Bachelor of Science (B.Sc) **Subject Offered:**
Compulsory English, Hindi/Marathi/Supplementary English
Group 1: Physics Chemistry , Maths
Group 2: Microbiology, Chemistry, Biotechnology
Group 3: Physics, Maths, Computer Science

Semester I

Inorganic Chemistry

Course Outcomes (COs)

CO-1: Details about quantum numbers Also factors affecting and trends in chemical properties like IonizationPotential, Electron affinity and Electronegativity.

CO-2: Learn, Lattice energy and Born- Haber cycle and Formation of Hydrogen molecule with Potential energydiagram by of VBT.

CO-3: Should learn,s- block elements, Ionization potential, reducing properties. Application of s-block elements(Na, Kand,Ca) in biosystem. And structures, bonding and applications of Xenon fluorides (XeF2, XeF4,XeF6). Structureand bonding in XeOF2 and XeOF4.

CO-4: Students Practice of p-block elements Oxides: Structure of P2O3, P2O5 Oxyacids of Phosphorous: Structureof H3PO3 and H3PO4 And Simple tests for the detection of food adulteration in tea leaves and coffee, spices (turmeric andchili powder) and, milk.

Physical Chemistry

CO-1: To impart the students' concepts of thermodynamics and thermochemistry.

CO-2: To understand the basics of Gaseous state, ideal gas and real gas.

CO-3: To provide an insight into the liquid state and properties of liquid state.

CO-4: To get an overview about the adsorption and colloidal state

Semester II
Organic Chemistry

CO-1: Describe in details, Structure and Bonding:Hybridization in case of Methane, Ethane, Ethylene and Acetylene. And Reactive intermediates: Carbocations, carbanions, free radicals and carbenes (Definition,formation, geometry, stability).

CO-2: Should learn Stereochemistry of Organic Compounds: Elements of symmetry,Optical activity,D & L and R& S system of nomenclature. And Geometrical isomerism, maleic acid, fumaric acid,Conformational analysis of ethane and n-butane.

CO-3: Students learn, methods of formation (Ethane and Propane): Wurtz reaction, Kolbe's reaction and decarboxylation of carboxylic acid. Baeyer's strain theory and its limitations. formation (ethylene andpropylene):. Markownikoff's rule and Peroxide effect. And

CO-4: Students prepare,Details of Classification of dienes. Methods of formation of 1,3-butadiene.And Methods of formation of acetylene from: Calcium carbide and dehydrohalogenation of dihalides, Chemical reaction:and MO picture, Huckel rule and aromaticity, Aromatic electrophilic substitution mechanism with energy profile diagram (e.g., nitration and sulphonation) And LPG, CNG, LNG, and Bio-Gas (definition, calorific value, composition, properties and uses). Octane number.Lubricants:Definition, classification

Physical Chemistry

Course Outcomes (COs)

CO-1: To learn the basics of second law of thermodynamics, Carnot cycle and partial molar properties.

CO-2: To learn and understand Phase equilibria and Solutions of

Liquids in Liquids.

CO-3: To understand the concept of chemical kinetics and theories

of reaction rate. CO-4: To get an overview about the nuclear

chemistry, pollution and its control.

Semester III

Inorganic chemistry

CO-01: Able to write structure and bonding of Inter-halogen and poly-halogen compound on the basis of VSEPRand MO theory.

CO-02: Able to write electronic configuration and periodic properties of Transition element.

CO-03: Able to understand the types of error in chemical analysis and types of solvent.

CO-04: Able to understand the chemistry of inner transition element.

Organic Chemistry

Course Outcomes (COs)

CO-1: Students should be able to identify the formation and identify chemical reactions of activating, deactivatingsubstituents, alkyl halides and polyhalogen compounds.

CO-2: Students should be able to classify and identify preparation methods, properties and analyse reactionmechanisms of alcohols and phenols

CO-3: Students should be able to evaluate and compare synthesis methods and reactions related to Aldehydes andKetones.

CO-4: Students should be able to analyse structure and bonding, compare different methods of synthesis, identifyreaction mechanisms of Carboxylic Acids and their derivatives.

Semester IV

Inorganic chemistry

CO-01: Able to understand coordination chemistry –types, classification,

nomenclature Warner theory, coordination number, EAN rule chelating complex.

CO-02: Able to understand the isomerism in coordination compound having 4 and 6, and oxidation reduction inEMF Series.

CO-03: Able to understand the Colorimetery and Spectrophotometery Method and Separation Techniques.

CO-04: Able to understand the Inorganic Polymers, Silicones chemistry, Phosphonitrilic halide polymers.

Physical Chemistry

Course Outcomes (COs)

CO-1: Students should be able to classify and explain different types of solids, crystals, crystal systems and shouldbe able to characterize and interpret them

CO-2: Students should be able to explain and evaluate different concepts and theories related to electrochemistryand its applications

CO-3: Students should be able to discuss concepts and applications of Rotational and Vibrational Spectroscopyand examine different spectra.

CO-4: Students should be able to interpret different principles and concepts of Quantum chemistry and discussabout dielectric and magnetic properties of molecules.

Semester V

Organic chemistry

CO-01: Able to understand classification, nomenclature, synthesis, mechanism of nitrogen containing organiccompound.

CO-02: Able to understand classification, nomenclature, synthesis, mechanism of Heterocyclic compound likefuran, thiophene, pyrrole and pyridine, Indole, Quinoline and Isoquinoline.

CO-03: Able to perform Quantitative Analysis of carbon, hydrogen, nitrogen, sulphur and halogens and preparationand chemical properties of Organometallic compounds.

CO-04: Ability to understand Spectroscopy technique like UV and IR.

Physical Chemistry

CO-1: To acquaint knowledge on basics of Electrochemistry, Nernst equation, applications of EMFmeasurement in pH determination and potentiometric titration.

CO-2: Students to learn and understand about applications of Schrodinger equation in one and three dimensional box, concept and shapes of orbitals, radial distribution curves for different orbitals andmolecular orbital theory

CO-3: To provide an insight into the photochemistry, laws of photochemistry, Quantum yield, Jablonskiidiagram, Raman spectroscopy and rotational-vibrational spectra of diatomic molecules.

CO-4: To get an overview about the colligative properties, determination of molecular mass from relative lowering of vapour pressure and Macromolecules, determination of molecular mass of macromoleculesusing viscometry, osmometry and light scattering methods.

Semester VI

Inorganic chemistry

CO-01: Able to understand Concept related VSEPR theory Calculation of CFSE and Electronic spectra ofTransition Metal Complexes.

CO-02: Able to understanding the Magnetic Properties of Transition Metal Complexes and Thermodynamic andKinetic aspect of metal complexes.

CO-03: Able to learn Nomenclature, Classification Preparation of Organometallic compound and metal carbonylcompound.

CO-04: Able to understanding the Essential and Trace elements in biological processes, Hard and Soft Acids andBases, HSAB Concept for acid base.

Organic Chemistry

CO-1: To learn the basics of NMR spectroscopy, Infrared spectroscopy and to understant the interpretation ofNMR spectra of organic molecules and Intensity and position of IR bands, applications of IR spectra.

CO-2: Students to learn and understand the synthesis, chemical properties of Malonic ester and acetocaceticester, classifications and reaction of glucose, mechanism of osazone formation, chain lengthing and chain shortening of aldoses.

CO-3: To understand the basics of amino acids, peptides, proteins,nucleic acids, fats, oils, soaps anddetergents.

CO-4: To get an overview about the synthetic dyes, synthetic polymers and green chemistry

B.Sc. Biotechnology

Semester I

PAPER 1-MICROBIOLOGY

Course outcomes: On completion of this course students will be able to

CO1 : Recognise the contribution of major scientist in the development of microbiology and will be understand and apply the principle of various types of Microscope and staining techniques.
CO2: Identify and describe bacterial morphology and subcellular structure including genetic material and its endospore generation.
CO3 :Understand the classification of microorganisms through Bergey's manual and describe general characteristics and classification of viruses.

CO4 :Students can and apply basic knowledge of nutrients required by different microorganisms for their growth

PAPER 2-MACROMOLECULES

Course outcomes: On completion of this course students will be able to

CO1 Describe the structure and function of DNA and RNA in the cell

CO2 Understand the concept of Gene and describe the structure and function of chromatin.

CO3 Recognize the structure of amino acid and classifies them on the basis of physicochemical properties and comprehends the primary structure of the protein.

CO4 Describe the three-dimensional structure of proteins, including the significance of amino acid R-groups and their impact on the three-dimensional structure of proteins.

Semester II

PAPER 1-MICROBIOLOGY AND CELL BIOLOGY

Course outcomes: On completion of this course students will be able to

CO1 Understanding of the different aspects of microbial growth and the concept of pure culture

CO2 Understand and apply the concept of microbial control and the mechanism of cell injury.
CO3 Identify and summarize the structure and function of eukaryotic sub-cellular structures.

CO4 Understand the structure and function of Plant cell walls and cytoskeleton and can reflect on the process in cell division. And the activity of muscle and nerve cell structure.

PAPER 2-CELL CONSTITUENTS AND ENZYMOLOGY

Course outcomes: On completion of this course students will be able to

CO1 Define and classify carbohydrates and understand the structure and function of different polysaccharides.
CO2 Understand and illustrate the structure of lipids and their function in biology. CO3

Understand and describe the terminology and concepts related to enzymology.

CO4 Explain the phenomenon behind enzyme assay and derive the kinetic equations related to enzymes.

Semester III

PAPER 1- METABOLISM

Course outcomes: On completion of this course students will be able to

CO1 Comprehend the concept of bioenergetics, various terminologies related to it and the concept of high-energy molecules and bonds
CO2 Develop an understanding of various metabolisms in cell

CO3 They will know the formation and the breakdown of different biomolecules and the places where it took place

CO4 Various physiological and pathological aspects of byproducts of metabolic pathways and their regulations relate with various industrial processes.

PAPER II –BIOPHYSICAL TECHNIQUES

Course outcomes: On completion of this course students will be able to

CO1 Understand and illustrate the principle and functioning behind spectrophotometry.

CO2 Enumerate the application of UB -Vis spectrophotometry and comprehend principles of other spectrometric methods.
CO3 Understand and illustrate the principle and functioning behind Chromatography.

CO4 Distinguish between different types of chromatography techniques.

Semester IV

PAPER I – IMMUNOLOGY

Course outcomes: On completion of this course students will be able to

CO1 Understand and explain immune system, properties of immune system, types of immunity, pathways of complement systems

CO2 Know the concept of antigen, antigenic determinants, hapten, and factors affecting antigenicity in various diseases.

CO3 Know immunoglobulin, structure, types, and functions and can apply the concept of Hypersensitivity and vaccination while observing the different diseased situations
CO4 Perform various immunological techniques.

PAPER II –BIOSTATISTICS AND BIOPHYSICAL TECHNIQUES

Course outcomes: On completion of this course students will be able to

CO1 Students will know and apply the concept of electrophoretic mobility, migration of ions in an electric field various type of electrophoretic techniques, their procedure, principle, and applications
CO2 Students will use detection and recovery methods of various macromolecules by electrophoretic methods by knowing their advantages and limitations.
CO3 Students will have an insight into the isotopic tracer technique and centrifugation their uses, different isotopes and their use in radiology, limitations and principle of tracer technique, limitations and application part of it, scintillation counters and can relate them with various tests performed during diagnosis of various disease like cancer.

CO4 Students will apply the basic concept of biostatistics for various research purposes.

Semester V

PAPER I - MOLECULAR BIOLOGY

Course outcomes: On completion of this course students will be able to

CO1 Understand and comprehend molecular biological processes like DNA replication and summarize the experiment proving its semiconservative nature.\
CO2 Illustrate the concept of mutation and DNA repair

CO3 Recall the steps and factors involved in the enzymatic synthesis of RNA

CO4 Describe the details of transcription termination, the concept of reverse transcription and regulation of prokaryotic transcription.

PAPER I - MOLECULAR BIOLOGY rDNA TECHNOLOGY

Course outcomes: On completion of this course students will be able to

CO1 Explain the concept of genetic code, decoding system, codon-anticodon interactions, selection of initiation codons,
CO2 Explain the concept of Initiation, elongation, termination, and also the regulation of translation

CO3 Students can give an introduction to rDNA technology, the basics of genetic engineering, various enzymes, the concept of different vectors and their applications and can apply them further.

CO4 Apply the concept of PCR, its applications, general features of expression vectors- advantages and problems, and various applications of r-DNA technology while performing experiments in r-DNA technology.

Semester V

PAPER I - APPLICATIONS OF BIOTECHNOLOGY

Course outcomes: On completion of this course students will be able to

CO1 Understand the process of water and waste water treatment process and able to define and describe the concept of biodegradation, biodeterioration and biotransformation.
CO2 Understand the concept of Xenobiotic and recalcitrant compounds and reflect on assessment of water and wastewater quality.

CO3 Comprehend the basic principles of Industrial Biotechnology

CO4 Comprehend the basic principles of Food Biotechnology

PAPER II-PLANT AND ANIMAL BIOTECHNOLOGY

Course outcomes: On completion of this course students will be able to

CO1 Describe and compare different plant tissue culture techniques.

CO2 Describe different plant biotechnology techniques and justify their application.

CO3 Describe and compare different Animal Cell culture techniques and laboratory management.
CO4 Describe different Animal biotechnology techniques and justify their app

COMPUTER SCIENCE

Semester : I **Paper** – I : Programming in C	
CO1	1. Students will gain the skills to design and implement algorithms. They will learn how to break down a problem into smaller subproblems and use control structures to create efficient and logical solutions. 2. Students will develop skills in algorithmic thinking and problem-solving, enabling them to design efficient algorithms and implement them.

CO2	1. Students will grasp the fundamental concepts of programming, such as variables, data types, operators , control structures (e.g., loops and conditionals), functions, and arrays. They will learn how to write simple programs using these elements. 2. Students will become familiar with the syntax and semantics of the C programming language, including the proper use of statements, expressions, and declarations. 3. Students will develop the skills to write C programs to solve various computational problems. They will learn how to write code that is clear, efficient, and follows best programming practices. 4. Students will learn how to identify and fix errors (bugs) in their programs using debugging techniques and strategies. They will gain proficiency in troubleshooting common programming issues. 5. Students will gain knowledge about various standard libraries and functions available in C, such as the standard input/output library (stdio.h), string manipulation functions (string.h), mathematical functions (math.h), and others. 6. Students will gain practical experience in writing, compiling, and executing C programs using integrated development environments (IDEs)
CO3	1. Students will grasp the concept of arrays as a collection of elements of the same data type stored in contiguous memory locations. They will learn how to declare and initialize arrays, as well as access and manipulate individual array elements. 2. Students will be introduced to coding best practices specific to string handling in C. This includes guidelines for string manipulation, error handling, memory management, code readability, and efficient algorithms for string operations. 3. Introduce guidelines for function naming conventions, parameter naming, code readability, modularity, and documentation to enhance code quality and maintainability. 4. Students will be introduced to coding best practices specific to storage classes in C. This includes guidelines for variable declaration, choosing appropriate storage classes, and understanding the impact of storage classes on program performance and memory usage.
CO4	1. Students will gain a solid understanding of how to declare, initialize, and use pointers.They will learn about pointer arithmetic and the role of pointers in accessing and manipulating data. 2. Students will grasp the concept of structures as a composite data type that allows the grouping of related data items under a single name. They will learn how to define and declare structures, as well as access and manipulate their individual members. 3. Students will learn about the differences between unions and structures in terms of memory allocation and member access. They will understand that unions store only one member at a time, whereas structures store all members simultaneously. 4. Students will learn how to read from and write to files using the file I/O functions available in C. They will understand concepts like file pointers, opening and closing files,

	and performing various operations on files. 5. Students will grasp the concept of command line arguments and their role in passing inputs to C programs during runtime. They will learn how command line arguments canbe used to provide flexibility and user interaction. 6. Students will learn how to read from and write to files in C. They will understand concepts like file pointers, opening and closing files, reading and writing data, and error handling related to file operations.
Semester : I **Paper** – II : Introduction to Information Technology	
CO1	Students will understand the basic principles of Information Technology like computer-based system and component to meet desired needs.
CO2	Understand fundamentals of the data/signal transmission over communication media
CO3	Understand the transmission media and their standards to practice different protectionschemes at individual and team level.
CO4	Explore the concept of network topology, and different ways of communication between PCs using Wi-Fi, Bluetooth and Infrared devices. And understand the architecture ofpeer-to-peer and client/server.
Semester : II **Paper**-I : Object Oriented Programming Using 'C++'	
CO1	1. Students will grasp the core concepts of OOP, including encapsulation, inheritance, and polymorphism. They will learn how these concepts contribute to code organization, reusability, and maintainability. 2. Students will learn how to define classes, create objects from those classes, and understand the relationship between classes and objects in OOP. They will gain insights into class structure, member variables, and member functions. 3. Students will grasp the concept of static data members in C++ and their behavior.They will learn that static data members belong to the class itself rather than individual objects, and they are shared among all objects of the class. 4. Students will grasp the concept of access specifiers in C++ and their role in controllingthe visibility and accessibility of class members. They will learn about three access specifiers: public, private, and protected.

CO2	1. Students will grasp the concept of constructors in C++ and their role in initializing objects of a class. They will learn about default constructors, parameterized constructors, copy constructors, and their syntax and usage. 2. Students will grasp the concept of operator overloading in C++ and its role in providing customized behavior for operators when working with user-defined types and classes. 3. Students will gain insights into how operator overloading can be used to create expressive and intuitive interfaces for classes. They will understand how operator overloading can enhance the object-oriented design and usability of user-defined types.
CO3	Students will be able to : 1. Demonstrate a clear understanding of dynamic memory allocation in C++. 2. Use new and delete operators to dynamically create and destroy objects during program execution. 3. Implement dynamic object creation and destruction using constructors and destructors. 4. Manipulate dynamic objects using pointers and understand the concept of pointerarithmetic. 5. Understand the concept of inheritance and its significance in object-oriented
	programming. 6. Analyze and compare different inheritance approaches (e.g., single inheritance, multiple inheritance, virtual inheritance) and select appropriate techniques based on specific design requirements.
CO4	Students will be able to : 1. Understand the concept of virtual functions in C++ and their significance in achievingpolymorphic behaviour. 2. Apply the concept of function overriding to redefine base class functions in derivedclasses, considering access specifiers and return types. 3. Utilize virtual destructors to ensure proper destruction of derived class objects throughbase class pointers. 4. Understand the concept of exception handling in C++ and its importance in managingprogram errors and ensuring robustness. 5. Utilize the try-catch block to handle exceptions and prevent program termination dueto errors.
Semester : II **Paper**-II : System Analysis and Design	
CO1	Define the system development life cycle. Conducts research on existing systems anddevelop plans for the new system.
CO2	Make the feasibility study about the system (Technical risks and technical possibilities).
CO3	Scheduling with using GANTT and PERT techniques. Evaluates the economic self-sufficiency whether to install the system.

CO4	Carry out the system analysis. Identifying the problems in the system. Determine thecause of the problem in the system. Find a solution of the problem in the system.
Semester : III **Paper- I** : Data structure	
CO1	Able to write the algorithms and implementing the algorithms based on Single linked Listand Double Linked list.
CO2	Able to write algorithms and implemented based on Stack and also understood theconcept and Application of stack
CO3	Able to write the algorithms and implementing the algorithms based on Queue and sortingTechniques.
CO4	Able to understand the concept of Binary tree and Graphs and Traversing methods ofTrees and Graphs.
Semester : III **Paper- II** : Operating System	
CO1	Able to understand structure of OS, Process management, Schedulers and different Scheduling algorithms.
CO2	Able to understand the concept related to Deadlock and Starvation.
CO3	Able to understand the concept related to memory management, partition Descriptiontable, Paging and Segmentation
CO4	Able to understand the concept of I/O management ,File management and Protectionmechanism
Semester : IV **Paper- I** : Java Programming	
CO1	Students will be able to : 1. Understand timeline, features of Java programming language. 2. Understand the concept of variables and their role in storing and manipulating data inJava. 3. Differentiate between different data types in Java, such as primitive types (int, double,boolean, etc.) and reference types (classes, arrays, etc.).
CO2	Students will be able to :

	1. Understand the concept of classes and objects in object-oriented programming (OOP)and their significance in Java. 2. Implement access specifiers to enforce encapsulation and data hiding principles inclass design. 3. Develop well-structured, efficient, and scalable Java programs that effectively utilizemethod overloading to enhance code flexibility and reusability. 4. Understand the structure and organization of the Java Class Library, including the corepackages (java.lang, java.util, etc.) and their respective functionalities. 5. Understand the concepts of decision making and conditional statements in Java. 6. Develop well-structured, efficient, and maintainable Java programs that effectivelyutilize arrays for data storage and manipulation. 7. Understand the concept of inheritance in object-oriented programming and itssignificance in code reuse and hierarchy establishment. 8. Develop well-structured, efficient, and scalable Java programs that effectively utilizeinheritance for code reuse and maintainable design. 9. Develop well-structured, efficient, and scalable Java programs that effectively utilizeinterfaces for abstraction, code reusability, and maintainable design.
CO3	Students will be able to : 1. Understand the package naming conventions and guidelines for creating and namingpackages. 2. Implement basic applet functionality, including rendering graphics, handling userinput, and responding to events. 3. Develop well-structured, efficient, and scalable Java programs that effectively utilizethreads for concurrent programming and multitasking. 4. Understand the concept of exceptions and errors in Java and their role in handling exceptional and error conditions.
CO4	Students will be able to : 1. Understand the event-driven programming model and utilize event listeners andhandlers to respond to user actions and events. 2. Design and create GUI components using AWT, such as buttons, labels, text fields,checkboxes, radio buttons, and list boxes. 3. Implement event handling for user actions, such as button clicks, menu selections, andkeyboard events. 4. Develop well-structured, efficient, and user-friendly GUI applications in Java usingAWT that meet specific requirements and usability standards.

Semester- IV
Paper – II : Linux Operating System

CO1	Understand the basic commands of Linux operating system.
CO2	Create file systems and directories and managing hardware.

CO3	Working on files (Sharing files with others, granting and revoking file access). Managing the user's account. Understand the processes background and fore groundby process and signals system calls.
CO4	Create shared memory segments, pipes, message queues and can exercise inter process communication. Working with different graphical user interfaces (KDE &GNOME)

Paper – I : Visual Basic Programming.
Semester- V

	Course Outcomes(COs)
CO1	1. Able to program in VB using controls 2. Understand to handle data types, loops and control structures
CO2	1. Able to handle homogeneous data 2. Apply code reusability with procedures, functions and modules
CO3	1. Design interface using Menus 2. Apply DAO to handle database
CO4	1. Apply ADO to handle database 2. Able to handle errors in program

Paper – II : Data Base Management System.
Semester- V

	Course Outcomes(COs)
CO1	Concept related to DBMS, Comparative differences with traditional file system and Non procedural concept and different Data models
CO2	Able to construct Entity Relationship diagram, understanding the concept of strong and Weak Entity sets.
CO3	Able to perform different operations on Database and concept related to Aggregatefunctions.
CO4	Ability to perform Normalized the database using different normal forms.

Paper – I : Compiler Construction
Semester- VI

	Course Outcomes(COs)
CO1	Able to understand the concept of Compilers and Translators and different phases of Compiler.
CO2	Able to understand the definitions of programming languages structure operations and storage management.

CO3	Able to understand the role of Lexical Analyzer, syntax Analyzer, Context free Grammer,Ambiguous Grammar.
CO4	Able to understand the concept of different Parsing techniques and DAG representation.
Paper – II : SQL and PL/SQL **Semester-** VI	
	Course Outcomes(COs)
CO1	Able to understand creating table, constraints, different Data types, functions, operations,different Database Sublanguages
CO2	Able to understand creating views ,PL/SQL programming Data types, Iterative and conditional statements and problem based on PL/SQL
CO3	Able to understand Exceptions, writing cursors and types creating procedures and Exampleson procedures
CO4	Able to understand the concept of Functions, Purity levels in functions, Triggers, Types of Triggers, Enabling disabling Triggers and problem based on Triggers

CORE COURSE: Physics

PHYSICS SEM1 PAPER 1: (101) Properties of Matter and Mechanics

	Course Outcome
CO1	Understanding Elasticity; Hooke's Law of Elasticity, Numerical based on topics.
CO2	Understand Kinematics of moving fluids; Variation of viscosity with temperature. Surface tension, Numerical
CO3	Understanding concept of surface tension, Newton's laws of motion and Co-ordinate systems
CO4	Understand Motion of a Rigid body; rotational motion, Numerical based on topics.

PHYSICS SEM1 PAPER 2: (102) Electrostatics, Time varying fields & ElectricCurrents

	Course Outcome
CO1	The concept of charge should be known along with the properties of electrical forces. Understand familiar forces such as gravitation, Coulomb's Law, along with the principle ofsuperposition, calculation of electrostatic forces from a given charge distribution.
CO2	Understand the concept of dielectric constant and polarization in dielectric materials.Summarizing various types of polarization of dielectrics. Interpreting Lorentz field and Claussius- Mosotti relation in dielectrics. To understand the basic concept of Capacitor.
CO3	To distinguish between static and time -varying fields. Gain knowledge of fundamentallaws and principles of electromagnetic induction. To explain electrical current, circuits, construction and their use and network theorems.

CO4	Knowing and Analyzing the Concepts of Alternating Currents and theory of transformer, its losses and uses. Numericals based on topic.

PHYSICS SEM2 PAPER 1: (201) Oscillations, Kinetic theory of gases andThermodynamics

	Course Outcome
CO1	Understand concept of Waves and Oscillation, Linear S.H.M, Angular S.H.M, Differential equations and solutions. Numerical based on topics. Superposition of two SHM of same frequency, Numerical based on topics.
CO2	Understand the concept of forced oscillation and topic based numericals. To build astrong foundation of knowledge in different areas of basics of Ideal Gas - Kinetic theory of Gases
CO3	Students understand the basics laws of thermodynamics laws. Numerical based on topics
CO4	Understand the Liquefaction of Gases Joule coefficient, Boyle, thermodynamic system

PHYSICS SEM 2 PAPER 2: (202) Gravitation, Astrophysics, Magnetism and Magnetostatics

	Course Outcome

CO1	To study the Newton's law of gravitation. To study the gravitational field and potential. To know the concept of gravitation.
CO2	Acquire knowledge of the Physical universe and its evolution. Define and use fundamental principles and techniques of astronomy and astrophysics. Understand and apply basic physics and computational techniques to solve problems in astrophysics, and interpret the results.
CO3	To understand basic concept of magnetism, classification of different types of magnetic materials and its application.
CO4	To understand the concept and study Biot-Savart's law and its application.
	To study the divergence and curl of magnetic field.

PHYSICS SEM 3 PAPER 1: (301) Sound waves, Applied acoustic, Ultrasonic and Power supply

	Course Outcome
CO1	Gain knowledge about superposition two waves, concept of phase velocity and group velocity etc.
CO2	Understand acoustic waves, noise and intensity of loudness, to gain the knowledge ofdesign of acoustic hall and auditorium.
CO3	To gain the knowledge of ultrasonics, ultrasonic waves and its effect and applications
CO4	Understand the concept of power supply. To apply the knowledge of rectifier and diode in application.

PHYSICS SEM3 PAPER 2: (302) Physical optics and Electromagnetic wavesPractical

	Course Outcome
CO1	To understand the light phenomenon such as Interference of light. To study Newton's rings and Michelson's Interferometer.
CO2	To know the concept and study of diffraction. To study types of diffraction such as Fresnel's and Fraunhofer diffraction and its application. Understand the concept ofresolving power of grating,
CO3	To know the concept and study of polarization and its application like double prism and Nicol's prism.
CO4	Understand Maxwell's relation for electromagnetic waves, their propagation in vacuum and other medium.

PHYSICS SEM 4 PAPER 1: (401) Solid State Physics, X-ray and Laser

	Course Outcome
CO1	Understanding basics of Crystallography, its type single, polycrystalline, Miller indices, X-rays diffraction, determination of lattice parameters, Understanding defects and dislocations in crystals.
CO2	To Interpret and understand X-rays and their properties. Describe and detect diffracted x-rays as well as the geometry of diffractions.
CO3	To understand the concept of reciprocal lattice, Bragg's law and X-ray diffraction methods.
CO4	Understand the concepts of Laser Optics, basic principle of Laser, its production, types and application and uses. Numerical based on topics

PHYSICS SEM 4 PAPER 2: (402) Solid State Electronics, and Molecular PhysicsPractical

	Course Outcome
CO1	To understand fundamentals of semiconductor and applications to theelectronic devices. Brief understanding of Solid-State Electronics and bipolar transistor.
CO2	To understand the working and principle of different type of Field effect transistors andtheir applications.
CO3	To develop basics of molecular physics and to generate the idea of all possible reasons of spectra and thus the thinking ability regarding empirical modelling. The problem-solving skill is developed by studying the mathematical concept of the rotational spectra.
CO4	To understand the fundamental theory behind Raman Spectra, various types of Raman Spectra, their selection rule. To understand the use of

	Spectroscopy and its Applications. To know the Principle of NMR, ESR etc and its applications.

PHYSICS SEM 5 PAPER 1: (501) Atomic Physics, Free Electron Theory and Statistical Physics

	Course Outcome
CO1	Understanding Spectra of Single and Multi-Electron Atoms, Fundamentals of atom and its structure.
CO2	Explain the theory and applications of Free Electron Theory and Band Theory of Solids.
CO3	Students develop the understanding of the concept of Probability, microstates and macrostates and how the particles are distributed in the system in different states.
CO4	To understand the Distribution of distinguishable and indistinguishable, tounderstand the methods of statistical mechanics used to develop statisticsfor Bose-Einstein Statistics. Photon gases and Fermi-Dirac statistics and Energy distribution law for electron gas in metal.

PHYSICS SEM 5 PAPER 2: (502) Quantum mechanics, Nanomaterials and Nanotechnology

	Course Outcome
CO1	Understand the general formulation of quantum mechanics using the phenomenon like photoelectric effect, Compton effect, Heisenberg uncertainty principle, wave and particle duality. Numerical based on topics.

CO2	Understanding the concept of wave function and wave packet is introduced. Study of probability, expectation value and Ehrenfest's theorem assist students to be enriched with mathematical calculation. Understanding and analyzing the Schrodinger Equations for time and time independents equations, its numericals.
CO3	To understand basic concept of Nanoscience and History of nano materials, quantum size effect, properties of nano materials.
CO4	To find different methods for synthesis of nanomaterials and characterization of nanomaterials. Its application.

PHYSICS SEM 6 PAPER 1: (601) Relativity, Nuclear physics and Bio Physics

	Course Outcome
CO1	Would be able to understand the inertial and non-inertial frame of references and describe how fictitious forces arise in a non-inertial frame. Understand the importance of Michelson Morley's experiment in reference to special theory of relativity
CO2	To Develop concepts in fission, neutron cycle and also explore ideas in fields of particle accelerators. To develop concepts of liquid drop model and shellmodel.
CO3	Ability to understand fundamental concepts in nuclear physics and physicsinvolved in alpha beta and gamma decay. Gaining knowledge on nuclear detectors.

CO4	An understanding of physics in biosensor, electrode. An understanding ofbiomedical instrumentation principles in aspects of device design and applications.

PHYSICS SEM 6 PAPER 2: (602) Electronics, Fiber optics, Communication and Digital Electronics

	Course Outcome
CO1	Students would learn about electronic circuits such as Amplifiers and Oscillators. Various types of Amplifier and Oscillator circuits their working and applications in domestic, industrial and scientific devices/equipments.
CO2	To understand the optical fiber. Its principle, operation and application.
CO3	To understand various modulation and demodulation techniques used for communication. The paper needs a basic knowledge in electronics and mathematics andthe learners are expected to come out with the ability to choose proper modulation techniques.
CO4	To develop basic understanding of Boolean algebra and digital circuits.Topics in course need to have a basic knowledge in Solid State Electronics and are expected to gain knowledge to design electronic circuits.

Mathematics

Course Outcomes

Course/Semester/Paper	Name of Paper	Course outcome
B.Sc. Sem I PaperI	**M-1: Elementary Mathematics**	**CO1:** Apply De Moivre's Theorem to find powers and roots of complex numbers, and solve polynomialequations involving complex roots. **CO2:** Analyze and manipulate matrices using various techniques, including determining the rank of a matrix, transforming matrices to row canonical form, solving systems of equations, and applying the Cayley- Hamilton theorem to derive propertiesof a matrix. **CO3:** Students will gain a comprehensive understanding of

		various theorems and techniques for analyzing and solving equations, including relations between roots andcoefficients, Descartes' rule of signs, Horner's process, transformation of equations, reciprocal equations, and solutions for cubic and biquadratic equations. **CO4:** Students will be able to understand and apply the division algorithm, greatest common divisor, Euclidean algorithm, Diophantine equations, the fundamental theorem of arithmetic, properties of congruence, linear congruence, and the Chinese remainder theorem.
B.Sc. Sem I PaperII	**M2: Differential andIntegral Calculus**	**CO1:** Students will be able to find out expansion of various functions. **CO2:** Students can find limit and continuity of functions of two variables. **CO3:** Students will able to solve problems of maxima and minima of functions of two variables. **CO4:** Students learn how to find nth derivative of functions by using reduction formulae.

B.Sc. Sem II Paper I	**M3: Geometry, Differential & Difference Equations**	**CO1:** Students get idea about sphere and they can find the equation of sphere. **CO2:** Students get idea about various
		Differential equations and they solve the problems. **CO3:** Students learn second order linear equation they are able to solve the problems. **CO4:** They learn definition of difference equation and are able to find the solutions of difference equations.
B.Sc. Sem II Paper II	**M-4: Vector Analysis**	**CO1:** Students will be able to effectively apply vector differentiation techniques, understand concepts of differential geometry, and confidently work with gradient, divergence, and curl operations. **CO2:** Students will possess the skills to successfully perform double integration, evaluate double integrals, apply double integrals in various applications, work with area in polar coordinates, perform triple integration, understand the gamma function, its transformation and relation with the beta function, and evaluate and manipulate the beta function including its symmetric property and

		transformation. **CO3:** Students will have the ability to effectively integrate vectors over curves, calculate line integrals, perform surface integrals, and evaluate volume integrals.
		CO4: Students will be able to apply Green's theorem in the plane and its applications, understand and utilize the Gauss divergence theorem, and apply Stokes' theorem to solve various problems in vector calculus.
B.Sc. Sem III Paper I	**M5: Partial differential equation and Calculus of variations**	**CO1:** Students learn PDE and come toknow how to solve the PDE. **CO2:** Students are able to find linear PDE by various method. **CO3:** Students know the various method of solving linear PDE with constant coefficients. **CO4:** Students get idea of definition of functional and able to find functional.
		CO1: Students will have a solid understanding of the definition and examples of groups, the concept of subgroups, and a counting principle related to group theory. **CO2:** Students will have a comprehensive understanding of

B.Sc. Sem III Paper II	**M-6: Modern Algebra**	normal subgroups and quotient groups, homomorphisms, and permutation groups. **CO3:** Students will have a thorough understanding of the definition and examples of rings, various special classes of rings, homomorphisms, ideals, and quotient rings. **CO4:** Students will have a deep
		understanding of the field of quotients of an integral domain, Euclidean rings, a specific Euclidean ring, and polynomial rings.
B.Sc. Sem IV Paper I	**M7:Real Analysis**	**CO1:** Students are able to find the open sets interior point and limit point of a set, they are able to solve the examples. **CO2:** Students are able to find theconvergent and divergent sequence **CO3:** Students learn the infinite seriesand able to solve the various problems.**CO4:** Students will be familiar with remain integral and properties of integral function.

B.Sc. Sem IV **Paper II**	**M-8:** **Mathematica lMethods**	**CO1:** Students will possess a comprehensive understanding of the introduction to series solutions, power series review, the series solution of first-order equations, second-order linear equations, ordinary and singular points, regular and irregular singularpoints, as well as Legendre's andBessel's equations. **CO2:** Students will have a solid graspof Legendre's and Bessel's functions,including their properties, generatingfunctions, recurrence relations, and theconcept of orthogonality of functions. **CO3:** Students will have a comprehensive understanding of the

		Laplace transform and its application, including the transformation of elementary functions, properties of Laplace transforms, inverse Laplace transforms, transforms of derivatives and integrals, Laplace transform of t·f(t), Laplace transform of f(t)/t, the convolution theorem, and the solution of ordinary differential equations with constant coefficients as well as simultaneous ordinary differential equations. **CO4:** Students will have a comprehensive understanding ofFourier coefficients, convergence issues, even and odd functions, half- range cosine and sine series, and the extension of Fourier series to arbitrary intervals.

B.Sc. Sem V **Paper I**	**M-9: Complex Analysis**	**CO1:** Students will have a comprehensive understanding of functions of complex variables, including their definition, limits, continuity, differentiability, analyticity, the necessary and sufficient conditions for a function to be analytic, the Cauchy-Riemann equations in polar form, orthogonal curves, harmonic functions, and methods for finding conjugate functions using the Milne-Thomson

		method. **CO2:** students will have a comprehensive understanding of transformations, including conformal transformations, linear transformations, magnification, rotation, inversion, reflection, their combinations, bilinear transformations, and the Schwarz-Christoffel transformation. **CO3:** Students will have a comprehensive understanding ofcomplex integration, including the Cauchy integral theorem, Cauchyintegral formula, Morera's theorem, Cauchy's inequality, and Liouville's theorem. **CO4:** Students will possess a comprehensive understanding of the convergence of series with complex terms, Taylor's theorem, Laurent's theorem, singular points, residues, residue theorem, evaluation of real definite integrals using contour integration, and evaluation of improper indefinite integrals.
B.Sc. Sem V Paper II	**M10:Metric Space , Boolean Algebra & Graph Theory**	**CO1:** Students get idea of metric space, interior point, open sets and closed sets. **CO2:** Students solve the problems of metric space and compact sets.

		CO3: Students learn the properties of lattices. **CO4:** Students know basic concept of graph theory and solve the problems. And learn how to find metric representation of graphs.
B.Sc. Sem V **Paper II**	**M-11:** **Mechanics** **(Optional)**	**CO1:** Students will have a comprehensive understanding of forces acting at a point, parallel forces, moments, couples, coplanar forces, reduction theorems, equilibrium under three forces, general conditions of equilibrium, and the concept of the center of gravity. **CO2:** Students will have developed a thorough understanding of work and energy principles, virtual work applications, the behavior of flexiblestrings, and the characteristics of the common catenary. **CO3:** Students will have acquired a comprehensive understanding of motion in a plane, including velocity and acceleration components, angular velocity and acceleration, the relationship between angular and linear velocities, tangential and normal components of velocity and acceleration, Newton's Laws of

		motion, and projectile motion. **CO4:** Students will have developed a

		comprehensive understanding of Lagrange's dynamics, constraints, generalized coordinates, the principle of virtual work and D'Alembert's principle, Lagrange's equations, thereduction of the two-body central force problem to the equivalent one-body problem, motion in a plane under central force, differential equations of an orbit, the inverse square law of force, and the Virial theorem.
B.Sc. Sem VI Paper I	**M-12: Linear Algebra**	**CO1:** Students are able to find that given set is a vector space or not. **CO2:** They learn definition of linear transformation and solve the problems. **CO3:** They come to know the application the theory of ordinary DE. **CO4:** Students get the idea of linear operation of matrices.
B.Sc. Sem VI Paper II	**M13: Numerical Methods (Optional)**	**CO1:** Students will have developed a strong understanding of various numerical methods for solving equations, including the bisection method, the method of false position, iteration methods, the Newton-Raphson method, Ramanujan's method, the secant method, Muller's method, and techniques for solving systems of non-linear equations.

		CO2: Students will have a solid understanding of finite differences, differences of a polynomial, Newton's formulae for interpolation, central difference interpolation formulae, interpolation with unevenly spaced points, divided differences and their properties, as well as inverse

		interpolation. **CO3:** Students will have acquired a comprehensive understanding of numerical differentiation, determiningmaximum and minimum values of a tabulated function, numerical integration techniques, and the application of the Euler-Maclaurin formula. **CO4:** Students will have developed a solid understanding of various numerical methods, including solutionby Taylor's series, Picard's method of successive approximation, Euler's method, Runge-Kutta method, predictor-corrector method, cubic spline method, and techniques for solving simultaneous and higher-orderequations.

B.Sc. Sem VI Paper II	**M-14: Special Theory of Relativity (Optional)**	**CO1:** Students will have developed a solid comprehension of Newtonian mechanics, covering topics such as inertial frames, the speed of light and Galilean relativity, the relative nature of space and time, the postulates of the special theory of relativity, the geometric interpretation of Lorentz transformation equations, and the group properties associated with Lorentz transformations. **CO2:** Students will have gained a comprehensive understanding ofrelativistic kinematics, including the composition of parallel velocities, the relativistic addition law for velocities, transformation equations for velocity and acceleration components, the transformation of Lorentz contraction factor, length contraction, and time dilation. **CO3:** Students will have developed a comprehensive understanding of the geometrical representation of space- time in the context of relativity, including the four-dimensional

		Minkowskian space-time, space-likeand time-like intervals, proper time, the concept of the light cone or null cone, and the use of four-vectors and tensors in Minkowskian space-time. **CO4:** Students will have developed a comprehensive understanding of relativistic mechanics and electromagnetism, covering topicssuch as the variation of mass with velocity, the equivalence of mass and energy, transformation equations for mass, momentum, and energy, relativistic force and its components, relativistic Lagrangian and Hamiltonian, Maxwell's equations in vacuum, propagation of electric and magnetic field strengths, the four- potential, and transformation equations for electromagnetic four-potential vector, electric and magnetic fieldstrengths.