIT4

AI Tools for Coding, Writing, and Productivity

AI coding assistants — code generation, explanation, and debugging support for simple programs.
AI writing assistants for reports, emails, and technical documentation.
AI tools for scheduling, note-taking, and meeting/lecture summarization.
AI-assisted presentation and slide-outline generation from a topic prompt.
Integrating AI tools into an efficient day-to-day academic and engineering workflow.

Teacher Practical Examples (for classroom demonstration):

1. Use an AI coding assistant to generate a simple program (e.g., a temperature converter), then intentionally introduce a bug and have the AI debug it.
2. Generate a presentation outline and speaker notes from a topic prompt using an AI writing/productivity tool.

Student Exercise Problems (for practice):

1. Use an AI coding tool to write and debug a simple program for a given problem statement.
2. Draft a formal email or short report using an AI writing assistant, then manually edit it for accuracy and tone.
3. Generate a slide outline for a 5-minute seminar topic using an AI tool and refine it.

UNIT5

Ethics, Reliability, and Emerging Trends

Bias and hallucination in AI outputs, and techniques for detecting and fact-checking them.
Academic integrity and appropriate citation of AI assistance in coursework and submissions.
Data privacy and security considerations, including obligations under India's Digital Personal Data Protection Act, 2023 (DPDP Act), when uploading personal or institutional data.
Copyright and intellectual property considerations in AI-generated text and image content.
Emerging trends — multimodal AI and AI agents — and their implications for future engineering practice.

Teacher Practical Examples (for classroom demonstration):

1. Show a documented case of AI hallucination (a fabricated fact or citation) and demonstrate how to fact-check it.
2. Walk through an example of properly citing AI assistance in an academic submission per institutional guidelines.
3. Walk through a worked example of checking whether AI-generated text or image output raises a copyright/IP concern (e.g., close paraphrasing of a source).

Student Exercise Problems (for practice):

1. Identify and document a hallucination or bias instance produced by an AI tool on a factual query.
2. Draft an "AI usage declaration" for a hypothetical assignment, citing tools and extent of use appropriately.
3. Review the data-handling/privacy policy of one AI tool used in this course and identify one DPDP Act, 2023 compliance consideration relevant to student data.

Learning Resources:

Text Books

1. Marr, B. (2024). Generative AI in practice: 100+ amazing ways generative artificial intelligence is changing business and society. Wiley.
2. Mollick, E. (2024). Co-intelligence: Living and working with AI. Portfolio/Penguin.

Reference Books

1. Selwyn, N. (2022). Education and technology: Key issues and debates (3rd ed.). Bloomsbury.
2. Susskind, R., & Susskind, D. (2022). The future of the professions: How technology will transform the work of human experts (Updated ed.). Oxford University Press.
3. Russell, S., & Norvig, P. (2021). Artificial intelligence: A modern approach (4th ed.). Pearson.

Web Resources

1. Google. (n.d.). Google AI essentials. Grow with Google. https://grow.google/ai-essentials/
2. OpenAI. (n.d.). OpenAI documentation and guides. https://platform.openai.com/docs
3. Anthropic. (n.d.). Prompt engineering overview. Claude Docs. https://docs.claude.com/en/docs/build-with-claude/prompt-engineering/overview
4. UNESCO. (2023). Guidance for generative AI in education and research. https://unesdoc.unesco.org/
5. AICTE. (2025). AICTE inputs on Artificial Intelligence — Year of AI initiative. https://www.aicte.gov.in/downloads/initiatives/AICTE%20inputs%20on%20Artificial%20Intelligence%20-comprehensive.pdf
6. Ministry of Electronics and Information Technology, Government of India. (2023). Digital Personal Data Protection Act. https://www.meity.gov.in/content/digital-personal-data-protection-act-2023

Course Code	Engineering Graphics	Category ESC	L-T-P-C 0-0-2-1

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

Pre-requisites: NIL

Course Objectives: *The course aims to*

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

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

CO1: Apply standard engineering graphics principles and conventions to prepare accurate sketches and engineering drawings.

CO2: Visualize and represent three-dimensional objects and systems using appropriate projection, orthographic, isometric, sectional, and surface-development techniques.

CO3: Interpret and transform engineering representations by converting between 2D drawings, 3D views, and physical objects.

CO4: Use CAD tools to create, modify, and communicate 2D drawings and 3D models with appropriate dimensions, annotations, symbols, and features

CO5: Communicate engineering design information effectively through graphical representations, CAD models, and engineering drawings for multidisciplinary engineering applications.

CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PSO1	PSO2	PSO 3
CO1	H	M	M	–	M	L	–	M	M	H	–			
CO2	H	H	H	M	M	L	–	M	M	M	–			
CO3	H	H	H	M	H	M	–	M	M	M	–			
CO4	H	H	H	M	H	L	–	M	M	H	M			
CO5	H	H	H	M	H	M	M	H	H	H	M			

SECTION A – Manual Engineering Drawing

Exp. Practical Exercise

1 **Fundamentals of Engineering Drawing:** Lines, lettering, dimensioning, geometrical constructions, symbols and standard drawing conventions

Exp.	Practical Exercise
2	**Engineering Curves:** Construction and applications of ellipse, parabola, hyperbola, cycloid, involute and other commonly used engineering curves
3	**Scales:** Construction and application of plain and diagonal scales for representing engineering dimensions
4	**Projection of Points and Straight Lines:** Projection of points in different quadrants and straight lines in different orientations
5	**Projection of Planes:** Projection of simple planes parallel, perpendicular and inclined to reference planes
6	**Projection of Solids and Engineering Objects:** Projection of basic solids and simple engineering objects in different orientations
7	**Orthographic and Isometric Views:** Conversion between orthographic and isometric representations of simple engineering objects and systems
8	**Sections of Solids and Engineering Objects:** Sectional views and true shapes of simple solids and objects
9	**Development of Surfaces:** Development of surfaces of prismatic, cylindrical, pyramidal, conical and other developable forms
10	**Freehand Engineering Sketching:** Freehand sketching, proportioning and dimensioning of simple engineering components, objects, assemblies and systems

SECTION B – Computer-Aided Engineering Graphics (CAD)

Exp.	Practical Exercise
11	**Introduction to 2D CAD:** Drawing setup, basic drawing and editing commands, layers, dimensions, text, symbols and hatching
12	**CAD Geometrical Constructions and Curves:** Construction of polygons, circles, arcs, ellipse and other engineering curves using CAD
13	**2D CAD – Orthographic Views:** Preparation of front, top, side and other appropriate views of simple engineering objects
14	**Basic 3D CAD Modelling:** Creation of simple three-dimensional engineering objects using basic modelling features
15	**3D CAD Modelling of Engineering Components:** Modelling of representative engineering components, structures and functional objects using basic modelling features
16	**3D CAD Modelling with Features:** Creation and modification of 3D models using features such as hole, fillet, chamfer, mirror, pattern and other appropriate tools

Exp. Practical Exercise

17	**CAD Sectional Views:** Creation of sectional views of 3D engineering objects and generation of corresponding 2D drawings
18	**CAD Surface Development:** Development of cylindrical, conical, prismatic and other developable surfaces using CAD
19	**3D Model to Engineering Drawing:** Generation of orthographic, isometric and sectional views with dimensions, annotations and symbols from a 3D CAD model
20	**CAD Modelling of Physical Engineering Objects:** Measurement and interpretation of a physical engineering object, recreation of its geometry in CAD, and preparation of its engineering drawing

Course Code	Engineering Geology Laboratory	Category ESC	L-T-P-C 0-0-2-1

Pre-requisite: NIL

Course Objectives:

- To identify the Megascopic types of Ore minerals & Rock forming minerals.
- To identify the Megascopic types of Igneous, Sedimentary, Metamorphic rocks.
- To identify the topography of the site & material selection

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

CO1: Identify Megascopic minerals & their properties. (K4)
CO2: Identify Megascopic rocks & their properties. (K4)
CO3: Identify the site parameters such as contour, slope & aspect for topography. (K4)
CO4: Know the occurrence of materials using the strike & dip problems. (K2)

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

LIST OF EXPERIMENTS

1. Physical properties of minerals: Mega-scopic identification of
   a) Rock forming minerals – Quartz group, Feldspar group, Garnet group, Micagroup & Talc, Chlorite, Olivine, Kyanite, Asbestos, Tourmelene, Calcite, Gypsum, etc…
   b) Ore forming minerals – Magnetite, Hematite, Pyrite, Pyralusite, Graphite,Chromite, etc…
2. Megascopic description and identification of rocks.
   a) Igneous rocks – Types of Granite, Pegmatite, Gabbro, Dolerite, Syenite,Granite Poryphery, Basalt, etc.
   b) Sedimentary rocks – Sand stone, Ferrugineous sand stone, Lime stone, Shale,Laterite, Conglamorate, etc.
   c) Metamorphic rocks – Biotite – Granite Gneiss, Slate, Muscovite &Biotiteschist, Marble, Khondalite, etc.
3. Interpretation and drawing of sections for geological maps showing tilted beds, faults,unconformities etc.
4. Simple Structural Geology problems.
5. Bore hole data.
6. Strength of the rock using laboratory tests.
7. Field work – To identify Minerals, Rocks, Geomorphology& Structural Geology.

LAB EXAMINATION PATTERN:

1. Description and identification of FOUR minerals
2. Description and identification of FOUR (including igneous, sedimentary andmetamorphic rocks)
3. ONE Question on Interpretation of a Geological map along with a geological section.
4. TWO Questions on Simple strike and Dip problems.
5. Bore hole problems.
6. Project report on geology.

References:

1. Maruthesha Reddy, M. T. (2008). *Applied engineering geology practicals* (2nd ed.). New Age International Publishers.
2. Waltham, T. (2009). *Foundations of engineering geology* (3rd ed.). Spon Press.

Course Code	Physics for Civil Engineers Laboratory (For Civil Engineering)	Category BSC	L-T-P-C 0-0-3-1.5

Course Objectives

- Develop practical skills in conducting experiments related to optics, electricity, magnetism, semiconductor physics, quantum physics, mechanics and acoustics.
- Enable students to use appropriate experimental instruments and measurement techniques to determine physical quantities and material properties.
- Develop the ability to collect, analyze, interpret and validate experimental data using appropriate physical laws, mathematical relations and graphical methods.
- Develop experimental problem-solving skills and the ability to identify sources of error, limitations and uncertainties in measurements.
- Foster scientific attitude, laboratory safety, ethical practices, teamwork, technical communication and independent learning through experimental investigation.

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

CO1: Apply fundamental principles of optics, mechanics, electricity, magnetism, acoustics and modern physics to perform and interpret laboratory experiments.

CO2: Use appropriate experimental instruments, measurement techniques and procedures to determine physical quantities and material properties.

CO3: Analyze and interpret experimental observations using mathematical relations, graphs and appropriate physical models to obtain valid conclusions.

CO4: Evaluate experimental errors, uncertainties, limitations and reliability of measured results and identify possible sources of deviation.

CO5: Demonstrate scientific ethics, laboratory safety, effective teamwork, technical communication and independent learning while conducting experiments.

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

LIST OF EXPERIMENTS

(Any **TEN** of the following listed experiments)
(Out of which any **TWO** experiments may be conducted in virtual mode)

1. Determination of the thickness of a thin object by the wedge method.
2. Determination of the radius of curvature of a given plano convex lens by forming Newton's rings.

3. Determination of wavelengths of different spectral lines in the mercury spectrum using a diffraction grating in normal incidence configuration.
4. Determination of the resolving power of a telescope.
5. Determination of the dielectric constant of a given capacitor by the charging and discharging method.
6. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
7. Determination of temperature coefficients of a thermistor.
8. Determination of the wavelength of a Laser and a grating element by using a grating.
9. Estimation of Planck's constant using the photoelectric effect.
10. Determination of the Resistivity of a semiconductor by the four probe method.
11. Determination of the energy gap of a semiconductor using a p**-**n junction diode.
13. Study the variation of magnetic field along the axis of a current carrying circular coil by Stewart & Gee's method.
14. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall Effect.
15. Determination of Acceleration due to gravity and Radius of gyration using a Compound pendulum.
16. Determination of magnetic susceptibility by Kundt's tube method.
17. Verification of Brewster's law.
18. Sonometer: Verification of laws of stretched string.
19. Determination of frequency of electrically maintained tuning fork by Melde's Apparatus.

References:

8. S. Balasubramanian, M.N. Srinivasan "A Text Book of Practical Physics"- S Chand Publishers, 2017.

V-Lab: vlab.co.in

Course Code	Environmental Science for Engineers	Category MNC	L-T-P-C 2-0-0-0

Pre-requisite: NIL

Course Objectives:

- To provide core foundational knowledge on natural resources, ecosystems, and their functional balances.
- To understand the causes, effects, and mitigation strategies of various environmental pollutions.
- To evaluate the socio-economic, ethical, and legal frameworks governing environmental protection.
- To mainstream sustainable development, green engineering practices, and climate action into technical designs.

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

CO1: Understand the structure, function, and interdependence of ecosystems and natural resources for their sustainable utilization. (K2)

CO2: Analyze the sources, effects, and control/mitigation measures of air, water, soil, and noise pollution. (K3).

CO3: Evaluate the significance of biodiversity and assess threats to ecosystems along with applicable conservation strategies. (K4)

CO4: Interpret environmental policies, legislation, and Environmental Impact Assessment (EIA) procedures relevant to engineering projects. (K4)

CO5: Apply principles of sustainability, climate change science, and environmental ethics to engineering decision-making and social responsibility. (K5)

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	M	M	L	L	L	H	L	--	L	--	M			
CO2	M	H	M	M	M	H	L	L	M	--	M			
C03	L	M	L	L	L	H	M	L	M	--	M			
CO4	L	M	M	L	L	H	H	--	M	L	M			
CO5	L	M	H	L	M	H	H	M	H	L	H			

UNIT-I

Ecosystems and Natural Resources: Concept, structure, and function of an ecosystem; biotic and abiotic components; Energy flow, food chains, food webs, ecological pyramids;

Biogeochemical cycles: carbon, nitrogen, phosphorus, sulphur, hydrological cycle; Types of ecosystems: forest, grassland, desert, aquatic (pond, lake, estuarine);

Natural resources: forest, water, mineral, food, energy and land resources — use and over-exploitation; Renewable vs. non-renewable resources; concept of carrying capacity; Role of an individual/engineer in conservation of natural resources

UNIT-II

Environmental Pollution and Control:

Air pollution: sources, classification of pollutants, effects, control equipment (ESP, scrubbers, cyclones).

Water pollution: point/non-point sources, water quality parameters (BOD, COD, DO), wastewater treatment overview.

Soil pollution: causes (pesticides, industrial waste), degradation, remediation approaches.

Noise pollution: sources, measurement (dB), health effects, control measures.

Solid and hazardous waste management: 3R principle, e-waste, biomedical waste, landfill/incineration basics. Introduction to Air Quality Index (AQI) and Central/State Pollution Control Board monitoring framework/

UNIT-III

Biodiversity and Conservation: Levels and values of biodiversity (consumptive, productive, social, ethical, aesthetic); India as a mega-biodiversity nation; biodiversity hotspots; Threats to biodiversity: habitat fragmentation, poaching, human-wildlife conflict, invasive/alien species; In-situ conservation: national parks, wildlife sanctuaries, biosphere reserves; Ex-situ conservation: seed banks, botanical/zoological gardens, gene banks; IUCN Red List categories; endangered and endemic species of India.

UNIT-IV

Environmental Policy, Law, and Impact Assessment: Overview of Indian environmental legislation: Environment (Protection) Act 1986, Water Act 1974, Air Act 1981, Wildlife Protection Act 1972, Forest (Conservation) Act 1980 Environmental Impact Assessment (EIA): concept, process, screening, scoping, public hearing, EMP Role of MoEFCC, CPCB/SPCB, and National Green Tribunal (NGT);

International agreements: Stockholm Conference, Rio Summit, Kyoto Protocol, Paris Agreement, SDGs (overview); Environmental clearance process for industrial/infrastructure projects; Engineer's professional and ethical responsibility in environmental compliance.

UNIT-V

Sustainability, Climate Change, and Global Environmental Issues: Concept of sustainable development; UN Sustainable Development Goals (SDGs) overview; Greenhouse effect, global warming, climate change causes and impactsl Ozone layer depletion; acid rain; sea-level rise; Renewable energy sources: solar, wind, biomass, hydro — engineering relevance; Green building concepts, cleaner production, circular economy, carbon footprint/net-zero concepts; Environmental ethics, sustainable lifestyle, and role of engineers/technologists as change agents; Disaster management basics: natural and man-made disasters (overview).

Learning Resources:

Text Books:

1. Bharucha, E. — Textbook of Environmental Studies for Undergraduate Courses, Universities Press.
2. Rajagopalan, R. — Environmental Studies: From Crisis to Cure, Oxford University Press.

Reference Books: (Maximum – 2 to 3 Books)

1. Kaushik, A. & Kaushik, C.P. — Perspectives in Environmental Studies, New Age International Publishers.
2. Miller, G.T. & Spoolman, S. — Environmental Science, Cengage Learning.

Web Resources:

1. Central Pollution Control Board (CPCB) — Official reports, AQI Bulletins, and standards (cpcb.nic.in)
2. Ministry of Environment, Forest and Climate Change (MoEFCC) — EIA Notification and policy documents (moefcc.gov.in)
3. UNEP / IPCC Assessment Reports — climate change and sustainability data (unep.org, ipcc.ch)
4. NPTEL/SWAYAM course: "Environmental Studies" — for supplementary video lectures