DIPLOMA & INTEGRATED B. TECH
FIRST SEMESTER
(ECE, EE & ME)
ENGINEERING PHYSICS-I

Course Type	Course Code	Course Title
BS-02		**Engineering Physics-I**

Course Outcomes:

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

CO 1: Explain the concepts of units, dimensions, errors in measurement, and significant figures, and apply dimensional analysis in solving physical problems. **(BL2-understand &3-Apply)**

CO 2: Analyze scalar and vector quantities, apply the laws of motion, and solve numerical problems related to linear and circular motion. **(BL 3-Apply & 4-Analyze)**

CO3: Understand the concepts of force, momentum, work, power, and energy, and apply the principles of conservation laws and friction in engineering applications. **(BL2- understand &3-Apply)**

CO 4: Describe the mechanical properties of matter, fluid behavior, viscosity, surface tension, and hydrodynamic principles, and solve related numerical problems**. (BL2-understand &3-Apply)**

CO 5: Describe the principles of heat transfer, thermodynamics, wave motion, and simple harmonic motion, and apply them in scientific and engineering contexts**. (BL2-understand 3-Apply)**

MODULE I: UNITS AND MEASUREMENTS (3 HOURS)

UNIT 1: Dimensions and dimensional formulas of physical quantities, principle of homogeneity of dimensions, dimensional equations and their applications (conversion from one system of units to another, checking of dimensional equations, and derivation of simple equations), and limitations of dimensional analysis.

UNIT 2: Errors in measurements (systematic and random), absolute error, relative error, error propagation, error estimation, and significant figures.

MODULE II: KINEMATICS (7 HOURS)

UNIT 3: Scalar and vector quantities—examples, representation of vectors, types of vectors, addition and subtraction of vectors, triangle and parallelogram law (statement only), scalar and vector product, resolution of a vector, and its application to inclined planes.

UNIT 4: Motion in a straight line, speed and velocity, uniform and non-uniform motion, average speed and instantaneous velocity, and uniformly accelerated motion. Numerical problems related to the theory of motion. Circular motion definition of angular displacement, angular velocity, angular acceleration, frequency, time period, relation between linear and angular velocity, and linear acceleration and angular acceleration.

MODULE III: FORCE, WORK, POWER, AND ENERGY (8 HOURS)

UNIT 5: Force, momentum, conservation of linear momentum and its applications, centripetal and centrifugal forces, expression, and applications.

Work: definition, work done by a constant force and a variable force, kinetic energy, and the work-energy theorem; Friction: concept, types, laws of limiting friction, coefficient of friction, reducing friction.

UNIT 6: Power and its units, power and work relationship, calculation of power (numerical problems);

Energy: Definition, types, units, kinetic energy, potential energy, total energy, conservation of energy for freely falling bodies, and transformation of energy (numerical problems).

MODULE IV: PROPERTIES OF MATTER (5 HOURS)

UNIT 7: Elasticity: Definition of stress and strain, moduli of elasticity, Hooke's law, and significance of stress-strain curve.

UNIT 8: Surface tension: Concept, units, cohesive and adhesive forces, angle of contact, Ascent Formula (no derivation), effect of temperature and impurity on surface tension;

Viscosity and coefficient of viscosity: terminal velocity, Stokes' law, and effect of temperature on viscosity and application in hydraulic systems.

UNIT 9: Hydrodynamics: fluid motion, streamline and turbulent flow, Reynolds number, equation of continuity, Bernoulli's Theorem (Derivation not needed), and its applications.

MODULE V: HEAT AND THERMOMETRY (4 HOURS)

UNIT 10: Heat, Specific heat capacity: Cp, Cv—calorimetry; change of state—latent heat. Heat transfer – conduction and thermal conductivity, convection and radiation, thermal equilibrium, laws of thermodynamics, heat, work, and internal energy, isothermal and adiabatic processes, reversible and irreversible processes, heat engines, and refrigerators.

MODULE VI: WAVES AND OSCILLATION (3 HOURS)

UNIT 11: Wave motion, transverse and longitudinal waves with examples, velocity, frequency, and wavelength and their relationship, phase, phase difference, and principle of superposition.

UNIT 12: Definition of simple harmonic motion, expression for displacement, velocity, acceleration, time period, etc.

References:

1. NCERT Text Book, Class 11
2. Concept of Physics by H C Verma
3. Principles of Physics by S. L. Arora

PRACTICAL COMPONENTS

Experiment 1: To measure dimensions of a given object using Vernier calipers (Module I)

Experiment 2: To measure diameter of a wire using screw gauge. (Module I)

Experiment 3: To measure the radius of curvature of a lense using spherometer. (Module I)

Experiment 4: To verify triangle law of vector addition. (Module II)

Experiment 5: To determine acceleration due to gravity using a simple pendulum. (Module II)

Experiment 6: To find the moment of inertia of an unknown body using MI table. (Module III)

Experiment 7: To find the spring constant of a spring by static method (Hooke's Law). (Module IV)

Experiment 8: To determine surface tension of a liquid by capillary method. (Module IV)

Experiment 9: To determine the specific heat of a liquid by laws of cooling methos. (Module V)

Experiment 10: Activity- Study of Wave Motion and Superposition Principle. (Module V)

Sl No.	Course Type	Course Code	Course Title
3		BS-03	Engineering Chemistry

Objective:

To introduce fundamental as well as applied concepts of chemistry relevant for the study of topics in smart manufacturing.

Course Outcomes:

CO1: To illustrate the concepts of atomic structure and chemical bonding

CO2: To analyze and identify the materials used for engineering applications**.**

CO3: To solve engineering problems using the concept of electrochemistry and corrosion**.**

CO4: To apply pollution control methods for solving domestic and industrial problems.

Module-I: States of Matter and Chemical Equations (25 Hours)

Theory (9 Hours):

Basic concepts of materials: Atomic and molecular masses, mole concept and molar masses, percentage composition, stoichiometry and stoichiometric calculations.
Solution**:** Idea of solute, solvent and solution, methods to express the concentration of solution- molarity, mass percentage, volume percentage and mole fraction. Properties of acids and bases -Lewis's concept of acids and bases –advantages - pH and pOH – Definition – Indicator – Definition – Buffer solution – Definition – Types of buffer solution with examples – Application of pH in industries.
Concept of chemical bonding: cause of chemical bonding, types of bonds- ionic bonding, covalent bond, coordination bond, hydrogen bonding, and metallic bonding.
Chemical equations: definition of a chemical equation, qualitative and quantitative significance, limitations. Balancing of chemical equations. Oxidation and reduction.

Practical (16 Hours):

1. Preparation of standard solution of oxalic acid or potassium permanganate.

2. To determine strength of given sodium hydroxide solution by titrating against standard oxalic acid solution using phenolphthalein indicator.
3. Standardization of $KMnO_4$ solution using standard oxalic acid and determine the percentage of iron present in given Hematite ore by $KMnO_4$ solution.
4. Determination of Concentration/Molarity of $KMnO_4$ Solution by Titrating it against a Standard Solution of- (i) Oxalic acid and (ii) Ferrous ammonium sulphate.
5. Iodometric estimation of copper in the copper pyrite ore.
6. To determine the concentration of strong acid by pH metry

Module II: Engineering Materials (23 Hours)

Theory (8 Hours):

Basic concepts of Hydrocarbons and Hydroalacynes, Compounds with Functional Groups.
Natural occurrence of metals: minerals, ores of iron, aluminum and copper; Metallurgy: Principles of metallurgy and their extraction; Alloys: definition, purposes of alloying, ferrous alloys and non-ferrous, properties and applications. General chemical composition and their applications: port land cement and hardening, glasses refractory and composite materials.
Polymers and Epoxies: monomer, homo and co-polymers, degree of polymerization, simple reactions involved in preparation and their application of thermoplastics and thermosetting plastics, rubber and vulcanization of rubber, glass transition temperature.

Practical (15 Hours):

7. Experiments related to organic chemistry
8. Qualitative analysis of an alloy (Brass).
9. Preparation of thermosetting resin-Urea-formaldehyde resins.
10. To determine the viscosity of lubricating oil by Redwood viscometer.
11. To estimate the heat content or heat of enthalpy of combustible solid or liquid compound by Bomb Calorimeter.
12. Total acid number (TAN) determination of a given oil.

Module III: Electrochemistry (22 Hours)

Theory (8 Hours):

Electronic concept of oxidation, reduction; electrolytes, non-electrolytes, Faraday's laws of electrolysis and simple numerical problems; industrial application of electrolysis- electrometallurgy, electroplating, electrolytic refining, application of redox reactions in electrochemical cells- primary and secondary cells, fuel and solar cells; corrosion- definition,

types of corrosion (chemical and electrochemical), mechanism of electrochemical corrosion, factors affecting the rate of corrosion; internal corrosion preventive measures- purification, alloying, and heat treatment; external corrosion preventive measures-metal coatings, organic inhibitors. Solder Chemistry: Composition of Pb based and Pb free (SAC) solder alloys. Flux chemistry and purpose

Practical (14 Hours):

13. To verify the first law of electrolysis of copper sulfate using copper electrodes.
14. Construction and measurement of emf of an electrochemical cell (Daniel cell).
15. Estimation of Mohr's salt by permanganometry
16. Comparison of strength of two $KMnO_4$ solutions

Module IV: Environmental Chemistry (20 Hours)

Theory (8 Hours):

Definition, types of pollution, pollutants; water pollution- causes, effect and health hazards, water quality parameters- dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, pH, turbidity, hardness, total dissolved solids; controlling of water pollution; air pollution- sources, effect and controlling. greenhouse effect, acid rain, ozone layer depletion, photochemical smoke; soil Pollution- sources and controlling. Solid Waste – Definition – Problems – Types of Solid waste methods of Disposal – Land fill and Incineration – Recycling – Definition – Examples – Advantages of Recycling (Basic ideas) Green Chemistry Definition – Goals of Green Chemistry.

Practical (12 Hours):

17. To determine and compare the pH of water samples from different sources- tape water, lake water and river water.
18. Volumetric estimation of-
    (i) Total hardness of given water sample using standard EDTA solution.
    (ii) Alkalinity of given water sample using 0.01M sulphuric acid
19. Crystallization of copper sulphate and identification of ions
20. To determine the conductivity of unknown water sample.
21. Total alkalinity determination of unknown water sample.

Suggested Readings:

1. Text Book of Chemistry for Class XI & XII (Part-I, Part-II); N.C.E.R.T., Delhi, 2017-18.
2. Agarwal, & Shikha, Engineering Chemistry, Cambridge University Press; New Delhi, 2015.
3. C.N. R. Rao, Understanding Chemistry, Universities Press (India) Pvt. Ltd., 2011.

4. Dara, S. S. & Dr. S.S. Umare, Engineering Chemistry, S. Chand. Publication, New Delhi, New Delhi, 2015.
5. Jain & Jain, Engineering Chemistry, Dhanpat Rai and Sons; New Delhi, 2015.
6. Dr. Vairam, S., Engineering Chemistry, Wiley India Pvt. Ltd., New Delhi, 2013.
7. Dr. G. H. Hugar & Prof A. N. Pathak, Applied Chemistry Laboratory Practices, Vol. I and Vol. II, NITTTR, Chandigarh, Publications, 2013-14.
8. Agnihotri, Rajesh, Chemistry for Engineers, Wiley India Pvt. Ltd., 2014.

Suggested MOOCs Course with Web Link

1. https://onlinecourses.nptel.ac.in/noc25_cy48/preview
2. https://www.udemy.com/course/general-chemistry-101-chapter-1-matter-measurment/?couponCode=PMNVD2025
3. https://www.youtube.com/@LearnChemE/search?query=introduction%20to%20%20chemistry\

E-Resource Link

1. https://ncert.nic.in/textbook.php
2. https://www.academia.edu/Documents/in/Electrochemistry
3. https://library.iiti.ac.in/?page_id=1232

Mapping of COs to Syllabus

CO	Module 1	Module 2	Module 3	Module 4
CO 1	H	L	M	L
CO 2	M	H	H	L
CO 3	L	M	H	L
CO 4	L	L	M	H

SYLLABUS FOR INTEGRATED B.TECH. in MECHANICAL ENGINEERING/ DIPLOMA IN ELECTRONICS/ELECTRICAL ENGINEERING

ASSAM SKILL UNIVERSITY

Sl. No.	Course Type	Course Code	Course Title
1	Co-requisite		English for Professional Communication
Programme		Integrated B.Tech. in Mechanical Engineering/Diploma in Electrical /Electronic Engineering	
Semester		Odd Semester of the first year of the programme	

Course Objective:

To equip students with the foundational and professional communication skills essential for technical and workplace settings by integrating theoretical knowledge with hands-on practice in listening, speaking, reading, writing, and interpersonal communication with application of appropriate grammar and vocabulary knowledge.

Course Outcomes:

CO1: To understand the principles and types of communication- verbal, non-verbal, and technical communication and the importance of effective listening skills to achieve effectiveness in diverse professional contexts.

CO2: To apply knowledge of sound and letter association for appropriate pronunciation, voice modulation, vocabulary development techniques and grammatical rules to enhance clarity, correctness, and expression in oral communication integrating soft skills while participating in group discussion, attending job interviews and delivering different types of speech etc.

CO3: To read technical and non-technical texts in order to comprehend and critically evaluate them to develop reading comprehension, vocabulary, and grammatical accuracy for professional usage.

CO4: To compose professional documents such as CV and resume, job application, e-mails, business letters, meeting minutes, notice and forms accurately and concisely, adhering to organizational formats.

CO5: To develop the knowledge of vocabulary and grammar to apply appropriately and effectively while participating in activities associated with the four language skills-listening, speaking, reading and writing in real life contexts

Module I: Basics of Communication and Importance of Listening Skill (15 Hours)

Theory (5 Hours):

Basics of communication: Introduction, meaning and definition, process of communication, etc. Types of communication: formal and informal, verbal, non-verbal and intrapersonal and interpersonal, barriers to effective communication; **7** Cs for effective communication, importance of listening skill, types of listening, barriers of listening, how to make listening effective

Practical (1O Hours):

Listening Process and Practice: Introduction to recorded lectures, listening to recorded interviews and various speeches, listening to group discussion, listening tests.

Module II: Speaking skill (15 Hours)

Theory (5 Hours):

Importance of speaking skill, ways of making oral communication effective, letters and sounds in English, Introduction to Phonetics, phonemes, introduction to IPA symbols, vowels and consonants, syllables, stress, intonation Errors in Pronunciation-Neutralising Mother Tongue Interference (MTI).

Practical (10 Hours):

Practice: Common Indian Variants in Pronunciation – Differences between British and American Pronunciation -Testing Exercises, transcription of words (IPA), use of dictionary for appropriate pronunciation, Ice-Breaking activity and JAM session, situational Dialogues – Role-Play-Expressions in Various Situations – Self-introduction and Introducing Others – Greetings – Apologies – Requests – Social and Professional Etiquette, oral presentations, public speaking, Group discussion, formal presentations, mock interviews

Module III: Reading Comprehension (15 Hours)

Theory (5 Hours):

Importance of reading comprehension skill for technical students, foundational reading techniques-skimming, scanning, intensive reading, comprehension levels and cognitive skills-literal

comprehension, inferential comprehension, analytical comprehension, technical vocabulary and syntax, interpreting visuals and data structures

Practical (10 Hours):

Reading comprehension activities on different types of reading materials - identifying the main idea, structure, and flow of technical articles or research reports (skimming), Locating specific, granular information (numbers, dates, parameters, or specifications) within dense manuals or data tables (scanning), reading journal articles to understand algorithms, methodologies, (intensive reading)extracting explicitly stated facts, step-by-step procedures, and hardware specifications from product manuals, user manuals, reading between lines to determine the underlying purpose of an experiment, implied limitations of a design

Module IV: Writing Skills for Professional Excellence (15 Hours)

Theory (5 Hours):
Importance of developing writing skills, essentials of technical writing, steps in effective writing, different types of letters and formats, different types of formal report, email etiquettes,

Practical (10 Hours):

Letters: business and personnel, drafting e-mail, notices, minutes of a meeting, etc. Filling out various forms, such as bank and online forms for placement, etc., Resume and CV, Job application

Module V Module V: Vocabulary and Grammar (15 Hours)

Theory (5 Hours):
Vocabulary of commonly used technical words, Glossary of administrative terms (English and Hindi), One-word substitution, Idioms and phrases, etc., Parts of speech, ,tense, Subject Verb Agreement, derivatives- nouns, verbs, and adjectives etc., active and passive voice, narration, Punctuation.

Practical (10 Hours):
Etymological study of words and construction of words, phrasal verbs, foreign phrases, idioms, and phrases. Jargon/ Register related to organizational set up and technology, word exercises to enhance self-expression and vocabulary of participants, error correction, deriving words, application of forms of voice and narration in different types of writing

Suggested Readings:

1. J.D.O'Connor. Better English Pronunciation. Cambridge: Cambridge University Press, 1980.
2. Lindley Murray. An English Grammar: Comprehending Principles and Rules. London: Wilson
3. and Sons, 1908.
4. Kulbhushan Kumar, Effective Communication Skills, Khanna Publishing House, New Delhi (Revised Edition 2018)
5. Margaret M. Maison. Examine your English. Orient Longman: New Delhi, 1964.
6. M. Ashraf Rizvi. Effective Technical Communication. Mc-Graw Hill: Delhi, 2002.
7. John Nielson. Effective Communication Skills. Xlibris, 2008.
8. Oxford Dictionary
9. Roget's Thesaurus of English Words and Phrases
10. Collin's English Dictionary
11. Daniel Jones. The Pronunciation of English. Cambridge: Cambridge University Press, 1956.
12. James Hartman & et al. Ed. English Pronouncing Dictionary. Cambridge: Cambridge University 35 First Year Curriculum Structure Common to All Branches Press, 2006.
13. J.Sethi & et al. A Practice Course in English Pronunciation. New Delhi: Prentice Hall, 2004.
14. Pfeiffer, William Sanborn and T.V.S Padmaja. Technical Communication: A Practical Approach. 6th ed. Delhi: Pearson, 2007.

Suggested MOOCs Course with Web Link:

1. https://onlinecourses.swayam2.ac.in/cec25_hs31/preview
2. https://www.my-mooc.com/en/mooc/take-your-english-communication-skills-to-the-next-level
3. https://www.udemy.com/course/learn-english-grammar-online/?couponCode=PMNVD2025
4. https://www.udemy.com/course/language-for-the-workplace/?couponCode=PMNVD2025
5. https://nptel.ac.in/courses/109106129
6. https://www.youtube.com/@BritishCouncilEnglish/videos

E-Resource Link

1. https://ve-iitg.vlabs.ac.in/
2. https://www.nielit.gov.in/ajmer/content/communication-skills-lab
3. https://iln.ieee.org/public/contentdetails.aspx?id=14A43D6C2AC3471DB6ED1990EBCC D6E8

Mapping of COs to Syllabus:

CO	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H	M	L	L	M
CO 2	M	H	L	L	M
CO 3	M	L	H	L	M
CO 4	M	L	L	H	M
CO 5	L	M	M	M	H

Common Engineering Mathematics Curriculum

First Year Diploma Framework with Course Outcomes

Assam Skill University

1 Semester I: Engineering Mathematics-I

1.1 Course Description

This course establishes a sequential progression of core analytical tools required for diploma engineering programs. Beginning with foundational set theory and algebraic structures, it transitions smoothly into multi-angle trigonometry and comprehensive differential and integral calculus within the same academic term.

1.2 Course Outcomes (COs)

Upon successful completion of this course, students will be able to:

CO1: Understand the fundamental concepts of sets, relations, and mapping functions.

CO2: Perform arithmetic and polar operations on complex numbers.

CO3: Apply logarithms, partial fractions, permutations, and combinations to mathematical problems.

CO4: Solve trigonometric expressions and periodic wave properties.

CO5: Calculate functions, limits, continuity, and basic derivatives from first principles.

CO6: Solve indefinite and definite integration models to compute areas underneath curves.

CO7: Use mathematical software for simulation, graphing, and engineering visualization.

1.3 Lecture & Practical Framework

1.3.1 Module I: Set Theory & Functions

- **Theory:** Concepts of sets, subsets, universal sets, and empty sets. Operations on sets: Venn diagrams, union, intersection, complement, and difference of sets. De Morgan's laws. Cartesian product of sets. Definition of relations, domain, and range. Types of functions (odd, even, one-one, onto).
- **Corresponding Practicals:**
  - **Venn Diagram Simulation (Software):** Program a visual routine to accept elements of multiple sets, execute union/intersection operations, and dynamically highlight the corresponding regions on a Venn diagram.

1.3.2 Module II: Foundational Algebra & Combinatorics

- **Theory:** Definition, geometric representation on the Argand plane, modulus, amplitude, polar form of a complex number, rationalization, addition, subtraction, multiplication, and division, De Moivre's theorem. Fundamental laws of logarithms, base conversion principles. Resolving algebraic fractions into partial fractions (linear, repeated, and non-repeated quadratic denominators). Fundamental principles of counting, factorial notation. Definitions and core operational properties of Permutations (${}^{n}P_{r}$) and Combinations. Binomial Theorem expansions for positive integral indices.
- **Corresponding Practicals:**
  - **Representation of Complex Numbers:** Plot complex numbers on the Argand plane and identify real and imaginary parts.
  - **Conversion between Cartesian and Polar Forms:** Convert complex numbers from Cartesian form to polar form and vice versa.
  - **Verification of Laws of Logarithms:** Verify fundamental logarithmic identities numerically and analytically.
  - **Partial Fraction Decomposition:** Resolve rational algebraic fractions into partial fractions involving linear and quadratic factors.

- **Combinatorial Calculator (Software):** Build an automated system to calculate factorials, permutations, and combinations dynamically for any given n and r values.

1.3.3 Module III: Trigonometry

- **Theory:** Compound angles and associated angles. Transformation of sums or differences into products, and products into sums or differences. Multiple and sub-multiple angle equations. Inverse Trigonometric Functions: Definition, domain, range, and basic structural properties of inverse trigonometric expressions. Properties of Triangles: Mathematical relationships between the sides and angles of a triangle; Sine and Cosine formulas.
- **Corresponding Practicals:**
  - **Verification of Compound Angle Formulae:** Verify identities for $\sin(A \pm B)$, $\cos(A \pm B)$, and $\tan(A \pm B)$.
  - **Transformation Formulae:** Verify sum-to-product and product-to-sum trigonometric identities.
  - **Trigonometric Waveforms & Graphs:** Plot graphs of $\sin x$, $\cos x$, $\tan x$, $\sin 2x$, and $\sin(x/2)$. Plot and analyze periodic waveforms using composite trigonometric functions, examining modifications in phase shifts and amplitudes.
  - **Verification of Sine and Cosine Rule:** Verify the sine rule and cosine rule for different triangles using measured data.

1.3.4 Module IV: Differential & Applied Differential Calculus

- **Theory:** Limits & Continuity: Definition of a mathematical function, concept of limits. Verification of continuity constraints at a given point. Differentiation Fundamentals: Geometrical significance of the first derivative. Differentiation from first principles. Differentiation of standard algebraic and trigonometric functions. Advanced Differentiation: Derivatives of standard algebraic, trigonometric, parametric, and implicit functions using the Chain Rule. Applications of Derivatives: Finding equations of tangents and normals to curves. Local maxima and minima of single-variable functions; absolute extrema within closed intervals.
- **Corresponding Practicals:**
  - **Evaluation of Algebraic and Transcendental Limits:** Evaluate limits of algebraic and transcendental functions analytically and graphically.
  - **Verification of Continuity of Functions:** Verify continuity of piecewise and standard functions at a given point. Build an iterative loop that demonstrates how $\Delta y = |f(x_0 + \Delta x) - f(x_0)|$ approaches zero as Δx is made micro-incrementally small, establishing continuity constraints.
  - **Differentiation from First Principles:** Find derivatives of functions using the definition of a derivative.
  - **Geometrical Meaning of Derivative:** Demonstrate the derivative as the slope of a tangent to a curve. Write a script to calculate the slope of a secant line across a curve as the interval decreases, demonstrating visually how it transitions into a tangent line.
  - **Differentiation using Chain Rule:** Find derivatives of composite functions using the chain rule.
  - **Implicit and Parametric Differentiation:** Determine derivatives of implicit and parametric functions.
  - **Tangent and Normal to Curves:** Find equations of tangent and normal at a given point on a curve.
  - **Maxima and Minima of Functions:** Determine local maxima, minima, and absolute extrema of functions graphically and analytically. Build an algorithm that traces a continuous function curve, approximates its turning points numerically, and highlights local maximum and absolute minimum nodes visually.

1.3.5 Module V: Integral Calculus Foundations

- **Theory:** Fundamental integration tables. Methods of integration: substitution, by parts, and rational algebraic functions. Definite Integrals & Applications: Fundamental theorem of definite integrals, evaluation using properties, and calculating the bounded area under curves.
- **Corresponding Practicals:**
  - **Basic Integration Techniques:** Evaluate integrals using standard integration formulas.

- **Integration by Substitution and Parts:** Perform integration using substitution and integration by parts methods.
- **Integration of Rational Functions:** Integrate rational algebraic functions using partial fractions.
- **Definite Integrals and Area under Curves:** Evaluate definite integrals and calculate area bounded by curves. Develop an interactive utility that shades the space beneath an integrated curve and calculates the total area using both analytic definite integration and definite Riemann sums.

Recommended Software Environment: MATLAB, Wolfram Mathematica.

2 Semester II: Engineering Mathematics-II

2.1 Course Description

This course groups the remaining spatial, statistical, and numerical structural competencies required for engineering applications. It covers multi-unknown matrix methods, geometric conic trajectories, three-dimensional grid frameworks, first-order differential equations, applied statistics with conditional probability layouts, and physical boundary measurements via solid mensuration.

2.2 Course Outcomes (COs)

Upon successful completion of this course, students will be able to:

CO1: Solve simultaneous linear systems with multiple unknowns using determinants, matrices, and inversion rules.

CO2: Apply two-dimensional coordinate geometry concepts to analyze straight lines and geometric properties of conic sections.

CO3: Formulate equations and calculate directional traits of lines within three-dimensional coordinate spaces.

CO4: Find solutions of first-order and first-degree differential equations by variable separation methods.

CO5: Profile raw engineering datasets using statistical measures, evaluate conditional risks using Bayes' theorem, and compute irregular boundaries using solid mensuration equations.

2.3 Lecture & Practical Framework

2.3.1 Module I: Matrices and Determinants

- **Theory:** Algebra of Matrices: Definition, equality, addition, subtraction, scalar multiplication, and matrix multiplication. Determinants: Definition and expansion of third-order determinants. Minors and cofactors. Properties of determinants and simplification configurations. Systems of Linear Equations: Solutions of simultaneous engineering equations with multiple unknowns using Cramer's rule.
- **Corresponding Practicals:**
  - **Matrix Operations:** Perform equality check, addition, subtraction, scalar multiplication, and multiplication of matrices.
  - **Determinants, Minors, and Cofactors:** Evaluate third-order determinants and determine minors and cofactors of matrices. Verify determinant properties and simplify configurations.
  - **Solution of Simultaneous Equations:** Solve systems of linear equations using Cramer's Rule and Matrix Inversion method. Write a routine to take an $N \times N$ matrix system, evaluate its determinant, compute its inverse matrix, and solve simultaneous engineering equations.

2.3.2 Module II: Two-Dimensional Coordinate Geometry

- **Theory:** Review of Cartesian coordinate systems, distance formulas, and section formulas in a 2D plane. Straight Lines: Equation of a straight line using point-slope form, slope-intercept form, and general form. Graphical study and mathematical conditions for parallel and perpendicular lines.
- **Corresponding Practicals:**
  - **Verification of Distance Formula:** Compute and verify the distance between two points geometrically.
  - **Verification of Section Formula:** Determine coordinates of points dividing a line segment internally and externally.
  - **Equation of Straight Line:** Derive and verify the equation of a straight line using point-slope form.
  - **Graphical Study of Parallel and Perpendicular Lines:** Verify conditions for parallelism and perpendicularity using slopes of lines.

2.3.3 Module III: Advanced Geometry (Conics & 3D) & Differential Equations

- **Theory:** Conic Sections: Standard equations of a circle under various coordinate conditions (center-radius form, general form). Concepts and problems on Parabolas, Ellipses, and Hyperbolas. Three-Dimensional Geometry: Basics of 3D coordinate grids, distance and section formulas in space, determination of direction cosines and direction ratios of a spatial line.

Differential Equations: Solution of first-order and first-degree differential equations by variable separation method (simple problems).

- **Corresponding Practicals:**
  - **Equation and Graph of Circle:** Plot circles using center-radius form and general equation form.
  - **Study of Conic Sections:** Plot and analyze parabola, ellipse, and hyperbola with standard equations. Program a script to render and plot conics from user-defined parameters (foci, vertices, center-point offsets).
  - **Distance and Section Formula in 3D:** Verify distance and section formulas between points in three-dimensional space.
  - **Direction Ratios and Direction Cosines:** Determine direction ratios and direction cosines of lines in space.
  - **Differential Equations Computational Solvers:** Implement computational routines using software scripts to solve, visualize, and analyze first-order differential equations relevant to engineering setups.

2.3.4 Module IV: Applied Statistics, Probability & Mensuration

- **Theory:** Statistical Data: Measures of central tendency including calculation and engineering properties of Mean, Median, and Mode. Measures of dispersion (range, mean deviation, standard deviation, and variance). Probability Distributions: Basic probability axioms, dependent and independent events, conditional probability theorems, and engineering applications of Bayes' Theorem. Curvilinear Estimation: Approximating the surface area of irregular curvilinear objects using Simpson's 1/3 rule. Solid Mensuration: Calculation formulas and practical application problems for the volume and surface area of prisms, pyramids, spheres, cones, and frustums of pyramids/cones.
- **Corresponding Practicals:**
  - **Statistical Data Profiler:** Implement a data parsing script to compute the mean, median, mode, variance, and standard deviation of an inputted engineering experimental dataset.
  - **Simpson's 1/3 Rule Solver:** Approximate the area of irregular curves using Simpson's 1/3 rule. Construct a program that takes discrete coordinate offsets along an irregular shape or topographical curve and estimates the cross-sectional area.
  - **Volume and Surface Area Operations:** Calculate volume and surface area of prisms, pyramids, spheres, cones, and frustums. Write a script to calculate and visually output the surface area, cross-sections, and total volume parameters based on geometric height and radius inputs.

Recommended Software Environment: MATLAB, Wolfram Mathematica.

Signatures:

1. Faculty, Mathematics:
2. Head, Department of Basic Sciences and Humanities:
3. Head, Electronics and Communication Engineering:
4. Head, Electrical Engineering:
5. Head, Mechanical Engineering:
6. Dean-Academics:

DIPLOMA & INTEGRATED B. TECH

SECOND SEMESTER

(ECE, EE & ME)

ENGINEERING PHYSICS-II

Course Type	Course Code	Course Title
BS-02		Engineering Physics-II

Course Outcomes (COs):

CO1. Explain the principles of ray optics and wave optics, including reflection, refraction, interference, diffraction, and polarization of light. **(L2-understand)**

CO2. Apply the concepts of electrostatics, capacitance, electric current, resistance, and network laws to solve numerical and practical electrical problems. **(L3-Apply)**

CO3. Analyze the principles of electromagnetism, electromagnetic induction, magnetic materials, transformers, galvanometers, and related devices. **(L4-Analyze)**

CO4. Explain the basic concepts of semiconductors, p-n junction diodes, and electronic devices and their applications. **(L2-understand)**

CO5. Describe the concepts of modern physics, including the photoelectric effect, matter waves, radioactivity, nuclear energy, and LASER technology, and relate them to practical applications. **(L2-understand & L3-Apply)**

MODULE I: RAY OPTICS AND WAVE OPTICS (5 HOURS)

UNIT 1: Basic Optical Laws: reflection, refraction, lenses, power of lenses, total internal reflection, Dispersion in a prism, Angle of minimum deviation.

UNIT 2: Coherence, Huygens' wave theory, the interference principle, Young's double slit experiment, diffraction (definition), types of diffraction, and polarization of light.

MODULE II: ELECTRICITY (9 HOURS)

UNIT 3: Coulomb's law, electric lines of force, electric flux, Gauss's law, and its application in a straight charged conductor, plane sheet, and charged sphere. Electric potential, potential difference.

Capacitor, Capacitance of a parallel plate capacitor, Series and parallel combination capacitor, Dielectric breakdown

UNIT 4: Electric current, resistance, its units, resistivity, carbon resistance and color coding, specific resistance, series and parallel combinations of resistance, Ohm's law and its verification, Kirchhoff's law, the Wheatstone bridge principle and application to the meter bridge, heating effect of current, and electric energy and its units.

MODULE III: ELECTROMAGNETISM (8 HOURS)

UNIT 5: Concept of electromagnetic induction, Lenz's law, force on a current-carrying wire, self-inductance & mutual inductance, and principle of a transformer.

Moving-coil galvanometer, conversion of galvanometer to ammeter and voltmeter.

UNIT 6: Magnetic material (dia, para, and ferro) and their properties, magnetic intensity, horizontal component of the earth's magnetic field, hysteresis, and BH curve (qualitative idea only)

MODULE IV: ELECTRONICS (3 HOURS)

UNIT 7: Energy bands in solid, types of material (insulator, semiconductor, conductor), intrinsic and extrinsic semiconductors, p-n junctions, I-V characteristics of a diode. Uses of diode.

MODULE V: MODERN PHYSICS (5 HOURS)

UNIT 8: Photoelectric effect, characteristics of photoelectrons, Einstein's photoelectric equation,

Dual nature of light, matter waves, and de Broglie's hypothesis.

UNIT 9: Radioactivity, Becquerel rays, binding energy and mass defect, and applications of radioactivity (nuclear fission, nuclear fusion, and nuclear fuel)

UNIT 10: Introduction to LASER, its properties and uses.

References:

1. NCERT Text Book, Class 11
2. Concept of Physics by H C Verma
3. Principles of Physics by S. L. Arora

PRACTICAL COMPONETS

Experiment 1: To prove the Snell's law and hence find the lateral shift in a glass slab using pin method. (Module I)

Experiment 2: To find the focal length of a given lens (convex) by U-V method using optical bench. (Module I)

Experiment 3: To find the angle of minimum deviation and hence to find the refractive index of the material of a prism. (Module I)

Experiment 4: To verify Ohm's law and determine resistance. (Module II)

Experiment 5: To determine unknown resistance using meter bridge by Wheatstone bridge principle. (Module II)

Experiment 6: To determine resistivity of a given wire. (Module II)

Experiment 7: To compare the emf of two given cell using potentiometer. (Module II)

Experiment 8: To draw the magnetic lines of force using a bar magnet and a compass needle. (Module III)

Experiment 9: To convert galvanometer into ammeter and voltmeter. (Module III)

Experiment 10: To study forward and reverse bias characteristics of a diode. (Module IV)

Experiment 11: To study properties of laser light. (Module V)