



SASTRA

ENGINEERING · MANAGEMENT · LAW · SCIENCES · HUMANITIES · EDUCATION

DEEMED TO BE UNIVERSITY

(U/S 3 OF THE UGC ACT, 1956)

THINK MERIT | THINK TRANSPARENCY | THINK SASTRA

Scheme of Study and Syllabus
for
First Year B. Tech. / M. Tech. (5 – Year Integrated)
Degree Programmes
for
Students admitted from 2024-25

I Semester

Course Code	Course Name	No of Contact Hours / Week			Credits
		L	T	P	
ENG101R01/ BIT101R01	Technical Communication	1	0	2	2
	Biology for Engineers	2	0	0	
MAT101R01 OR MAT143 & MAT144	Engineering Mathematics – I OR Trigonometry & Matrix Algebra Calculus & Theory of Equations	3 2 2	1 1 1	0 0 0	4 3 3
CSE101R01	Problem Solving & Programming in C	3	0	2	4
PHY101R01 / CHY101	Engineering Physics /	3	0	2	4
	Engineering Chemistry	3	0	2	4
EEE101R01 / EIE101R01	Basic Electrical Engineering /	2	0	2	3
	Basic Electronics Engineering	2	0	2	3
CIV101/ MEC101	Basic Civil Engineering /	2	0	2	3
	Basic Mechanical Engineering	2	0	2	3
CIV102 / CIV103	Engineering Mechanics /	2	1	0	3
	Engineering Graphics	1	0	4	3
MEC102	Introduction to Engineering Design	2	0	0	2
TOTAL	Group I (Technical Communication, Physics, Electrical, Civil, Mechanics & Design)	18	2	10	25
	Group II (Biology, Chemistry, Electronics, Mechanical & Graphics)	16	1	12	23
	Non-Maths Students (Chemistry, Electronics, Mechanical & Graphics)	15	2	12	23

Students with non-maths background in XII shall have MAT143 & MAT144

Students with non-maths background in XII shall not have ENG101R01 and BIT101R01

II Semester

Course Code	Course Name	No of Contact Hours / Week			Credits
		L	T	P	
ENG101R01/ BIT101R01	Technical Communication	1	0	2	2
	Biology for Engineers	2	0	0	
MAT102R01 MAT145#	Engineering Mathematics – II Ordinary Differential Equations & Vector Calculus	3	1	0	4
CSE201R01	Object Oriented Programming in C++	3	0	2	4
PHY101 R01/ CHY101	Engineering Physics /	3	0	2	4
	Engineering Chemistry	3	0	2	4
EEE101R01 / EIE101R01	Basic Electrical Engineering /	2	0	2	3
	Basic Electronics Engineering	2	0	2	3
CIV101/ MEC101	Basic Civil Engineering /	2	0	2	3
	Basic Mechanical Engineering	2	0	2	3
CIV102 / CIV103	Engineering Mechanics /	2	1	0	3
	Engineering Graphics	1	0	4	3
MEC102	Introduction to Engineering Design	2	0	0	2
TOTAL	Group I (Biology, Chemistry, Electronics, Mechanical, &Graphics)				
	Non-Maths Students (Chemistry, Electronics, Mechanical, &Graphics)	16	1	12	23
	Group II (Technical Communication, Physics, Electrical, Civil, Mechanics & Design) including Non-Maths	18	2	10	25

Students with non-maths background in XII shall have ENG101R01 and MAT145

L	T	P	C
1	0	2	2

Course Code: ENG101R01
Semester: I / II

TECHNICAL COMMUNICATION

Course Objectives

The course enables the Engineering students to communicate effectively in their courses and in their careers. Centred on both technical and business communication, the course endeavours to train the learners in written and oral communication.

Unit I: Technical Communication Basics

8 Periods

Technical Communication: Nature and Scope; Characteristics of a Technical Document; Planning, Drafting, Revising, Understanding audience and purpose; Researching the subject; Understanding the research process; Choosing appropriate research methods; Secondary and Primary research; Continuous collaboration between technical communicators and stakeholders. Principles for Organizing Technical Information; Conventional Organizational Patterns: Chronological, Spatial, General to Specific, More Important to Less Important, Comparison and Contrast, Classification or Partition, Problem-Methods-Solution, Cause and Effect.

Unit II: Writing Technical Documents

12 Periods

Writing Reports: Understanding the Process of Writing Informational Reports; Writing Directives, Field Reports, Progress and Status Reports, Incident Reports Meeting Minutes; Writing Recommendation Reports; Writing Lab Reports; Writing Proposals: Understanding the Process; The Logistics of Proposals; Internal and External Proposals; Solicited and Unsolicited Proposals, Research Proposals; The "Deliverables" and Structure; Writing Definitions: Parenthetical Definitions, Sentence Definitions, Extended Definitions; Guidelines for Writing Effective Definitions. Writing Descriptions: The Nature and Scope of the Description; Introducing the Description; Providing Appropriate Detail; Writing Instructions: Understanding the role of instructional videos, Designing a set of written instructions; General Instructions, Step-By-Step Instructions. Writing User Manuals; Scientific Papers.

Unit III: Business Communication

10 Periods

Understanding the Process of Writing Business Correspondence; Selecting a Type of Correspondence; Using the appropriate level of formality; Communicating correctly; Projecting the "you attitude." Avoiding correspondence clichés; Writing honest business correspondence.

Elements of a Letter; Common Types of Letters: Inquiry Letter Response to an Inquiry, Claim Letter, Adjustment Letter, Calling for quotation, Placing order. Writing Memos, Emails, Microblogs, Writing Correspondence to Multicultural Readers; Employment correspondence: Understanding the Job-Application Process, Establishing Your Professional Brand; Planning the Job Search, Writing Résumés and Job-Application Letters, Preparing for a Job Interview; Writing Follow-up Letters after Interview.

Unit IV: Making Oral Presentations

7 Periods

Understanding the Role of Oral Presentations; the Process of Preparing and Delivering Presentation. Analyzing the Speaking Situation; Analyzing the Audience and Purpose; Organizing and Developing the Presentation. Planning the Introduction and the Conclusion; Preparing Presentation Graphics; Using Language to Signal Advance Organizers, Summaries, and Transitions; Rehearsing and Delivering the Presentation. Using Voice and Body Effectively; Answering Questions after Presentation.

Unit V: Language Aspects in Technical Communication

8 Periods

Skimming Sources and Taking Notes: Paraphrasing, quoting and summarizing; Documenting Your Sources: APA, IEEE and MLA Style; Editing and Proofreading Documents: Punctuation, Mechanics, Proofreading symbols; Cultural and Stylistic Communication Issues. Sentence-Level Issues: Articles and Nouns, Prepositions and Sentence Structure; Writing Grammatically Correct and Effective Sentences; Choosing the Right Words and Phrases; Using technical jargon appropriately; Avoiding: Sentence Fragments, Comma Splices, Run-On Sentences, Ambiguous Pronoun References; Using Adjectives Clearly, Maintaining Subject-Verb Agreement, Pronoun-Antecedent Agreement, Using Tenses Correctly.

REFERENCES

1. Houpp W, Kenneth et al. Reporting Technical Information. New York: Oxford. 2009.
2. Markel, Mike. Technical Communication. New York: Bedford. 2007.
3. Laplante, A. Philip. Technical Writing: A Practical Guide for Engineers, Scientists, and Nontechnical Professionals. CRC Press. 2019.
4. Gerson, Sharon & Steven Gerson. Technical Communication: Process and Product. Pearson. 2019.
5. Barrass, Robert. *Scientists Must Write*. London: Routledge. 2003
6. Faculty of English. *Technical Communication*. SASTRA Publication. 2017.
7. Ingre, David & Robert Basis. Engineering Communication: A Practice Guide to Workplace Communications for Engineers. Cengage. 2017.
8. Bailey, Stephen. Academic Writing: A Handbook for Students. Routledge. 2018.

ONLINE RESOURCES

1. Strunk, W., Jr. and White, E.B. *Elements of Style*.
<http://faculty.washington.edu/heagerty/Courses/b572/public/StrunkWhite.pdf>
2. Purdue Online Writing Lab: <https://owl.english.purdue.edu/owl/section/1/>

LEARNING OUTCOMES

At the end of the course, the learner will be able to:

Unit I	Recognize the nature and scope of technical communication Apply conventional patterns of organizing of technical texts
Unit II	Draft various kinds of technical documents like: reports, proposals, user manuals and so on. Produce technical definitions, descriptions and instructions
Unit III	Prepare all types of business correspondence with appropriate level of formality Write planned job-related correspondence
Unit IV	Demonstrate skill of oral presentation on technical and general contexts
Unit V	Recognize the grammatical structures Follow style manuals while documenting sources

L	T	P	C
2	0	0	2

Course Code: BIT101R01
Semester: I / II

BIOLOGY FOR ENGINEERS

COURSE OBJECTIVES

The objective of this course is to enable learners to understand the basic organization, functions and characteristics of living organisms, and apply them for various Engineering applications.

Module 1 Introduction to Bio-inspired Engineering (1 h)

Introduce the course with examples of bioinspiration, biomimicry and biomimetics

Module 2 Cell & its constituents for the Development of Bio-sensors (11 h)

Biomolecules - the building blocks of Cell: Carbohydrates-classification, types and functions; Nucleic Acids - types and functions (DNA and RNA); Lipids – classification and functions; Proteins – types, structure and functions; Enzymes – Activation energy, co-enzymes; Biosensor (Applications in Healthcare, Food and Environmental Science)

Cell structure and function; Microorganisms, Biofilters (Pollution control and treatment), Self-healing concrete

Module 3 Flow of Genetic Information - Storage, Optimization and Retrieval (4 h)

The central dogma in molecular biology - Transcription and Translation, DNA as data storage system; Darwinian evolution, Genetic Algorithms

Module 4 Interdisciplinary technologies inspired from organ systems-I (6 h)

Immune System, artificial immune system and swarm robotics; Cardiovascular, Respiratory, Renal system, Stem Cells & 3D bio-printing, Human Organ-on-chip

Module 5 Interdisciplinary technologies inspired from organ systems-II (7 h)

Muscular System, Ionic and Electroactive polymers, Bio-robotics; Sensory organs (eye, ear, smell, taste, touch); Bio-optics & Bionics; Nervous System, Artificial neural networks

Module 6 Laboratory Experiments (2 h)

Exp. 1: Introduction to biosafety laboratory practices and bio-waste disposal

Exp. 2: Comparison of self-cleaning property on natural and synthetic surfaces

Exp. 3: Demonstration of 3D Printing

Textbooks:

1. Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece. 2016. Campbell Biology (11th edition), Pearson
2. Bar-Cohen, Y. 2012. Biomimetics: Nature-Based Innovation.: CRC Press, Taylor & Francis.

References:

1. Karp, G. 2007. Cell and Molecular Biology, 5th ed. John Wiley and Sons, Inc.
2. Shier D, N., Butler J.L., Lewis R. 2010. Hole's Human Anatomy and Physiology, 12thed. New York, N.Y.: McGraw-Hill.

Learning Outcomes

Upon completion of the course, the learners will be able to	
Module 1	Outline the current technological inventions inspired from biology
Module 2	Explain the basic units of life and apply the concepts for engineering applications
Module 3	Describe the flow of information in cell and evolution and apply them for data optimisation and storage
Modules 4 & 5	Illustrate the interdisciplinary technologies inspired from human organ systems
Module 6	Apply theoretical knowledge of basic biology in engineering applications

L	T	P	C
3	1	0	4

Course code: MAT101R01
Semester: I

ENGINEERING MATHEMATICS – I

Course Objectives

The course aims to train the learner to:

- Understand the various techniques of expansion of trigonometric functions, hyperbolic and logarithmic functions.
- Know methods of finding Eigen values and Eigen vectors for a given matrix and understand the transformation of quadratic forms to canonical forms through orthogonal transformations.
- Know the various techniques to find the summation of infinite series and in the transformation of algebraic equations that will serve them well towards tackling more topics at advanced levels of mathematics.
- Understand the concepts of Improper integrals and their applications.

UNIT I: Trigonometry

15 Periods

Expansions of $\sin n\theta$ and $\cos n\theta$ in powers of $\sin\theta$ and $\cos\theta$ – Expansions of $\sin^n \theta$ and $\cos^n \theta$ in terms of sines and cosines of multiples of θ – Expansions of $\sin \theta$ and $\cos \theta$ as powers of θ – Related problems - Hyperbolic and Inverse hyperbolic functions – Logarithm of complex numbers – separation of complex functions into real and imaginary parts.
Problems related to hyperbolic and circular functions

UNIT – II: Matrix Algebra:

15 Periods

Elementary transformation – Rank of a matrix - Linear independence of vectors – Consistence and Inconsistence system of linear equations - Eigen values and Eigen vectors – Properties of Eigen values and Eigen vectors – Singular value decomposition – Similarity transformation – Orthogonal transformation of a real symmetric matrix – Diagonalisation of a matrix through transformations - Quadratic Forms – Nature of Quadratic forms – Reduction of Quadratic form to Canonical form
Applications related to system of equations and Eigen values

UNIT – III : Theory of Equations & Algebra

15 Periods

Theory of Equations : Review-(Fundamental theorem of Algebra(Statement only) – complex and irrational roots – equations whose roots are in A.P,G.P and in H.P – Relations between the roots and coefficients) – Symmetric functions – Formation of equations – Decreasing and Increasing the roots – Transformation of equations – Reciprocal equations – Descarte's rule of Signs.

Stability analysis based on zeros of a polynomial equation.

Algebra: Binomial, Exponential and Logarithmic Series (without proof) – Problems on summation, coefficient and approximations and its applications in probability distributions.

UNIT – IV: Improper and Multiple Integrals

15 Periods

Improper Integrals :Concept of improper integrals with examples – Definition of Beta and Gamma integrals – Relation between them – Properties of Beta and Gamma integrals – Evaluation of definite integrals in terms of Beta and Gamma integrals – Simple applications (evaluation of double and triple integrals).

Multiple Integrals: Double Integrals – Evaluations – Change of order of integration – Triple integrals (problems involving Jacobians are not included).

Density, Volume, Mass, Moments of Inertia

TEXT BOOKS

1. T.Veerarajan, K.Kannan, *Engineering Mathematics – I* , Tata McGraw Hill Education (India) , 2020.
2. NP.Bali, Dr.Manish Goyal , *A text book of Engineering Mathematics*, 9th edition, Laxmi Publications, 2014.
2. CB Gupta, SR Singh, *Engineering Mathematics for semester I and II*, Mukesh kumar, McGraw Hill (India), 2015.

REFERENCES

1. BS. Grewal , *Higher Engineering Mathematics*, 44th edition, Khanna Publishers, 2020.
2. Erwin Kreyszig, *Advanced Engineering Mathematics*, 10th Edition, John Wiley and Sons 2015.
3. Srimanta Pal, SC. Bhunia, *Engineering Mathematics*, Oxford University Press, 2015.
4. W.Jordan, P. Smith, *Mathematical techniques*, Oxford University Press, 2014.
5. Donald A. McQuarrie , *Mathematical methods for Scientists and Engineers*, Viva Books, 2003.

Online materials:

1. NPTEL : <https://nptel.ac.in/courses/122/104/122104017/>
2. NPTEL : <https://nptel.ac.in/courses/111/105/111105035/>
3. NPTEL : <https://nptel.ac.in/courses/111/107/111107108/>
4. NPTEL : <https://nptel.ac.in/courses/122/104/122104018/>

UNIT-WISE LEARNING OUTCOMES

Upon completion of each unit, the learner will be able to:

Unit I	Demonstrate an understanding of circular and hyperbolic functions and their applications.
Unit II	Calculate rank of matrix, compute the Eigen values and Eigen vectors for diagonalisation of matrices
Unit III	Develop skills to locate the position of roots and determine their characteristics.
Unit IV	Apply the concept of change of order of integration, evaluation of multiple integrals and their usage in computing the areas and volumes.

COURSE LEARNING OUTCOMES

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

CO No.	Course Outcome	Knowledge Level
CO1.	Acquire the knowledge of circular and hyperbolic functions of a complex variable.	K3
CO2.	Apply the theoretical knowledge for finding the roots of a given equation in practical problems.	K3
CO3.	Applying a polynomial method to perform stability analysis in control systems	K3
CO4.	Apply the matrix techniques to reduce the quadratic forms to canonical forms, find solutions of systems of linear equations in different areas of Linear Algebra.	K3
CO5.	Evaluate some special functions like Gamma & Beta functions and learn the relation between them to definite integrals arising in various branches of Engineering.	K3
CO6.	Evaluate the mass, moment of inertia and density of solid objects.	K3

L	T	P	C
3	0	2	4

Course Code: CSE101R01

Semester: I

PROBLEM SOLVING & PROGRAMMING IN C

Course Objective:

This course will help the learner to formulate simple algorithms for arithmetic & logical problems and translate the algorithms to C programs using constructs like arrays, functions, pointers, structures & files

UNIT - I: Introduction to C, Decision Control and Looping Statements

12

Periods

Introduction to Algorithms - Building Blocks of Algorithms - Notation for Deploying Algorithms. **Introduction to C:** Introduction - Structure of C program - Files used in C Program - Tokens - Character Set - Keyword - Identifiers - Basic Data Type - Constants and Variables - I/O Statements - Operators - Type Conversion and Type Casting.

Applications: Swapping of two numbers, Simple arithmetic problems. **Decision Control and Looping Statements:** Conditional Branching - Iterative - Nested Loops - Break and Continue - goto. **Applications:** Even or odd number, Greatest of three numbers, Finding roots of a quadratic equation, Factorial, Sum of n numbers, Operations on digits of an integer, gcd, Base conversion, Generation of fibonacci series.

UNIT - II : Functions and Arrays

11

Periods

Functions: Introduction - Declarations - Definitions - Call and Return statement - Passing Parameters - Variable Scope - Storage Class - Recursive Functions and its Types **Applications:** Factorial, Sum of n numbers, Operations on digits of an integer, gcd, Base conversion, Generation of Fibonacci series. **Arrays:** Introduction - Declaration - Access of Array Elements - Storing Value - Operations - Passing Array to Functions - 2D Array and its Operations - Passing 2D Array to Functions - Multidimensional Array.

Applications: Insertion and deletion in an array, Bubble sort, Linear and binary search, Removal of duplicates from an ordered array, Basic matrix operations.

UNIT - III : Strings, Structures and Unions

11

Periods

Strings: Introduction - Suppressing Input - Taxonomy - Operations on Strings - Miscellaneous and Character Functions - Array of Strings. **Applications:** Keyword searching in a text, Searching & sorting of strings. **Structures and Unions:** Introduction - Nested and Array of Structures - Structures and Functions - Union - Enumerated Data Type. **Applications:** Programs using array of structures.

UNIT - IV : Pointers and Files

11

Periods

Pointers: Introduction - Declaration - Pointer Expression and Arithmetic - Null and Generic Pointers - Passing Arguments using Functions - Comparison of Array and Pointer - Pointers and Strings - Array of Pointers - Function Pointer - Pointer to Pointer - Self Referential Structure - Dynamic Memory Allocation - Drawbacks of Pointers.

Applications: Linked List operations. **Files:** Introduction - Using Files in C - Read and Write - EoF - Error Handling - Functions for Selecting a Record Randomly - Rename a File. Applications: Random read and write on files

TEXTBOOK

1. Reema Thareja, *Programming in C*, 3rd Edition, Oxford University Press, 2023.

REFERENCES

1. Pradip Dey. and Manas Ghosh, *Computer fundamentals and programming in C*, 2nd Edition, Oxford University Press, 2013.
2. Byron, Gottfried, *Programming with C*. 3rd Edition, McGraw Hill Education, 2017.
3. Anil Bikas Chaudhuri, *The art of programming through flowcharts & algorithms*, 1st Edition, Firewall Media, 2018.
4. Brian W Kernighan. and Dennis M Ritchie, *The C programming language*, 2nd Edition, Pearson Education, 2017.

ONLINE MATERIALS

1. NPTEL -<http://nptel.ac.in/courses/106104128/>
2. NPTEL -<http://nptel.ac.in/courses/106102066/>

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">• Develop an algorithms for arithmetic and logical problems• Develop programs using input and output statements• Recall the syntax of branching and looping constructs
Unit II	<ul style="list-style-type: none">• Select an appropriate construct to solve the given problem• Develop programs using functions• Illustrate the operations on arrays
Unit III	<ul style="list-style-type: none">• Demonstrate string operations• Develop programs using structures and unions
Unit IV	<ul style="list-style-type: none">• Develop programs using pointers• Illustrate the operations on files

LIST OF LAB EXERCISES

1. Programs using Input, Output and Assignment Statements
2. Programs using Branching Statements
3. Programs using Looping Statements
4. Programs using Functions & Recursion
5. Programs using Single and Multidimensional Arrays
6. Programs using Strings
7. Programs using Structures
8. Programs using Pointers & Dynamic Memory Allocation
9. Programs using Files

L	T	P	C
3	0	2	4

Course code: PHY101R01

Semester: I / II

ENGINEERING PHYSICS

Course Objectives:

The objectives of the course are:

- To provide fundamental knowledge about quantum mechanics, lasers, fiber optics and different kinds of engineering materials.
- To correlate the theoretical physics principles with application oriented engineering studies.

Unit – I

11 periods

Quantum Mechanics: Limitations of Classical Mechanics – Photoelectric Effect - Einstein's Photoelectric Equation - Planck's Quantum Theory (Qualitative) - Wave Particle Duality - de-Broglie's Wave – Heisenberg's Uncertainty Principle - Time Independent and Time Dependent Forms of Schrödinger Wave Equation – Particle in a Box (1D) – Quantum Mechanical Tunneling – Scanning Tunneling Microscope -Quantum Well, Quantum Wire and Quantum Dot.

Unit – II

11 periods

Introduction to Laser: Spontaneous and Stimulated Emissions - Einstein's A and B Coefficients – Basic Principles of LASER – Population Inversion – Two, Three and Four Level Systems – Different Types of Pumping – Characteristics of LASER. Types of Laser: Nd-YAG LASER– CO₂ Laser – Semiconductor Laser - Applications of Laser

Fiber Optics: Structure and Principles of Optical Fiber – Acceptance Angle and Numerical Aperture – V-Number - Types of Fibers: Step Index, Graded Index, Single Mode & Multimode - Application of Optical Fibers

UNIT - III

12 periods

Dielectric materials: Properties of Dielectric Materials – Dielectric Constant, Induced and Permanent Dipoles, Polar and Non-Polar Dielectrics, Polarization of Dielectric Materials, Types of Polarization- Electronic Polarizability Derivation- Local Field Derivation- Clausius- Mossotti Equation- Ferro and Piezo-Electricity (Qualitative), Frequency Dependence of Dielectric Constant, Applications of Dielectric Materials.

Magnetic materials: Basics of Magnetic Materials – Classification of Magnetic Materials and Properties – Weiss Theory of Ferromagnetism –Domain Concepts– Hard and Soft Magnetic Materials and its Applications.

Unit – IV

11 periods

Semiconductor Physics: Intrinsic & Extrinsic Semiconductors -Direct and Indirect Band Gap Semiconductors - Carrier Concentration of Intrinsic Semiconductors – Extrinsic Semiconductors - Carrier Concentration of p and n Type Semiconductors - Hall Effect: Determination of Carrier Concentration & Mobility.

TEXT BOOKS:

1. M. N. Avadhanulu and P. G. Kshirsagar, "A Text Book of Engineering Physics", S. Chand and Company, New Delhi (2009).
2. V. Rajendran, "Engineering Physics", McGraw Hill Education, 1st Edition (2017)

REFERENCE BOOKS:

1. Charles Kittel, "Introduction to Solid State Physics", Wiley Publications, 8th Edition (2012).
2. Arthur Beiser, "Concepts of Modern Physics", McGraw Hill Publications, 7th Edition (2015).
3. K. Thiyagarajan and Ajay Ghatak, "Laser Fundamentals and Applications", Springer Publications, 2nd Edition (2010).
4. G. P Agarwal, "Fiber Optic Communication System", Wiley Publications, 3rd Edition (2007).

NPTEL Links:

1. Quantum Physics: <https://nptel.ac.in/courses/122106034/>
2. Lasers: <https://nptel.ac.in/courses/115101008/5>
3. Fiber Optics: <https://nptel.ac.in/courses/115107095/>
4. Dielectrics: <https://nptel.ac.in/courses/115101005/downloads/lectures-doc/Lecture-20.pdf>
5. Magnetic Materials: <https://nptel.ac.in/courses/115104088/42>
6. Semiconductor Physics: <https://nptel.ac.in/courses/115102025/>

Learning Outcomes:

Upon successful completion of each unit, the learner will be able to:

Unit I	Distinguish the classical limits and existence of quantum nature of particles.
Unit II	Classify the different types of lasers, optical fibers including their applications.
Unit III	Recall the preambles of dielectrics and to comprehend different types of polarizations in dielectrics, to identify the applications of ferroelectric materials in various engineering fields, and to distinguish the different types of magnetic materials.
Unit IV	Recognize intrinsic, extrinsic, elemental and compound semiconductors.

OVERALL LEARNING OUTCOME:

Upon successful completion of this course, the learner will be able to apply the concepts of quantum mechanics & semiconductor physics and the principles of lasers & optical fibers for various engineering applications

ENGINEERING PHYSICS LABORATORY

Course Objectives:

The objectives of the course are to help students to,

1. Gain practical knowledge through experimental methods and find correlation with physics theory
2. Learn the usage of electrical and optical systems for various measurements
3. Apply the analytical techniques and graphical analysis to the experimental data.

List of Experiments

1. LASER Grating –Determination of wavelength using diffraction grating.
2. Finding the particle size using LASER
3. Spectrometer Grating- Measurement of Wavelengths of Hg Spectrum.
4. Fiber Optics- Measurement of Acceptance angle and Numerical Aperture.
5. Photoelectric effect – Determination of Planck's constant.
6. Diffraction of Light by Ultrasonic waves.
7. Ultrasonic Interferometer – Determination of velocity of ultrasonic waves in different liquids.
8. Ultrasonic Testing of Materials (NDT)
9. Superconductivity- measurement of transition temperature
10. Measurement of dielectric constant – Parallel plate capacitor method
11. Hall Effect -Determination of mobility and carrier concentration for semiconductors.
12. Band gap measurement of semiconductors by Four Probe Method.
13. Thermistor – Determination of Energy gap.
14. B-H curve – Measurement of Hysteresis loss, Retentivity and Coercivity of a toroid.
15. Electron Spin Resonance- Determination of g-factor

LEARNING OUTCOMES

Expts.1-4	Comprehend the different physical parameters of optics with ordinary light and lasers
Expt. 5	Realize photoelectric effect and its applications
Expts.6-8	Perceive the production of ultrasonic waves through inverse piezoelectric effect and demonstrate the applications of ultrasounds
Expt. 9	Identify the transition temperature of any given superconductors
Expt. 10	Distinguish active and passive dielectrics based on the measured dielectric constants
Expts. 11-13	Understand the principle of semiconductors and thereby to measure energy band gap and carrier concentration of semiconductors
Expts. 14-15	Recognize the preambles and characteristics of ferromagnetic materials and to realize the importance of electron spin resonance

L	T	P	C
3	0	2	4

Course Code: CHY101
Semester: I / II

ENGINEERING CHEMISTRY

Course Objectives:

The main objectives of the course are to impart knowledge on the fundamental chemistry principles involved in several important engineering materials used in industry. In particular, the learners will study the basic chemistry concepts and industrial applications of lubricants, redox reactions, water treatment technologies and advanced engineering materials. The semi theory – semi lab format of this course will also enable the learners to get hands-on experience on the principles discussed during the theory classes in the laboratory sessions where they will perform experiments to understand the applications of these concepts in engineering.

UNIT – I

11 Periods

WATER TREATMENT TECHNOLOGY

Definition of hard and soft water, Sources of water and classification of impurities, Hardness and its types, Units of hardness, Determination of hardness of water by EDTA method. Boiler problems – Scale and Sludge formation in boiler, Priming & Foaming, Caustic Embrittlement. Internal treatment methods. Water softening processes –Zeolite process, Ion-exchange process. Brackish water treatment-Electrodialysis, Reverse osmosis. BOD, COD-definition and significance. Sterilization - ozonolysis, UV, chlorination, Specifications (Indian standards) for: Drinking water, Boiler feed water, Water used in electronic and construction industries.

UNIT – II

11 Periods

REDOX REACTIONS AND ELECTROCHEMISTRY

Electrochemistry - Single electrode potential, Nernst equation, Electrochemical series and its applications. Electrolysis of water. Electrodeposition, Electroless deposition, Plating on plastics.

Energy devices -Primary battery (Alkaline battery), Secondary battery (Lead-Acid, Ni-Cd and Li-ion). Supercapacitor- Principle. Fuel cells – Principle and advantages, Hydrogen-Oxygen Fuel cells, Proton exchange membrane fuel cell, Alkaline fuel cell, Solid oxide fuel cell.

Corrosion and its control - Chemical and electrochemical corrosion, Microbial induced concrete corrosion and biofouling. Corrosion control - Design, Anodic and cathodic protection. Surface Coatings - Inorganic coatings (Galvanization, Tinning, Electrode position, Anodization) and Organic coatings - oil paints. Inhibitors (cathodic and anodic).

UNIT –III

12 Periods

ASSOCIATIVE INTERACTIONS AND LUBRICANTS

Intermolecular interactions– ionic interactions, ion-dipole interactions, hydrogen bonding, dipole-dipole interactions, London dispersion forces. Relative strength of intermolecular forces - H₂O-H₂S, HCl-HF, Ethanol-diethyl ether, Polyethylene-Teflon. Consequences - surface tension.

Lubricants- Mechanisms of lubrication - Fluid film, Boundary film & Extreme pressure. Types of lubricants – Solid lubricants – Molybdenum disulphide, Graphite. Liquid lubricants – Vegetable, Animal, Mineral & Synthetic oils. Semi solid lubricants – Greases, Lubricating Emulsions – Oil in water, Water in oil.

Properties of lubricants and its significance – Physical properties – Viscosity & Viscosity Index. Determination of viscosity by Redwood viscometer, Flash & Fire point by Pensky-Marten's apparatus, Cloud & Pour point.

Lubricating oils – Acid value, Saponification value, Steam emulsification number.

UNIT – IV

11 Periods

ADVANCED MATERIALS

Composites –Introduction, Constitution-Matrix phase, Dispersed phase. Characteristic properties of composite materials. Classification- (A) Particle - reinforced composites- i) Large – particle reinforced composites ii) Dispersion – strengthened composites. (B) Fiber – reinforced composites- i) Continuous – aligned ii) Discontinuous – aligned (short)- (a) aligned (b) randomly oriented (C) Structural Composites- i) Laminates (ii) Sandwich Panels.

Nanomaterials-Classification. Synthesis–Top down method (Ball milling), Bottom up methods – wet chemical, physical and chemical vapor deposition, Sol-Gel method, Self-assembly (DNA-directed self-assembly of AuNPs), Applications of nanomaterials - AuNPs based anti-cancer agents, ZnO and Fe₃O₄ based memristors, Water purification using AgNPs, TiO₂ based self-cleaning glass.

TEXTBOOK

Gopalan, R, D.Venkappayya and Sulochana Nagarajan, *A Textbook of Engineering Chemistry*. Vikas Publishing House, New Delhi, 4th edition, 2013.

REFERENCES

1. Jain, P.C. and Monika Jain. *Engineering Chemistry*. Dhanpat Rai Publications, New Delhi, 16th edition, 2015.
2. Palanna, O. G. *Engineering Chemistry*. McGraw Hill Publishing Company, Chennai, 2nd edition, 2009.
3. Kuriacose, J. C. and J. Rajaraman. *Chemistry in Engineering & Technology*. Vol I & II. Tata McGraw Hill Publishing Company, New Delhi, 2001.
4. Rao, C. N. R., A. Muller, A.K. Cheetam. *The Chemistry of Nanomaterials: Synthesis, Properties and Applications*. Wiley-VCH Verlag GmbH, 2004.

LEARNING OUTCOMES

Upon completion of the theoretical sessions of this course, the learners will be able to:

Unit –I	Select and employ suitable water treatment technologies for domestic and industrial applications
Unit –II	Demonstrate an understanding of the fundamental concepts used in electrochemistry Describe various energy storage devices and emerging technologies Apply the principles of electrochemistry to design corrosion control measures
Unit –III	Identify the various intermolecular interactions existing in the given system Demonstrate an understanding of lubricants, their properties and industrial applications
Unit –IV	Become familiar with the various concepts of composite materials and their properties as well as on the synthesis and applications of nanomaterials in various sectors

ENGINEERING CHEMISTRY LABORATORY

SESSION OBJECTIVES

This session aims to provide the learners hands-on-training on the practical applications of the concepts learnt in the theoretical sessions on water treatment, electrochemistry, lubricants, composites and nanomaterials using simple chemical methods. The course will also train the learner to observe good lab practices, record readings and graphically represent the results, as well as analyse and interpret the influence of reaction conditions on the results.

LIST OF EXPERIMENTS

1. Determination of alkalinity and chemical oxygen demand of effluent water
2. Determination of percentage of available chlorine in the given sample of bleaching powder by iodometry
3. Complexometric analysis:
 - a. Estimation of nickel/ aluminium /zinc
 - b. Determination of total hardness in the given water by EDTA method
4. Measurement of single electrode potential and construction of an electrochemical cell
5. Applications of Nernst equation:
 - a. Estimation of Fe^{2+} , Cu^{2+} or Ce^{2+}
 - b. Estimation of amount of HCl in a given solution by pH meter
 - c. Determination of concentration of given electrolyte
6. Conductometric titration:
 - a. Strong acid/Strong base
 - b. Strong acid/Weak base
 - c. Weak acid/Strong base
7. Adsorption of acetic acid or oxalic acid by activated charcoal
8. Estimation of iodine value and acid value of oil
9. Determination of viscosity of polymer composites using Oswald viscometer
10. Synthesis of silver nanoparticles by chemical reduction
11. Electroplating/Anodization at a production facility – An example of electrolysis (Demonstration)
12. Preparation of soap (Demonstration)

LEARNING OUTCOMES

Upon completion of the laboratory sessions, the learner will be able to:

Expt. 1	Measure the quantitative capacity required to neutralize the water and quantify oxidizable chemical impurities present in waste water
Expt.2	Evaluate the quality of bleaching powder by iodometric titration
Expt.3	Employ complexometric titrations to quantify anthropogenic metals or estimate total hardness of a water sample
Expt.4	Measure the single electrode potential of a particular electrode Construct an electrochemical cell and demonstrate its utility
Expt.5	Correlate redox potential, Nernst equation, relationship between pH and redox potential to estimate the strength of various redox couples and given electrolytes Apply the practical aspects of first derivatives which they learn in their introductory calculus lessons
Expt.6	Estimate the strength of given acid or base using conductance measurements
Expt.7	Demonstrate the interaction between adsorbate and adsorbent and estimate the

	amount of given acid adsorbed by the charcoal
Expt.8	Estimate two important properties of oils and select appropriate oil for edible or lubrication applications
Expt.9	Demonstrate the influence of additives on the change in the physical properties of polymer composites
Expt.10	Synthesize metal nanoparticles by simple wet chemical method and demonstrate the influence of capping agents on their stability
Expt.11	Employ a technology to apply thin coherent metal coating on a metal surface using the principle of electrolysis
Expt.12	Produce a value-added product from readily available precursors using saponification reaction

L	T	P	C
2	0	2	3

Course Code: EEE101R01

Semester: I / II

BASIC ELECTRICAL ENGINEERING

Course Objectives:

This course enables the learners to

1. Understand the basic knowledge of DC and AC circuits.
2. Understand the construction and operation of DC machines.
3. Understand the construction and operation of transformers.
4. Provide an insight into the electric power supply systems and various types of electrical loads.

UNIT – I

8 Periods

Direct Current (DC) Circuits

Ohm's law, Kirchhoff's laws, Series and parallel circuits, Ideal and practical voltage and current source, Mesh and Nodal analysis, Source transformation, Star delta transformation

UNIT – II

8 Periods

Alternating Current (AC) Circuits

Definition of AC quantities, Form factor, Peak factor, Analysis of steady-state AC circuits with R, L, C, R-L, R-C and R-L-C elements, Complex notation, Phasor diagrams, Power and power factor

UNIT – III

8 Periods

Electromagnetic induction and Electrical Machines

Definition of MMF, Flux, Reluctance, Flux density, Comparison between electric and magnetic circuits, Force on a current carrying element in a magnetic field, Faraday's Law of Electromagnetic Induction, Lenz's law, Fleming's right- and left-hand rules, Statically and dynamically induced EMF, Self and Mutual Inductances, Coefficient of coupling

Basic structure and construction of DC machines, working principle of motors and generators, Types and its application, Need of starters

Construction and principle of operation of transformers, EMF equation, Losses and Efficiency, Application of transformers

UNIT – IV

6 Periods

Electrical Supply System

Domestic wiring – types and accessories, Basic principles of Earthing, General safety requirement as per IE rules, Single line diagram of electric power supply system – Single phase and three phase supply system

Electrical loads – Relationship between line and phase parameters of three phase balanced loads - Power rating, Calculation of energy consumption

TEXT BOOKS

1. Vijayarekha, K, Balasubramanian, M, Karthikaikannan D, Mohamed Ghouse, S and J. Rajamohan. *Basic Electrical Engineering*. Cengage Learning India Pvt. Ltd., 1st Edition, 2023.
2. Edward Hughes. *Electrical and Electronics Technology*: Pearson Education, 12th Edition, 2016.
3. Muthusubramanian, R. and S. Salivahanan. *Basic Electrical and Electronics Engineering*: Tata Mc Graw Hill Education Pvt. Ltd., 2010.
4. Mittal, V.N. and Arvind Mittal. *Basic Electrical Engineering*: Tata Mc Graw Hill Education Pvt. Ltd., 2nd Edition, 2005.

REFERENCE

1. Theraja, B.L. and A.K. Theraja. *A text book of Electrical Technology*: S. Chand Publishers, 24th Edition, 2014.

ONLINE MATERIALS

1. NPTEL –<http://nptel.ac.in/courses/108108076/1>
2. MIT Courseware – <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-01sc-introduction-to-electrical-engineering-and-computer-science-i-spring-011/>

LABORATORY EXPERIMENTS

1. Verification of basic laws of electric circuits
2. Verification of voltage division and current division rules
3. Mesh and node analysis
4. Voltage–current relationship in a R-L & R-C series circuits and to determine the power factor of the circuit
5. Study of statically and dynamically induced EMF
6. Domestic wiring
7. Electric power supply system
8. Calculation of energy consumption for various loads

LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to:

Unit I	<ul style="list-style-type: none">• Apply Ohm's law and Kirchhoff's laws for solving series and parallel circuits and analyze a circuit using mesh and nodal methods
Unit II	<ul style="list-style-type: none">• Analyze steady state behaviour of AC circuits with R, R-L, R-C, and R-L-C circuits
Unit III	<ul style="list-style-type: none">• Understand the generation of dynamically induced EMF in a DC generator and explain the construction and operation of DC machines• Understand the generation of statically induced EMF in a transformer and explain the construction and operation of transformers
Unit IV	<ul style="list-style-type: none">• Demonstrate simple domestic wiring, summarise general safety requirements as per IE rules, understand electric power system and classify various types of loads

L	T	P	C
2	0	2	3

Course Code: EIE101R01

Semester: I /II

BASIC ELECTRONICS ENGINEERING

Course Objectives:

1. To familiarise the fundamental concepts of electronic devices like semiconductor diodes, BJT, JFET, MOSFET and Op-Amp
2. To design a regulated power supply unit to power various circuits
3. To introduce the basic concepts of measuring devices and its measurements

UNIT – I

9 Periods

Semiconductor Diode

P-N junction: Construction – working – characteristics – Zener diode: Working – characteristics – Rectifiers: Half-wave rectifier – full-wave rectifier – center-tapped and bridge rectifiers – Clipper: Positive clipper – negative clipper – biased clipper – Clamper – Logic gates using diodes (AND/OR gates) – Zener diode as voltage regulator – Light Emitting Diode (LED) - Photodiode

UNIT - II

7 Periods

Bipolar Junction Transistor

BJT: Construction – working of PNP/NPN – input and output characteristics – common emitter configuration – common base configuration – common collector configuration - DC load line – Q-Point (fixed bias only) – Transistor as an amplifier and switch

UNIT - III

7 Periods

Field Effect Transistor

JFET: Construction – working – drain and transfer characteristics – Depletion mode MOSFET: Construction – working – characteristics – Enhancement mode MOSFET: Construction – working – characteristics – MOSFET as a switch – CMOS as an inverter

UNIT - IV

7 Periods

Power Supply and Measuring Instruments

Basic building blocks of regulated power supply, Series and shunt voltage regulator using Transistor.

Permanent Magnet Moving Coil (PMMC) – Basic DC voltmeter and DC ammeter

Oscilloscope: Block diagram – Measurement of voltage, current, phase and frequency using CRO – Digital Storage Oscilloscope: Block diagram

TEXTBOOK

1. Mehta V. K. and Rohith Mehta, Principles of Electronics, 11th edition, S. Chand and company, 2008.

REFERENCES

1. Jacob Millman, Christos Halkias and Chetan D. Parikh, Integrated Electronics Analog and Digital circuits and systems, 2nd edition, McGraw Hill Education, 2011.

2. S.K. Bhattacharya, Basic Electrical and Electronics Engineering, 1st edition, Pearson, 2011.
3. Kalsi H.S., Electronic Instrumentation, 3rd edition, Tata McGraw Hill, 2010.
4. Salivahanan S, Suresh Kumar N, and Vallavaraj A, Electronic Devices and Circuits, 2nd edition, Tata McGraw Hill, 2008.
5. Edward Hughes, Electrical and Electronic Technology, 10th edition, Pearson, 2008.
6. B.L. Theraja, Dr. R.S. Sedha, Principles of Electronic Devices and Circuits, 5th edition, S. Chand and company, 2005.

UNIT-WISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to:

Unit I	<ul style="list-style-type: none">➤ Outline the working principle of semiconductor diodes➤ Apply the concept of diodes for different applications
Unit II	<ul style="list-style-type: none">➤ Illustrate the working of BJT, analyze the circuit configuration and characteristics in active region of operation.➤ Apply the concept to determine the Q-point, analyze the transistor as an amplifier and switch
Unit III	<ul style="list-style-type: none">➤ Demonstrate the working of JFET, E-MOSFET and D-MOSFET➤ Analyze the characteristics of JFET and MOSFET➤ Analyze the MOSFET switch and CMOS as an inverter
Unit IV	<ul style="list-style-type: none">➤ Construct the regulated power Supply unit➤ Explain the working of oscilloscope and PMMC instruments

List of Experiments:

1. V-I characteristics of P-N junction diode
2. V-I characteristics of Zener diode
3. Half wave rectifier and full wave rectifier (center tapped) using P-N junction diode
4. Biased Clippers using P-N junction diode
5. Zener diode as voltage regulator
6. Input and output characteristics of common emitter configuration
7. Drain and transfer characteristics of JFET
8. Measurement of frequency and phase using CRO

COURSE LEARNING OUTCOMES

Upon completion of this course, the learners will be able to:

- Infer the characteristics of semiconductor devices and use them for different applications.
- Design a voltage regulator using Zener diode.
- Make use of CRO to measure various electrical parameters

L	T	P	C
2	0	2	3

Course Code: CIV 101

Semester: I / II

BASIC CIVIL ENGINEERING

Course Objectives:

1. By successfully completing this course, the student will be able to assess the requirements of a construction project, including principles and by-laws, building materials and their properties
2. Student will be able to identify the basis of methods of surveying
3. Student will understand the fundamentals of road, dams, water management and irrigation techniques

UNIT – I

8 Periods

Building Planning

Branches of civil engineering, Site selection, Principles of planning, Planning regulations and By-laws.

Civil Engineering Materials

Properties, types and uses of civil engineering materials - Bricks, Stones, Aggregates, Cement, Cement mortar, Concrete, Steel and Timber.

UNIT – II

9 Periods

Building Construction

Loads acting on structure, types of construction – Load bearing walled structures and framed structures, Bearing capacity of soil, foundations – functions and its types, Superstructure and its components, Brick and stone masonry construction, Technical terms related to doors, windows and stairs.

Road Construction

Classification of roads - rigid and flexible pavements, functions of camber and super-elevation.

UNIT – III

6 Periods

Geographical Measurement

Principles of survey, measurement of distance by chain and tape, area calculation, prismatic compass, measurement of bearing and conversions, the study of levels, benchmarks and determination of reduced levels, contour and their characteristics, Introduction to remote sensing.

UNIT – IV

7 Periods

Water Management

Definition of watershed, necessity of watershed management works, different structures involved in watershed management, Roof top rainwater harvesting and ground water recharge, Classifications of dams, typical cross section of gravity dam and zoned earthen embankment, Necessity of irrigation, benefits and types of irrigation.

TEXTBOOKS

1. M.S. Palanichamy and C. Shanmugham. *Basic Civil Engineering and Basic Mechanical Engineering*. Tata McGraw–Hill Publishing Company Ltd., 2000.

REFERENCES

1. B. C. Punmia, Ashok K. Jain and Arun K. Jain. *Basic Civil Engineering*. Laxmi Publications Pvt. Ltd., 2017.
2. Satheesh Gopi. *Basic Civil Engineering*. Pearson Publications, 2010.

ONLINE MATERIALS

1. NPTEL - <http://nptel.ac.in/syllabus/syllabus.php?subjectId=105104101>
2. NPTEL - <http://nptel.ac.in/syllabus/syllabus.php?subjectId=105107122>
3. NPTEL - <http://nptel.ac.in/syllabus/syllabus.php?subjectId=105102088>
4. NPTEL - <http://nptel.ac.in/downloads/105105110>

LEARNING OUTCOMES

Unit I	Student will be able to <ul style="list-style-type: none">• Explain the planning regulations and by-laws.• Classify civil engineering materials based on their properties and uses.
Unit II	Student will be able to <ul style="list-style-type: none">• Identify the loads acting on a structure.• Explain the functions of the sub-structure and super-structure elements of a building.• Classify the roads and explain the functions of flexible and rigid pavements.
Unit III	Student will be able to <ul style="list-style-type: none">• Explain the fundamental principles of surveying• Measure length, orientation, rise/fall using chain, compass, dumpy level, total station and their allied instruments.• Compute area of a land and calculate reduced levels of different stations on the land.
Unit IV	Student will be able to <ul style="list-style-type: none">• Explain the fundamental principles of watershed management and rain water harvesting.• Classify dams and explain their functions.• Explain the principle and methods of irrigation.

BASIC CIVIL ENGINEERING LAB

1. Drawing standard – BIS - Lettering, dimensioning, type of lines, scales, symbols and conventions
2. Drawing of measured laboratory/hall (with furniture layout)
3. Line plan of residential building – scheme development
4. Typical section of a single storey building
5. Study of various bonds using bricks
6. Pipe fittings and fixtures in field
7. Introduction to surveying equipment
8. Exercise on Total station (measurement of distances, horizontal and vertical angles)
9. Parallelogram Law of forces
10. Lami's Theorem
11. Equilibrium of parallel forces
12. Coefficient of friction and Angle of repose
13. Centre of gravity for irregular lamina
14. A report based on site visit to construction site – Assignment.

LEARNING OUTCOMES

Expt 1	Student will be able to apply the BIS drawing standards and specifications
Expt 2	Student will be able to construct a plan using field measurements
Expt 3	Student will be able to design a line plan for a residential building
Expt 4	Student will be able to construct the cross sectional view of framed structures
Expt 5	Student will be able to construct various bonds using bricks
Expt 6	Student will be able to demonstrate the types of pipe fittings and joints in the field
Expt 7	Student will be able to demonstrate various surveying instruments
Expt 8	Student will be able to employ total station for terrain measurements
Expt 9	Student will be able to find the resultant of two forces inclined to one another
Expt 10	Student will be able to check for equilibrium of three concurrent forces
Expt 11	Student will be able to check data sufficiency of a given system of parallel forces
Expt 12	Student will be able to calculate the coefficient of friction at the interface of two materials; will be able to assess the maximum angle at which a granular material can be piled
Expt 13	Student will be able to locate the centre of gravity of an irregular lamina
Expt 14	Student will witness construction activities of different elements and structures and understand the complexity

L	T	P	C
2	0	2	3

Course Code: MEC101

Semester: I / II

BASIC MECHANICAL ENGINEERING

Course Objective:

To provide an overview of basic principles and applications of Mechanical Engineering with practical exposure on various basic engineering practices and manufacturing processes.

UNIT – I

8 Periods

MANUFACTURING TECHNOLOGY (MACHINING AND FORMING)

Machining – Operations on Lathe (Turning, Facing, Knurling, Forming, Drilling, Boring, Reaming, Counter Boring, Chamfering and Grooving Operations Only), Drilling (Drilling, Reaming, Boring, Counter Boring, Counter Sinking, Spot Facing and Tapping Operations Only) and Shaping (Shaping Horizontal Surface, Shaping Vertical Surface, Shaping Angular Surface, Shaping Slots, Grooves & Keyways And Shaping Irregular Surface Operations Only), Introduction to CNC Machining.

Forming – Principles of Forging – Rolling – Extrusion – Sheet Metal Forming (Blanking, Punching & Bending) – Wire Drawing.

UNIT – II

7 Periods

MANUFACTURING TECHNOLOGY (FOUNDRY AND WELDING)

Foundry – Pattern Making (Single Piece, Split Pieces and Core) – Casting (Preparation of Green Sand Mould, Pouring of Molten Metal, Fettling and Cleaning).

Welding – Principles – Types (Manual Metal Arc Welding and Oxy-Acetylene Gas Welding).

UNIT – III

7 Periods

REFRIGERATION & AIR-CONDITIONING AND I.C. ENGINES

Refrigeration and Air-Conditioning – *Principles* - Operation of Refrigerator (Vapour Compression System only) and Air-Conditioner (Window and Central Air Conditioning Systems).

I.C. Engines – Types – Working Principles of 2-Stroke (Petrol Engine) and 4-Stroke Engines (Petrol and Diesel Engine) – Fuel Injection Systems (Fuel Injection Pump and Injector for Diesel Engine & MPFI for Petrol Engine) – Ignition Systems (Battery and Magneto Ignition) – Cooling and Lubrication Systems.

UNIT – IV

8 Periods

ENERGY RESOURCES AND POWER PLANTS

Conventional and Non-Conventional Energy Resources – Applications.

Power Plants – Steam, Hydel, Nuclear, Gas Turbine and Combined Cycle Power Plants.

Steam Boilers – High Pressure Boilers (Babcock & Wilcox Boiler, La-Mont Boiler and Benson Boiler Only).

Steam Turbines – Types, Operating Principle (Simple Impulse, Reaction, Velocity Compounding, Pressure Compounding and Pressure – Velocity Compounding).

List of Experiments

1. Square / Angle Fitting by filing of Steel flats
2. Fabrication of Cylinder /Tray from G. I sheet
3. Conversion of round rod to square / Hexagonal Rod by hot Forging
4. Welding of Lap and Butt joints
5. Preparation of Mould cavity for Solid & Split Patterns
6. Dismantling, study and assembly of I.C. Engine
7. Dismantling, study and assembly of Gear Box
8. Study of various parts, different operations and Demonstration on Lathe
9. Study of various parts, different operations and Demonstration on Shaper.
10. Study of various parts, different operations and Demonstration on Drilling Machine
11. Study and Demonstration of CNC Turning and Machining Center
12. Study and demonstration of 3D printing machines

LEARNING OUTCOMES

Upon successful completion of the course, the learner will be able to:

Theory	
Unit I	Apply the different aspects of manufacturing technology in machining and forming areas
Unit II	Explain the primary operations of casting and metal joining processes
Unit III	Explain the basic principles applied in refrigeration and air conditioning systems and identify the components & systems of IC Engine
Unit IV	Discuss the various forms of energy sources available, its application for power generation, energy conservation and the components of various types of power plant
Practical	
<ul style="list-style-type: none"> ▪ Identify different tools, select and apply suitable machining processes ▪ Demonstrate the working of IC engine and transmission system ▪ Explain CNC machining and additive manufacturing technology 	

TEXTBOOK

1. K. Venugopal and V. Prabu Raja, Basic Mechanical Engineering, Anuradha Publications, 2007

REFERENCES

1. T. J. Prabhu, V. Jaiganesh and S. Jebaraj, Basic Mechanical Engineering, SCITECH Publications Ltd., 2001.
2. R.K. Rajput, Thermal Engineering, Lakshmi Publishers, 2010.
3. S.K.Hajra Choudry. Elements of workshop Technology Vol I&II, Asia Publishing House.

ONLINE MATERIALS

1. <http://nptel.ac.in/syllabus/syllabus.php?subjectId=112107144>
2. <http://nptel.ac.in/syllabus/syllabus.php?subjectId=112108148>
3. <http://nptel.ac.in/syllabus/syllabus.php?subjectId=112104113>

L	T	P	C
2	1	0	3

Course Code: CIV 102
Semester: I / II

ENGINEERING MECHANICS

Course Objectives:

1. The learner, after successfully completing the course, will be able to recognize the importance of mathematics in engineering and solve problems in rigid body mechanics in a logically consistent and step-wise manner.
2. The basic concepts dealt in this course will enable the students to grasp higher level topics in solid, structural, fluid, aero-, bio-mechanics, machine design and electrical and robotic devices.

UNIT – I

12 Periods

Force Systems

Introduction to simple vector operations; Frames of Reference and Coordinate Systems; Newton's Laws; Particles and rigid bodies. Concept of force, classification of force systems (linear and moments), combining forces (resultant), nullifying the effect of force systems (equilibrant) in vector forms, including moments about a point, about a line, resolution of a force into a force and moment and reverse(parallel shifting of forces)and wrench.

Forces in two dimensions (Free Body Diagrams) - Parallelogram Law, Lami's theorem, Triangular Law, polygon law, moments about a point, Varignon's theorem, moment about a line, resultants, equilibrant, resolution of a force into a force and a couple and vice versa.

UNIT – II

12 Periods

Properties of lines, areas, volumes

Concept of centroid, center of mass, center of gravity of standard shapes including semi-circular and segmental arcs (lines),circles, quadrants, parabolas, square/rectangle (areas), cubes, spheres, hemispheres (volumes), combined sections of the above.

Concept of second moment of area, polar second moment of area, parallel axis theorem, perpendicular axis theorem, radius of gyration. Calculations of Second Moment of Area of circles, segments of circles, squares, rectangles, combined shapes. Applications of Pappus and Guldinus theorems.

UNIT – III

12 Periods

Unit III – Friction (Static friction only)

Concept of friction; its uses; laws of friction; various types of friction (block, block-on-block - horizontal and inclined surface -, screw, ladder, wedge) presented in a unified approach (anchored to FBDs) to solve friction problems. Belt friction (static) treated separately.

UNIT – IV

9 Periods

Dynamics – kinematics and kinetics

Equations of motion – applications; Relationships between distance, velocity, acceleration and time. Introduction to curvilinear motion, projectile motion.

Applications of D'Alembert's principle, work-energy principle, impulse and momentum – conservation of linear momentum.

TEXTBOOK

1. Basudeb Bhattacharyya, Engineering Mechanics, Second Edition, OUP,2014

REFERENCES

1. N H Dubey, Engineering Mechanics, McGraw Hill Education, 2016.
2. S Rajasekaran, G Sankarasubramanian, Fundamentals of Engineering Mechanics, Third Edition, Vikas Publishing house Pvt. Ltd. Reprint 2011.
3. Beer F.P and Johnston.E.R, Vector Mechanics for Engineers – Statics and Dynamics, McGraw Hill International Book Company, 2002.
4. Ferdinand L.Singer, Engineering Mechanics (Statics and Dynamics), Harper Row Publishers.2007.
5. Meriam.J.L and Kraige.L.G, Engineering Mechanics (Statics and Dynamics), John Wiley and Sons.2001.
6. Shames.I.H, Engineering Mechanics (Statics and Dynamics), Prentice Hall of India, New Delhi, 2004.
7. Timoshenko.S.P and Young.D.H, Engineering Mechanics, McGraw Hill Book Co. Ltd.2003.

ONLINE MATERIALS

1. <http://nptel.ac.in/syllabus/syllabus.php?subjectId=122104014>
2. <http://nptel.ac.in/syllabus/syllabus.php?subjectId=122104015>

LEARNING OUTCOMES

Unit I	The learner will be able to identify the different frames of reference, coordinate systems; identify whether a body is in equilibrium, in 3D and 2D systems, for particles (dimensionless)/rigid bodies (undeformable).
Unit II	The learner will be able to calculate the geometric properties of lines, areas, surfaces and volumes and solve problems involving surface of revolution and volume of revolution. The learner can calculate the second moment of area about any given axis for standard sections and combinations of these.
Unit III	The learner will be able to apply concepts of friction to various situations such as bodies in contact, (horizontal and inclined surfaces), screw, ladder, and wedge. The learner will be able to calculate belt friction (static friction only).
Unit IV	The learner will be able to solve equations of motions for a given problem using. D'Alembert's principle, work-energy and impulse-momentum principles. The learner can solve projectile motion.

L	T	P	C
1	0	4	3

Course Code: CIV 103

Semester: I / II

ENGINEERING GRAPHICS

Course Objectives:

The student will possess the skill for efficient drafting depending on the operational function in order to perform day-to-day activity and in creating simple engineering designs of Industrial components using AutoCAD Software.

UNIT – I

10 Periods

Introduction to Engineering drawing & Drafting Software.

Principles of engineering graphics and their significance – Overview of Computer graphics-introduction to drafting software – Demonstrating knowledge of the theory of CAD software - Menu System, Toolbars (commands- Draw, Modify and Dimension)

Geometrical constructions – Curves used in engineering practice –conic sections, Cycloidal curves, Involutés – square and circle .

UNIT – II

10 Periods

Orthographic projection

Principles –First angle projections-projection of points - straight lines-Inclined to both the principal planes – true lengths and true inclinations by rotating line method.

Projection of solids inclined to one reference plane- prisms, pyramids, cylinder, and cone – change of position method.

UNIT – III

10 Periods

Section, Intersection and Development of Surfaces of solids

Section planes perpendicular to one plane and parallel or inclined to other plane true shape of section- Intersection of surfaces-Development of lateral surfaces of prisms, cylinders, cone and pyramids.

UNIT – IV

15 Periods

Isometric projection

Principles of Isometric projection – construction of isometric view of prisms, cylinders, pyramid and cones- Construction of isometric view from orthographic views of industrial objects (2D to 3D).

LIST OF EXERCISES USING AUTOCAD SOFTWARE:

1. Construction of ellipse and parabola.
2. Orthographic projections of simple solids.
3. Sectional orthographic views of a cone and cylinder
4. Intersection of cylinder to cone.
5. Development of lateral surfaces of solids.
6. Isometric view of prism, cone and industrial objects.

TEXTBOOKS

1. Venugopal, K. and V. Prabhu Raja. *Engineering Drawing*. New Age International (P) Limited, 2010
2. Narayana, K. L. and P. Kannaiah. *Textbook on Engineering Drawing*. Scitech Publications, 2010.

REFERENCES

1. Gopalakrishna, K. R. *Engineering Drawing*. Subas Publications, 2010.
2. Bhatt, N. D. and V. M. Panchal. *Engineering Drawing*. Charotar Publishing house, 2012.
3. Natarajan, K. V. *A text book of Engineering Drawing Graphics*. Dhanalakshmi Publishers, Chennai, 2008.
4. Dhananjay AJolhe. *Engineering Graphics* McGraw-Hill Publishing Company, Ltd, 2009.

ONLINE MATERIALS

1. NPTEL- <http://nptel.ac.in/courses/112104031/1>
2. NPTEL- <http://nptel.ac.in/courses/112103019/>
3. <http://nptel.ac.in/syllabus/syllabus.php?subjectId=107103002>

LEARNING OUTCOMES

Unit I	The learner will be able to draw plane and special curves which are of great importance to engineers using Auto CAD software.
Unit II	The learner will be able to draw the projection of solids in the first quadrant.
Unit III	The learner will be able to draw sectional views, intersection of surfaces of solids and development of lateral surfaces of solids.
Unit IV	The learner will be able to draw isometric projection of simple solids and will be able draw isometric view of the industrial object from orthographic projection.

L	T	P	C
2	0	0	2

Course Code: MEC102
Semester: I / II

INTRODUCTION TO ENGINEERING DESIGN

Course Objective:

To familiarize the students with Engineering Design process and induce design thinking.

UNIT – I

7 Periods

Introduction: Engineering design – meaning and significance

Definition, considerations and assumptions; designer, client and user triangle; design vocabulary: design levels and design process

UNIT – II

8 Periods

Problem Definition: Needs and goals

Objective tree – illustrative examples; market analysis and information gathering; identification of needs and user requirements; Functions and specifications.

Quality Function Deployment (QFD) method – House of Quality – Kano model for customer satisfaction.

UNIT – III

8 Periods

Conceptual design: generation of alternative concepts

Design space – Morphological chart and design thinking; Brainstorming – creativity – developing concepts from functions; Illustrative cases.

UNIT – IV

7 Periods

Concepts evaluation and selection

Decision matrix; applying metrics to objectives towards selection of preferred concepts.

Numerical evaluation matrices - Priority checkmark method - The best-of-class chart.

TEXTBOOKS

1. Engineering Design – a project based introduction, Clive L. Dym, Patrick Little and Elizabeth J Orwin, Wiley India edition, 2016.
2. Engineering design process, Yousef Haik and Tamer Shahin, Cengage Learning, 2011.

LEARNING OUTCOMES

Upon successful completion of the course, students will be able to identify problems, gather data, prepare need statements, generate alternative conceptual solutions and choose the best concept.

L	T	P	C
3	1	0	4

Course code: MAT102R01

Semester: II

ENGINEERING MATHEMATICS - II

Course Objectives:

The course aims to train the learner to:

- Extend their knowledge of derivatives to find curvature, evolutes etc. and measure extreme values of a given function of several variables.
- Employ various techniques for solving differential equations to solve problems arising in different engineering fields.
- Understand the directional derivative and gradient of a function, illustrate their geometric meaning with the aid of sketches and apply gradients to solve problems involving normal vectors to level surfaces.
- Apply vector integral theorems to interpret the work done by a force, understand the physical interpretations of divergence and curl of a vector.

UNIT – I: Differential Calculus and Functions of Several variables

15 Periods

Differential Calculus: Curvature – Radius of Curvature (Cartesian, Polar, and Parametric form) – Evolutes – Involutives – Envelope of a family of curves (one parameter and two parameters)

Functions of several variables: Maxima and Minima of functions of two or more independent variables - Lagrange's method of undetermined multipliers.

UNIT – II : Ordinary Differential Equations

18 Periods

Differential equations of first order and first degree - Bernoulli's equation – Exact equation - First order and higher degree equations - solvable for p , x , y and Clairaut's form - Higher order differential equations with constant coefficients – Method of variation of parameters - Euler's differential equation with variable coefficients – Simultaneous differential equations with constant coefficients.

Orthogonal trajectories - Law of growth and Decay - Newton's law of cooling – L-C-R circuit problems – Bending of beams.

UNIT- III : Vector Differentiation

12 Periods

Differentiation of vectors – Velocity and acceleration - Vector differential operator: Gradient, Divergent and Curl operators - Directional derivative - Scalar potential of a vector function - Irrotational and Solenoidal vector fields – Vector operator identities(without proof)
Flow of a compressible fluid – Condition of incompressibility - Conservative forces.

UNIT – IV: Vector Integration

15 Periods

Line Integrals – Surface and Volume integrals – Vector integral theorems: Green's theorem for scalar point functions, Gauss divergence theorem, Stoke's theorem (without proof) – verification and evaluation.

Work done by a force - Determination of potential function - Area of a plane region as a line integral over the boundary.

TEXTBOOKS

1. T.Veerarajan, K.Kannan, *Engineering Mathematics II*, Revised Edition, McGraw Hill Education, 2020.
2. Erwin Kreyszig, *Advanced Engineering Mathematics*, 10th Edition, Wiley and Sons, 2015.
3. BS.Grewal , *Higher Engineering Mathematics* , 44th Edition, Khanna Publishers, 2020.

REFERENCES

1. MK.Venkataraman, *Engineering Mathematics*, Volume I & II, The National publishing Company, 2009.
2. BV. Ramana, *Engineering Mathematics*, Tata McGraw Publishing Company Limited, New Delhi, 2006.
3. Dennis G. Zill, Michael R.Cullen, *Advanced Engineering Mathematics*, Third Edition, Narosa Publishing House, New Delhi, 2010.
4. Srimanta Pal, SC. Bhunia, *Engineering Mathematics*, Oxford University Press, 2015.
5. Donald A. McQuarrie, *Mathematical methods for Scientists and Engineers*, Viva Books, 2003.

ONLINE MATERIALS

1. <https://nptel.ac.in/courses/111104092/>
2. <https://nptel.ac.in/courses/111104085/>
3. <https://nptel.ac.in/courses/111108081/>
4. <https://nptel.ac.in/courses/111104031/>
5. <https://nptel.ac.in/courses/111105122/>
6. http://www.cdeep.iitb.ac.in/webpage_data/nptel/Core%20Science/Mathematics%20I/TOC-middle-M15.html
7. <https://nptel.ac.in/courses/111105122/>
8. http://www.cdeep.iitb.ac.in/webpage_data/nptel/Core%20Science/Mathematics%20I/TOC-middle-M15.html

UNIT-WISE LEARNING OUTCOMES

Upon completion of each unit, the learner will be able to

Unit I	Apply the concepts differentiability to study the curvature and find the optimum value of function of several variables.
Unit II	Find the solution of first and higher order differential equations.
Unit III	Understand the basic knowledge on vector differentiation and work with the different emerging fields in the engineering domain
Unit IV	Apply vector integral theorems in various engineering disciplines

COURSE LEARNING OUTCOMES

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

CO No.	Course Outcome	Knowledge Level
CO 1.	Determine the Envelopes and Evolutes of various families of curves.	K3
CO 2.	Measure the extreme values of a given function of two variables	K3
CO 3.	Identify appropriate methods to solve various differential equations	K2,K3
CO 4.	Solve differential equations governed by various physical phenomena	K3
CO 5.	Evaluate derivatives over vector fields	K3
CO 6.	Identify solenoidal and irrotational vectors	K2
CO 7.	Evaluate integrals over vector fields to find work done, potential function etc.	K3

L	T	P	C
3	0	2	4

Course Code: CSE201R01
Semester: II

OBJECT ORIENTED PROGRAMMING IN C++

Course Objective:

This course will help the learner to employ object oriented concepts for developing programs catering to different applications

UNIT - I

11 Periods

Introduction: Fundamentals of object oriented programming - procedure oriented programming vs. Object Oriented Programming (OOP), Characteristics of Object Oriented Programming. **C++ Programming Basics:** Output using cout, directives, input with cin, type bool, Manipulators, type conversions. **Functions:** Returning values from functions, reference arguments, overloaded functions, inlinefunctions, default arguments, returning by reference

UNIT - II

11 Periods

Objects and Classes: Implementation of classes in C++, C++ objects as physical objects, C++ objects as data types, constructors, objects as function arguments, returning object from function, default copy constructor, structures and classes, objects and memory, static class data, const data and classes, mutable. **Arrays and String Fundamentals:** Arrays as class member data, arrays of objects, strings, standard C++ string class. **Templates:** Function template, class template.

UNIT - III

11 Periods

Operator Overloading: Overloading unary operators, overloading of binary operators. **Inheritance:** Concept of inheritance, derived class and base class, derived class constructors, overriding member function, class hierarchies, public and private inheritance, levels of inheritance, multiple inheritance, ambiguity in multiple inheritance, aggregation: classes within classes.

UNIT - IV

12 Periods

Memory Management: Introduction to pointers, Pointers vs Reference variable, New and delete, pointers to objects, debugging pointers. **Virtual Functions:** Virtual functions, friend functions, static functions, assignment and copy initialization, this pointer, dynamic type information. **Streams and Files:** Stream classes, stream errors. disk file I/O with streams, file pointers, error handling in file I/O, file I/O with member functions, overloading the extraction and insertion operators

TEXTBOOK

1. Robert Lafore. *Object oriented programming in C++*.4th Edition, Pearson Education,2012.

REFERENCES

1. Behrouz A Forouzan, and Richard FGilberg. *Computer Science: A Structured Approach using C++*.2nd Edition,Cengage Learning, 2014.

2. Joyce Farrell. *Object Oriented Programming using C++*. 4th Edition, Cengage Learning, 2014.

ONLINE MATERIAL

1. MIT Courseware - <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-s096-introduction-to-c-and-c-january-iap-2013/index.htm>

LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none"> • Describe the object-oriented concepts • Use basic constructs and varieties of functions in C++, in programs for given applications
Unit II	<ul style="list-style-type: none"> • Employ the concepts of classes and objects for a given application • Develop applications using string class objects for text data
Unit III	<ul style="list-style-type: none"> • Create user defined data types with overloaded operators • Develop applications by making use of inheritance
Unit IV	<ul style="list-style-type: none"> • Employ pointers for better memory management • Demonstrate the use of Virtual and friend functions • Develop applications using file streams

COURSE LEARNING OUTCOMES

Upon successful completion the course, the learner will be able to

- Describe the object-oriented concepts and write programs using basic constructs and functions in C++
- Employ the concepts of classes and objects for a given application
- Develop applications using string class objects for text data
- Create user defined data types and demonstrate operator overloading, inheritance
- Use pointers and demonstrate memory management, virtual and friend functions
- Develop applications using file streams

LIST OF LAB EXERCISES

1. Basic C++ Programs using Input / Output, branching and Loops
2. Programs using functions with default arguments, inline functions and function overloading
3. Programs using classes with constructors and destructors
4. Programs using array as data members of a class and array of objects
5. Programs using String class
6. Programs Using Templates
7. Programs using operator overloading
8. Programs using inheritance
9. Programs using virtual functions and friend functions
10. Programs using file Input / Output

Course code: MAT143

Semester: I

L	T	P	C
2	1	0	3

TRIGONOMETRY & MATRIX ALGEBRA

Course Objectives

- This course enables the learner to use matrix analysis in solving the system of linear equations
- This course enables the learner to apply the basic principles of Trigonometry in simplification of some complex functions

UNIT I: MATRIX ALGEBRA

15 Periods

Matrices: Introduction- Types of matrices- Algebra of matrices-Determinants-Inverse of a matrix-elementary transformations-Rank of a matrix-Normal form-Echelon form- Consistency of system of equations -Solution of simultaneous linear equations - Cramer's method and Inversion method

Applications: Balancing chemical equations, Traffic flow problems

UNIT II: EIGEN VECTORS & QUADRATIC FORMS

15 Periods

Eigen values and Eigen vectors – Properties of eigen values and eigen vectors – Singular value decomposition – Similarity transformation – Orthogonal transformation of a real symmetric matrix – Diagonalization of a matrix through transformations

Quadratic Forms – Nature of Quadratic forms – Reduction of Quadratic form to Canonical Form – Nature of the QF – Index – Signature – Rank of QF

Application: Decoupled model: Solution of two logistic equations

UNIT III: COMPLEX NUMBERS & TRIGONOMETRY

15 Periods

Complex Numbers: Introduction-Definition-Geometrical Representation-Algebra of complex numbers-Conjugate of complex number- Modulus and Argument-Polar form-De Moivre's theorem - Logarithm of complex numbers – Separation of complex functions into real and imaginary parts

Trigonometry: Expansions of $\sin n\theta$ and $\cos n\theta$ in powers of $\sin\theta$ and $\cos\theta$ – Expansions of $\sin^n\theta$ and $\cos^n\theta$ in terms of sines and cosines of multiples of θ – Expansions of $\sin \theta$ and $\cos \theta$ as powers of θ - Hyperbolic and Inverse hyperbolic functions

REFERENCES

1. R.S. Aggarwal, Senior Secondary School Mathematics for Classes 11&12, Bharati Bhavan Publishers, 2021.
2. R.D. Sharma, Mathematics for Classes 11 & 12, Dhanpat Rai Publications, 2021
3. H.K. Das, Higher Engineering Mathematics, S. Chand & Sons, 2018.
4. C.B. Gupta, Engineering Mathematics for semesters I and II, McGraw Hill Education (India), 2019.
5. T. Veerarajan, K. Kannan, Engineering Mathematics – I , Tata McGraw Hill Education (India) , 2020.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publications, 44thEdition, 2020.

LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to:

UNIT - I	Comprehend the data in matrix form and hence solve the system of linear equations
UNIT - II	Identify the deformed state by reducing to canonical form
UNIT - III	Differentiate relation and function and express the complex number in circular form

COURSE-WISE LEARNING OUTCOMES

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

- Apply matrix method to solve linear system of equations
- Determine the eigen values and vectors
- Convert a complex number into a circular function

L	T	P	C
2	1	0	3

Course code: MAT144

Semester: I

CALCULUS & THEORY OF EQUATIONS

Course Objectives

- This course enables the learner to determine the extreme values of a function
- This course enables the learner to apply transformation techniques to solve a reciprocal equation

UNIT I: ALGEBRAIC EQUATIONS & EXPANSIONS

15 Periods

Theory of Equations: Fundamental theorem of Algebra (Statement only) – complex and irrational roots – equations whose roots are in A.P, G.P and in H.P – Relations between the roots and coefficients – Symmetric functions – Formation of equations – Diminishing the roots– Transformation of equations – Reciprocal equations – Descartes rule of signs

Algebraic Expansions: Binomial, Exponential and Logarithmic Series (without proof) – Problems on summation, coefficient and approximations

Application: Stability analysis based on zeros of a polynomial equation

UNIT II: DIFFERENTIAL & INTEGRAL CALCULUS

15 Periods

Differential Calculus: Introduction-Differentiation-Successive Differentiation-Leibnitz Theorem-Partial differentiation- Euler's theorem for Homogeneous functions- Maxima minima of one independent variable function- Total derivative - Taylor and Maclaurin's Series of function of single variable

Integral Calculus: Introduction-Indefinite integral- Substitution methods – Integration by parts Definite integral- Reduction formulae for the integrals

Application: Determination of area of curves.

UNIT III: FUNCTIONS OF SEVERAL VARIABLES

15 Periods

Introduction to extreme values – Conditions for extremum values – Working rule to find extremum values – Lagrange's method of undetermined multipliers – Taylor's series of two variables – Maclaurin series - Jacobians – Properties of Jacobians – Partial derivatives of implicit functions by Jacobian

Application: Determination of extreme temperatures on the surfaces

REFERENCES

1. R.S. Aggarwal, Senior Secondary School Mathematics for Classes 11 & 12, Bharati Bhavan Publishers, 2021.
2. R.D. Sharma, Mathematics for Classes 11 & 12, Dhanpat Rai Publications, 2021
3. H.K. Das, Higher Engineering Mathematics, S. Chand & Sons, 2018.
4. C.B. Gupta, Engineering Mathematics for semesters I and II, McGraw Hill Education (India), 2019.
5. T. Veerarajan, K. Kannan, Engineering Mathematics – I , Tata McGraw Hill Education (India) , 2020.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publications, 44th Edition, 2020.

LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to:

UNIT - I	Examine the stability of a system
UNIT - II	Determine the extremum of a function of a single variable
UNIT - III	Evaluate the optimum values for nonlinear functions of multi variables

COURSE-WISE LEARNING OUTCOMES

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

- Examine the stability of a system
- Evaluate integrals using various methods
- Determine extreme values of the function

Course code: MAT145

Semester: II

L	T	P	C
3	1	0	4

ORDINARY DIFFERENTIAL EQUATIONS & VECTOR CALCULUS

Course Objective:

- This course enables the learner to determine various physical quantities of substances through multiple integrals
- This course enables the learner to solve various ordinary differential equations
- The course enables the learner to relate surface integrals with volume integrals through vector differentiation and integration

UNIT I: IMPROPER AND MULTIPLE INTEGRALS

15 Periods

Beta & Gamma functions: Definitions – Relation between Beta and Gamma integrals - Properties of Beta and Gamma integrals – Evaluation of definite integrals in terms of Beta and Gamma integrals

Multiple Integrals: Double Integrals – Change of order of integration – Triple integrals (problems involving Jacobians are not included)

Applications: Evaluation of double and triple integrals in terms of Beta and Gamma functions.

UNIT II: FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS

15 Periods

Introduction-Formation of ordinary Differential equations- Solution of first order first degree equations -Variable separable method- Homogeneous equations - Linear equations -Bernoulli's equations - Exact equations (Equations reducible to exactness are not included)

Applications: Rate of growth/decay (Food production and Bacteria culture) - Chemical reactions and solutions, Newton's law of cooling – Temperature model – Velocity of escape from earth.

UNIT III: ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER

15 Periods

Introduction-Higher order differential equations with constant coefficients – Method of finding complementary function – Method of finding particular integrals - Method of variation of parameters for second order ODE with constant coefficients- Simultaneous differential equations with constant coefficients - Euler's differential equation with variable coefficients.

Application: L – C – R circuit problems – Tunnel effect – Assembly dynamics of a neuron

UNIT IV: VECTOR CALCULUS

15 Periods

Vector Differentiation: Differentiation of vectors - Vector differential operator: Gradient, Divergent and Curl operators - Directional derivative - Scalar potential of a vector function - Irrotational and Solenoidal vector fields. Vector Integration: Introduction to Line, Surface, and Volume integrals – Green's theorem in a Plane - Gauss divergence theorem - Stoke's theorem (theorems without proof). Applications: Verification of standard theorems in evaluating line, surface and volume integrals.

REFERENCES

1. R.S. Aggarwal, Senior Secondary School Mathematics for Class 12, BharatiBhavan Publishers, 2021.
2. R.D. Sharma, Mathematics for Class 12, Dhanpat Rai Publications, 2021
3. H.K. Das, Higher Engineering Mathematics, S. Chand & Sons, 2018.

4. C.B. Gupta, Engineering Mathematics for semesters I and II, McGraw Hill Education (India), 2019.
5. T. Veerarajan, K. Kannan, Engineering Mathematics – I, Tata McGraw Hill Education (India), 2020.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publications, 44th Edition, 2020.
7. Erwin Kreyszig, Advanced Engineering Mathematics, 10th edition, John Wiley and Sons, 2015.
8. Srimanta Pal, Subodh C. Bhunia, Engineering Mathematics, Oxford University Press, USA 2015.
9. Paras Ram, Engineering Mathematics through Applications, CBS Publishers, 2nd Edition, 2015.

LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to:

UNIT - I	Apply the multiple integration techniques to find area and volume of surfaces
UNIT - II	Solve first-order differential equations that occur in the physical and chemical sciences.
UNIT - III	Apply the shortcut method to solve the higher-order ODE
UNIT - IV	Relate the line, surface, and volume integrals through vector differentiation and integration.

COURSE-WISE LEARNING OUTCOMES

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

- Apply beta and gamma integrals to determine the area and volume.
- Solve the rate of growth and chemical reaction problems.
- Transform variable coefficient problem to constant coefficient problem.
- Compute the normal to a given surface and use it to evaluate the double and triple integrals.