

The Berar General Education Society's  
**Shri Radhakisan Laxminarayan Toshniwal  
College of Science, Akola (M.S.)  
(R. L. T. College of Science)**

Recognized by Government of Maharashtra  
Affiliated to Sant Gadge Baba Amravati University, Amravati  
Re-accredited 'A' by NAAC, Bangalore With CGPA-3.12



# Programme and Course Outcomes

Shri R.L.T. College of Science, Akola (MS)

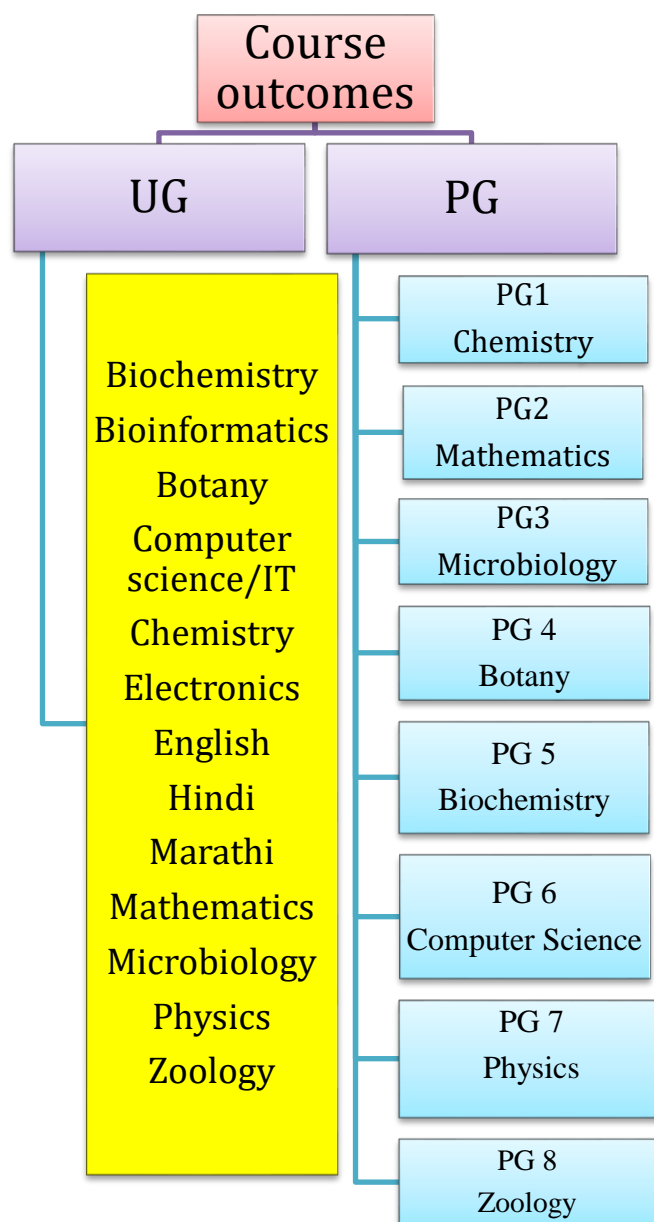
## Index

<b>Sr. No</b>	<b>Contents</b>	<b>Page. Nos</b>
1.	Programme outcomes: UG	5
2.	Course Outcomes: Biochemistry	6-8
3.	Course Outcomes: Bioinformatics	9-12
4.	Course Outcomes: Botany	13-14
5.	Course Outcomes: Computer Science	15
6.	Course Outcomes: Chemistry	16-17
7.	Course Outcomes: Electronics	18-19
8.	Course Outcomes: English	20-21
9.	Course Outcomes: Marathi	22-23
10.	Course Outcomes: Hindi	24-25
11.	Course Outcomes: Mathematics	26-31
12.	Course Outcomes: Microbiology	32-34
13.	Course Outcomes: Physics	35-37
14.	Course Outcomes: Zoology	38-40
15.	Programme outcomes: PG	41
16.	PSOs and Course outcome : PG	42-43
17.	Course Outcomes: Biochemistry	44-48
18.	Course Outcomes: Botany	49-52
19.	Course Outcomes: Computer Science	53-64
20.	Course Outcomes : Chemistry	65-68
21.	Course Outcomes : Mathematics	69-74
22.	Course Outcomes : Microbiology	75-80
23.	Course Outcomes : Physics	81-83
24.	Course Outcomes : Zoology	84-86

In higher education institutions, outcome-based education has now become the standard for quality education. The college clearly pre-states well-defined Programme Outcomes (POs) and Programme Specific Outcomes (PSOs) for every programme.

Similarly, there are pre-stated Course Outcomes (Cos) for all the courses of all the programmes offered by the college. POs are the statements which describe the knowledge, qualities and skills that the students are expected to acquire after the completion of the programme. POs stated by our college are in line with the Vision & Mission of the college. Pre-stated POs are defined in such a way that after the attainment of POs, the graduated students get equipped with the knowledge and skills such as Scientific Knowledge, Experimental Skills, Communication skills, Critical Thinking & Problem-Solving Ability, Team Spirit, Leadership Qualities, Patience and Persistence, Project Management, Digital Proficiency in using Modern Digital Tools, Environmental and Societal Consciousness, Ethics and Human values and an urge for Lifelong Learning.

COs are the theoretical and experimental skills the students are expected to acquire after the completion of each course of the programme. COs for the courses run by the college are defined by the faculty of the respective department. As faculty members are involved in framing the Cos and they are well aware of the pre-stated COs. Pre-stated COs, for all the courses for all the programmes run by the departments, are communicated to students through the departmental notice boards and the college website. COs for the curricula of the given programmes are stated in such a way that they should co-relate with the expected POs of the said programme. POs and COs are also communicated to the first year students through the Principal's Address held every year at the beginning of an academic session. Also, the guardian teachers (mentors), in their regular meetings and interactions with their mentees, make them aware about the COs.



## **B.Sc. Programme Outcomes**

Students of undergraduate degree programme at the time of graduation would be able to

- **Think critically:** Take informed actions after identifying the assumptions that frame our thinking and actions, check out the degree to which these assumptions are accurate and valid, and perceive our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
- **Develop multidisciplinary and interdisciplinary approach:** This course forms the basis of science for clear understanding of academic field to pursue multidisciplinary and interdisciplinary science careers in future with good communication skills. These subject areas include Biochemistry, Botany, Computer Science, Chemistry, Electronics, Mathematics, Microbiology, Physics and Zoology along with languages English, Marathi and Hindi.
- **Social Interaction:** Understand views of others, mediate disagreements and help reach conclusions in group settings.
- **Effective Citizenship:** Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness on issues and participate in civic life through volunteering.
- **Ethics:** Recognize different value systems including our own, understand the moral dimensions of our decisions, and accept responsibility for them.
- **Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.
- **Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning
- **Research Approach:** Develop scientific temper that can prove to be more beneficial for society as scientific developments can make a nation or society to grow at a rapid pace through research

**Course Outcomes: B.Sc.**

	<b>Biochemistry</b>
<b>Code</b>	<b>Course Outcomes</b>
<b>Biochemistry CO P1</b>	<p><b>After successful completion of this course students will be able to perform / analyze/ understand</b></p> <p><b>Biomolecules and Nutrition</b></p> <ul style="list-style-type: none"><li>• Chemical structure, properties, type of classification and biological importance of Carbohydrates.</li><li>• Differentiation between saturated and unsaturated fatty acids and suggest good quality edible oil.</li><li>• Physicochemical properties, types, classification and biological importance of Proteins.</li><li>• Differentiation between gene, genome and chromosome structure and basic structure and properties of nucleic acids.</li><li>• Chemistry of vitamins and hormones and suggest daily allowances of vitamins and importance of both.</li><li>• Calculate energy value of all food types and design complete food plan.</li></ul>
<b>Biochemistry CO P2</b>	<p><b>Biophysical and Biochemical techniques</b></p> <ul style="list-style-type: none"><li>• Application of knowledge of thermodynamics to understand biochemical reactions.</li><li>• Quantitative estimation of Carbohydrates, DNA and RNA.</li><li>• Techniques for isolation of biologically important products from natural sources.</li><li>• Formulation of techniques for separation of biomolecules using physicochemical principles.</li></ul>
<b>Biochemistry CO P3</b>	<p><b>Intermediary metabolism</b></p> <ul style="list-style-type: none"><li>• The formation and breakdown of carbohydrates and the metabolic pathways involved in the production of ATP and the regulatory and inhibitory factors and enzymes</li><li>• The metabolic pathways of conjugated and compound lipids such as phospholipids and glycolipids. Special emphasis is given on cholesterol metabolism and its regulation</li><li>• Metabolism of proteins and amino acids with special focus on urea cycle. This course also will help students understand the different reactions of amino acids such as transamination, deamination, and decarboxylation</li><li>• The biosynthesis and degradation pathways of purines and pyrimidines and the regulation of these pathways</li><li>• The anabolic and catabolic pathways of important porphyrins and production</li></ul>

	of bile pigments
<b>Biochemistry CO P4</b>	<p><b>Enzymology</b></p> <ul style="list-style-type: none"> <li>• The fundamental knowledge on enzymes, their components, units of enzyme activity, characteristics and importance of enzymes in biological reactions</li> <li>• The isolation, purification, and assay of enzymes and effects of various factors on enzyme activity and <math>K_m</math> with respect to MM equation and LB plot</li> <li>• The types of reactions and mechanisms of enzyme action along with inhibition, types of inhibition reactions, and effect of inhibitors in various reactions</li> <li>• The important co-factors and metal ions and their role in enzyme action along with the structure and mechanism of allosteric enzymes</li> <li>• The mechanism of enzyme action under various conditions and the effects of factors like proximity on enzyme action</li> <li>• The learning of different applications of enzymes in different areas such as industries, laboratories, and medicine along with methods to immobilize enzymes</li> </ul>
<b>Biochemistry CO P5</b>	<p><b>Molecular Biology and Biotechnology</b></p> <ul style="list-style-type: none"> <li>• The basic concepts of genetic information, central dogma of molecular biology, types of DNA and RNA, Watson and Crick model, and its application in molecular biology</li> <li>• The first two steps of the central dogma of molecular biology: Replication and transcription along with the factors involved in both and the processing of RNA after transcription</li> <li>• Translation and regulation of gene expression including the basic features of genetic code, factors influencing translation, and the concept of operons</li> <li>• The basic concepts of hybridization and nucleic acid sequencing and their applications in the field of recombinant DNA technology</li> <li>• Basic understanding about animal biotechnology such as its history, techniques involved in cell and organ culture, and applications</li> <li>• Plant biotechnology such as media, techniques involved in cell suspension culture and tissue culture, and applications</li> </ul>
<b>Biochemistry CO P6</b>	<p><b>Immunology and Clinical Biochemistry</b></p> <ul style="list-style-type: none"> <li>• The basic concepts and classification of immunology, antigen, and antibody</li> <li>• the reactions involving antigen and antibody complexes and the assays involving identification of immunological components</li> <li>• the technology involved in producing monoclonal antibodies and role of complement and types of hypersensitivities</li> <li>• the basic concepts of clinical biochemistry and quality control involved in a</li> </ul>

	<p>biochemistry laboratory and the automation used in clinical laboratories</p> <ul style="list-style-type: none"><li>• the collection, preservation, chemical analysis, and normal constituents of biological fluids in human body mainly focussing on urea and creatinine</li><li>• the functions and diagnostic applications of clinically important enzymes and the correlation between diseases and enzymes</li></ul>
--	--



	<b>Bioinformatics</b>
<b>Code</b>	<b>Course Outcome</b>
<b>Bioinformatics CO-01</b>	<p><b>After successful completion of this course students will be able to perform / analyze/ understand</b></p> <p style="text-align: center;"><b>Elementary Mathematics &amp; Statistics</b></p> <ul style="list-style-type: none"> <li>• Types of Functions, limits and continuity theorem, they also able to understand the functions of limits and continuity. Differentiation function, its physical significance, derivatives of trigonometry also understand by students</li> <li>• Integration, their partial fractions, sum, difference and products of two functions will understand. They can calculates areas and volumes of bounded regions</li> <li>• Differential equation, its function, general and partial solution, orders and degree of differential equations can solved and understand by students</li> <li>• Representation of data, discrete and continuous data, histogram, PolyGram's frequency curve, Mean, variability of data can understands and evaluate by students. Standard deviation, median, quartiles, percentiles can evaluate</li> <li>• Probability, outcomes, and probability rules for combines events can evaluates. Conditional and independent events can evaluate</li> <li>• Random variable distribution, cumulative distribution function can understand. Probability mass function and probability density can evaluate. Experimental approach and theoretical approach develops in students</li> </ul>

<p><b>Bioinformatics</b> CO P2</p>	<p><b>Computer Fundamentals and Operating Systems</b></p> <ul style="list-style-type: none"> <li>• Evaluate and use appropriate methods and professional standards in computing practice. Apply knowledge of computing within technical domains. Analyse, design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs.</li> <li>• Operating system and the role it plays and understanding of the structure of operating systems, applications, and the relationship between them. Students will get trained in navigation through documents and Use keyboard shortcuts to perform tasks. Navigate the Start menu to locate programs, files, and settings.</li> <li>• Different components of the Excel worksheet, Differentiate between an Excel workbook &amp; worksheet.</li> <li>• Enter text and formulas in to an Excel spreadsheet. Create a spreadsheet to tabulate and record numeric values. Use the print function to create a printable copy of data stored on an Excel spreadsheet. Set up the chart function of Excel to represent numeric data in multiple formats.</li> <li>• Linux utilities to create and manage simple file processing operations. They can Use Linux commands to manage files and file systems. Explain the structure of the Linux operating system.</li> <li>• Multi-user operating system which allows more than one person to use the computer resources at a time and the services provided by operating systems.</li> <li>• The different elements of our network and where they connect. And interconnections of computers with communication lines and other hardware devices which allows users to share information and resources.</li> </ul>
<p><b>Bioinformatics</b> CO P3</p>	<p><b>Essential Mathematics, Biostatistics, Bioinformatics and Biophysical methods</b></p> <ul style="list-style-type: none"> <li>• Water with its structure by explaining various concepts such as osmolarity, ionization. it clears the basic idea of students and makes them realize the importance of water.</li> <li>• Role of carbohydrates in living bodies with all the minute points with total carbohydrate contents which is essential to know by everyone.</li> <li>• Role of lipids and their classification and mechanism in the living beings</li> <li>• Proteins in structure and functions</li> <li>• Enzymatic concepts with their characters, properties, mechanism, value and working of enzymes in the living bodies.</li> <li>• The process of metabolism with various pathways such as ATP,EMP,TCA, synthesis and biosynthesis of proteins and lipids.</li> </ul>

<b>Bioinformatics</b> CO P4	<b>Fundamentals of Bioinformatics</b> <ul style="list-style-type: none"> <li>• The fundamentals of molecular biology in which they will study the structure of DNA and RNA in detail with their forms and will gain the process of replication as well as structural organization of eukaryotes and prokaryotes.</li> <li>• Concept of Gene, Genome, genomics, genome sequencing, various applications and methods, analysis and gene expression</li> <li>• Process of translation, its factors with regulation and structure which</li> <li>• Immunity with immune system and their function and working of antibodies in a living body</li> <li>• Types of immunity which fight against different types of infectious disease. It makes the understanding easily about various naturally present immune cells.</li> <li>• The theories of antigen-antibodies and different classes of immunoglobulin, applications and the molecular basis of immunity.</li> </ul>
<b>Bioinformatics</b> CO P5	<b>Methods in Bioinformatics</b> <ul style="list-style-type: none"> <li>• Develop logics which will help them to create programs, applications with C++ with computing theory and programming principles to practical software design and development.</li> <li>• By studying this will help students understand computer architecture. Since C++ is a low-level language that directly interacts with hardware, it allows students to learn how computer memory works and how information is stored.</li> <li>• DDL, DQL, DML Commands and Understand the basics of Oracle RDBMS Architecture and be able to write SQL commands to create tables and indexes, insert/update/delete data, and query data in a relational DBMS.</li> <li>• The structure of functions, character function, number function, block structure etc. in PL/SQL. Students will be able for calling function, defining new function, declare its variable, constant and data type at the end of this course.</li> <li>• Basic concepts in PL/SQL , database analysis and design.</li> <li>• Perl programming language. Creation of simple program using Perl language and manipulation of biological data present in Perl scripts and retrieve information.</li> </ul>

<p><b>Bioinformatics</b> CO P6</p>	<p><b>Advanced Bio-computing</b></p> <ul style="list-style-type: none"> <li>• Database concepts and database management system software. Students can analyse and retrieve different kind of data from various databases.</li> <li>• Basic bioinformatics operation using tools and databases such as Insilco analysis of primary structure of a nucleotide, representing DNA sequence, how to store it as well and computer application in biology.</li> <li>• Research methods in Bioinformatics to understand computational and experimental data with using FASTA and BLAST.</li> <li>• Restriction mapping by using biological database like PDB, SRS etc.</li> <li>• Biological database i.e. PROTEIN DATA BANK to get information through an internet information portal and downloadable data archive, 3D structure data by PDB for large biological molecules (proteins, DNA, and RNA).</li> <li>• Hidden Marcov Model and its application in sequences alignment. Along with HMM based software like HMMER and HMMSTR.</li> </ul>
--	---

	<b>Botany</b>
<b>Code</b>	<b>Course Outcomes</b>
<b>Botany CO P1</b>	<p><b>After successful completion of this course students will be able to perform / analyze/ understand</b></p> <p style="text-align: center;"><b>Diversity and application of Microbes and Cryptograms</b></p> <ul style="list-style-type: none"> <li>• Basics of cryptogam's plant diversity like viruses, bacteria, lichens, algae, and fungi</li> <li>• The different forms of algae, their habitat, cell structure, pigments, reserve food found in them &amp; morphology of different classes</li> <li>• Fungal diversity, morphological and reproductive features of various genera and classification of fungi and lichens with their economical importance</li> <li>• The geographical distribution, anatomy, reproduction and alternation of generation of classes of Bryophyte and contribution of Indian Bryologists</li> <li>• The classification, occurrence, structure, reproduction and life cycle of different classes, stellar evolution, heterospory &amp; seed habit of pteridophytes</li> <li>• Economic importance of algae &amp; fungi along with the plant diseases due to viral, bacterial &amp; fungal pathogens</li> </ul>
<b>Botany CO P2</b>	<p><b>Gymnosperm, Morphology of angiosperm and utilization of plants</b></p> <ul style="list-style-type: none"> <li>• Fossils, the types and process of fossil formation, geological time scale, and some fossil gymnosperms</li> <li>• Morphology, anatomy, life cycle and taxonomic positions of some gymnosperms along with affinities of gymnosperm with pteridophytes and angiosperms and their economic importance</li> <li>• Diversity of plant habits and morphology and modification in root, stem and leaves of angiosperms</li> <li>• Morphology of inflorescence, structure of flower, and types of pollination</li> <li>• Morphology of fruits and some economically important plants</li> <li>• Economic importance of various plants and pharmacognosy and phytochemistry of some medicinal plants</li> </ul>
<b>Botany CO P3</b>	<p><b>Angiosperm systematics, anatomy and embryology</b></p> <ul style="list-style-type: none"> <li>• Different branches of botany such as origin and evolution of angiosperm</li> <li>• Botanical nomenclature, principles of ICBN, taxonomic rank, concept and significance of herbarium, Indian royal botanical gardens, and biodiversity</li> <li>• Systems of classification and study the various systematic studies in the families of Dicotyledon-Brassicaceae, Leguminaceae, Malvaceae, Apiaceae along with families of Dicotyledon-Asteraceae, Apocynaceae, Asclepiadaceae, Solanaceae, Laminaceae, Verbenaceae, Euphorbiaceae Monocotyledons-Liliaceae, Poaceae</li> <li>• Components of tissue meristematic and permanent tissue, growth ring, anatomy of primary dicot and monocot root, and normal secondary growth in dicot root</li> </ul>

	<ul style="list-style-type: none"> <li>• The primary monocot and dicot stem, normal secondary growth in dicot stem, anomalous primary structure of Boerhaavia stem, Bignonia, Dracaena, Leaf Anatomy of Nerium and Maize.</li> <li>• Microsporogium and megasporogium. Understand male and female gametophytes. Know double fertilization and Triple fusion , endosperm and embryogeny</li> </ul>
<b>Botany CO P4</b>	<p><b>Cell biology, genetics and biochemistry</b></p> <ul style="list-style-type: none"> <li>• General concept of cell and structure and function of various cell organelles, and cell cycle.</li> <li>• Morphology and types of chromosomes and chromosomal aberration</li> <li>• Mendellian genetics, linkage, crossing over and gene mutation</li> <li>• Basics of enzymes</li> </ul>
<b>Botany CO P5</b>	<p><b>Plant physiology and ecology</b></p> <ul style="list-style-type: none"> <li>• Plant water relations with definitions of diffusion, osmosis, plasmolysis, and transpiration</li> <li>• Process of photosynthesis and respiration in plants</li> <li>• Nitrogen metabolism along with uptake and role of bacteria in N<sub>2</sub> fixation</li> <li>• Physiology of flowering and types of plants based on photoperiod</li> <li>• Concept of environment including ecological factors like light, temperature, and water and composition of atmosphere along with adaptations in hydrophytes and xerophytes</li> <li>• Types of ecosystem including food chain, food web, energy flow model, population ecology and ecological succession</li> </ul>
<b>Botany CO P6</b>	<p><b>Molecular biology and Biotechnology</b></p> <ul style="list-style-type: none"> <li>• The structure and replication of DNA, nucleosome model and DNA packaging, and transformation of genetic information</li> <li>• Structure of gene, gene expression including central dogma, types of RNA, genetic code, transcription, and translation process in eukaryotic cell.</li> <li>• Regulation of gene expression in prokaryotes-Operon concept and regulation of gene expression in eukaryotes-Britton Davidson model, Protein folding mechanism and structure, protein sorting</li> <li>• Tools and techniques of recombinant DNA technology, cloning vectors like plasmids, phages, cosmids, and gene transfer and gene amplification technique</li> <li>• Techniques and instruments in plant tissue culture</li> <li>• Applications of biotechnology in various industries</li> </ul>

<b>Computer Science/ Information Technology</b>	
<b>Code</b>	<b>Course Outcome</b>
<b>CO P1 (CPS / IT)</b>	<p><b>After successful completion of this course students will be able to perform / analyze/ understand</b></p> <p><b>Fundamentals of Information Technology and C Programming</b>            After the successfully completion of this course learner will be able to know basics of Computer system with its peripheral devices, understand the concepts of the Computer Operating System, different concept of Computer Communication Network as well as understanding the basic and concepts of C Programming language.</p>
<b>CO P2 (CPS / IT)</b>	<p><b>Web Technology and Advanced programming in C</b>            After this course learners understand Hyper Text Markup Language (HTML) its programming as well as Cascading style sheet (CSS) and programming in XML (eXtensible Markup Language). Also understand the advanced concepts like arrays, functions, Structure, Union and File Handling of C Programming Language.</p>
<b>CO P3 (CPS / IT)</b>	<p><b>Data structure and C++</b>            Data structure types and different operations perform on Data Structures like Arrays, stacks, queues, linked lists, Tree as well as know the Basics of C++ language with objects oriented concepts.</p>
<b>CO P4 (CPS / IT)</b>	<p><b>Relational Database Management System</b>            Database Management system (DBMS), data models ,understand DBMS structure, manipulation of DBMS using DDL, DML commands as well as Implementation of Program in PL/SQL with different functionalities.</p>
<b>CO P5 (CPS)</b>	<p><b>.Net Technology and Java Programming</b>            .NET Technology like its Framework with different related concepts, understand the concepts of visual programming (Visual Basic(VB) with Console application and windows application and VB.NETs control structure, string and function handling as well as basics of JAVA language its structure with control statements, arrays, with object oriented concepts.</p>
<b>CO P6 (CPS)</b>	<p><b>Advanced Java and VB.net</b>            Advanced JAVA language concepts like Exception Handling, Multithreading, Applet, Event Handling as well as concepts of Windows Applications in VB.NET and Object Oriented Programming also of Data Access with Active X Data objects (ADO.Net)</p>
<b>CO P7 (IT)</b>	<p><b>.Net C#</b>            C # programming with .NET framework and related concepts with concepts of C# tokens, Operators and expression, control statements, arrays, Structures and enumeration with object oriented concepts</p>
<b>CO P8 (IT)</b>	<p><b>Computer Graphics, Multimedia &amp; Animation</b>            Graphics system working of monitor, output primitives with various algorithm, understand the concepts multimedia and hypermedia with multimedia compressions techniques and concepts of Animation.</p>

<b>Chemistry</b>	
<b>Code</b>	<b>Course outcome</b>
<b>Chemistry CO P1</b>	<p><b>After successful completion of this course students will be able to perform / analyze/ understand</b></p> <ul style="list-style-type: none"> <li>• Radii, electro negativity, electron affinity, ionization potential, and ionic bonding</li> <li>• The properties of s- and p-block elements in periodic table</li> <li>• Electron displacements and its applications on various reaction mechanisms and preparation and properties of alkane, alkene and alkyne</li> <li>• Aromatic, non-aromatic and anti-aromatic compounds, mechanism of electrophilic aromatic substitution, and benzene ring activation and deactivation</li> <li>• Laws of thermodynamics and their limitations, Carnot cycles to calculate different cycle of process and efficiency of heat engine, and factors affecting entropy and its applications</li> <li>• Postulates of kinetic theory of gases, Maxwell-Boltzmann distribution, laws of molecular velocities, mean free path, collision number and diameter, Vanderwaal's equation of state and its derivation for real gases, critical phenomenon, Andrew's experiment, critical state and constant, Pc, Vc and Tc in terms of Vanderwaal's constants and law of corresponding state</li> <li>• Phase rule, number of phases, component, and calculation of number of phase</li> </ul>
<b>Chemistry CO P2</b>	<ul style="list-style-type: none"> <li>• Fajan's rule and polarization, hybridisation to find the geometry and shape of molecule, and soft and hard acids and bases</li> <li>• Properties of p-block elements and noble gases and merits and demerits of various solvents</li> <li>• The preparation and properties of alkyl, aryl halide, and alcohol and the reactivity of vinyl and allyl chloride and well as aryl and benzylic halide</li> <li>• Nomenclature, preparation, and properties of ether, phenol, and peroxides</li> <li>• The dipole moment, magnetic moment and their applications to determine the molecular structure</li> <li>• Order and molecularity of reactions and factors affecting on reaction rate</li> </ul>
<b>Chemistry CO P3</b>	<ul style="list-style-type: none"> <li>• The structure of various molecules and characteristics of metals as well as VSEPR theory</li> <li>• Volumetric and gravimetric estimations to calculate molarity, molality, and normality of solutions</li> <li>• Different reactions and methods of preparation and properties of acids</li> <li>• Stereochemistry, 3-D structure of compound, and applications of geometrical &amp; conformational isomerism</li> </ul>



	<ul style="list-style-type: none"> <li>• Laws of thermodynamics, adsorption, and calculation of EMF, enthalpy change, and <math>K_p</math></li> <li>• Concept, applications, and equations of liquid state, surface tension and viscosity</li> </ul>
<b>Chemistry CO P4</b>	<ul style="list-style-type: none"> <li>• Concept and importance of molecular symmetry and transition series elements and the role and importance of coordination compound in biological processes</li> <li>• The properties of lanthanides, actinides and their comparative study</li> <li>• Different methods of preparation of polynuclear hydrocarbon and synthetic application of reactive methylene compound</li> <li>• Aromatic nitro compounds, amino compounds, synthetic application of benzene, phenol, and aniline, and structural determination of polypeptides by end-group analysis</li> <li>• Importance of colligative properties</li> <li>• Crystalline solids and amorphous solids along with different experimental methods for determination of crystal structure</li> </ul>
<b>Chemistry CO P5</b>	<ul style="list-style-type: none"> <li>• Use of coordination compounds to determine the geometry, shape, magnetic property of compounds using VBT</li> <li>• Crystal field theory and electron distribution in the structure</li> <li>• Heterocyclic compounds</li> <li>• Drugs, Dyes, and pesticides and their industrial use</li> <li>• The interaction of light with matter, Lambert-Beer's law, laws of photochemistry, and quantum yield</li> <li>• Nature of light and its properties and microwave spectroscopy</li> </ul>
<b>Chemistry CO P6</b>	<ul style="list-style-type: none"> <li>• Principles, procedures, types, and applications of chromatography and Spectrophotometry</li> <li>• Organometallic compounds and polymers</li> <li>• Principles, procedures, and applications of electronic spectroscopy and IR spectroscopy</li> <li>• Nuclear magnetic resonance to understand the structure of the compound along with mass spectroscopy</li> <li>• Photoelectric effect and Compton effect</li> <li>• Electrochemistry and nuclear chemistry and its applications</li> </ul>

	<b>Electronics</b>
<b>Code</b>	<b>Course Outcome</b>
<b>Electronics CO P1</b>	<p><b>After successful completion of this course students will be able to perform / analyze/ understand</b></p> <p><b>Basics of Electronics</b></p> <ul style="list-style-type: none"> <li>• Passive components, transformer, Kirchhoff's laws, theorem on voltage and currents</li> <li>• CRO, measurements in electronics</li> <li>• Concepts of designing power supply and semiconductor diodes</li> <li>• The overall concepts of transistor</li> <li>• The switching and optoelectronics devices</li> <li>• The classification of ICS and their types</li> </ul>
<b>Electronics CO P2</b>	<p><b>Digital Electronics</b></p> <ul style="list-style-type: none"> <li>• Binary arithmetic's and logic gates</li> <li>• Design the Boolean algebra and logic families</li> <li>• Knowledge of multivibrators and flipflop</li> <li>• Basic concepts of counters and shift registers</li> <li>• Concepts of combinational logic circuit</li> <li>• Knowledge of semiconductor memories</li> </ul>
<b>Electronics CO P3</b>	<p><b>Electronic Devices and Circuits</b></p> <ul style="list-style-type: none"> <li>• Hybrid -parameters and cascaded amplifier</li> <li>• Basic concept of power amplifier</li> <li>• Knowledge of feedback amplifiers and oscillators</li> <li>• Overall detail of IC 741 op amp</li> <li>• Knowledge of advance application of op amp</li> <li>• Converters analogue and digital</li> </ul>
<b>Electronics CO P4</b>	<p><b>Communication Electronics &amp; Microprocessor 8085</b></p> <ul style="list-style-type: none"> <li>• Concepts of modulation and demodulation</li> <li>• Concepts of fibre optics</li> <li>• Pulse modulation and digital communication</li> <li>• The architecture of 8085 and its timing</li> <li>• The instruction and programming of 8085</li> <li>• The basic concepts PPI 8255</li> </ul>

<b>Electronics CO P5</b>	<b>Measuring Instruments</b> <ul style="list-style-type: none"> <li>• The basic concepts of LVDT and GI systems</li> <li>• The knowledge of IC 555 and PLL 566</li> <li>• The concepts, types of various types of temperature measuring devices</li> <li>• The display , digital instrument and encoder</li> <li>• The basic concept of sensors and actuators</li> <li>• The knowledge of biomedical electronics</li> </ul>
<b>Electronics CO P6</b>	<b>Advance Microprocessor and Microcontroller</b> <ul style="list-style-type: none"> <li>• The architecture of 8086 and its timing</li> <li>• The instruction and programming of 8086</li> <li>• The architecture of 8051</li> <li>• The instruction and programming of 8051</li> <li>• The 8051 interfacing and application</li> <li>• The architecture of Advance microcontroller (AVR)</li> </ul>

<b>English</b>	
<b>Code</b>	<b>Course Outcome (Prose)</b>
<b>English CO P1</b>	<p><b>After successfully completing this course, students will be able to understand various types of prose and poetry as discussed below:</b></p> <p style="text-align: center;"><b>The Child Premchand</b></p> <ul style="list-style-type: none"> <li>• The story highlights a new sense of social awareness in people and the story describes the generous nature of the narrator.</li> </ul> <p style="text-align: center;"><b>A Simple Philosophy Seathl</b></p> <ul style="list-style-type: none"> <li>• The story tells us about the love and affection of Chief Seathl towards the nature and the right and respect for Native American.</li> </ul> <p style="text-align: center;"><b>Values in Life Rudyard Kipling</b></p> <ul style="list-style-type: none"> <li>• The lesson have the themes of greed, honesty, conflict and acceptance.</li> </ul> <p style="text-align: center;"><b>Water: The Elixir of Life C. V. Raman</b></p> <ul style="list-style-type: none"> <li>• The story tells about Water, the common substance which we take for granted in our everyday life and the significant role it plays in shaping all life on Earth.</li> </ul> <p style="text-align: center;"><b>Introduction to Right to Information Act,2005 Pralhad Kachare</b></p> <ul style="list-style-type: none"> <li>• The lesson creates awareness about the RTI act, so that public can seek information of public importance from government and Semi-Government Institution.</li> </ul> <p style="text-align: center;"><b>Say Not the Struggle Naught Avaieth Authur Huge Clough</b></p> <ul style="list-style-type: none"> <li>• The poetry tells us about Optimism and Moralism. It tells us that there will be no total darkness, there will always be a little Light.</li> </ul> <p style="text-align: center;"><b>God's Grandeur Gernard Manley Hopkins</b></p> <ul style="list-style-type: none"> <li>• The poem is in the form of Petrarchan sonnet. It highlights God's presence everywhere in nature, but poet rues that men do not pay heed to god anymore.</li> </ul> <p style="text-align: center;"><b>To Autumn John Keats</b></p> <ul style="list-style-type: none"> <li>• The keynote of this poem is tranquility. It describes about the Autumn season and the structure here is simple and clean.</li> </ul> <p style="text-align: center;"><b>Bangle Sellers Sarojini Naidu</b></p> <ul style="list-style-type: none"> <li>• The poem describes the vivid picture of life in India. It tells us about different colors and designs of Bangles, which decorate the wrists of a new bride and at other times a young girl or those of an older woman.</li> </ul> <p style="text-align: center;"><b>Stay Calm Grenville Kleiser</b></p> <ul style="list-style-type: none"> <li>• The poem gives the messages to readers to keep calm in the face of the many big and small upsets of life. Tranquil is the weapon one can have against adversity.</li> </ul>

**English  
CO P2**

**What is Courage? *William Slim***

- The story tells us about the two types of Courage- Physical and Moral. It describes courage is the capability of working with a strong mind in all situation.

**The Hazards of Food Colouring**

- The lesson tells us about the hazards of food coloring on human health such as allergic reaction in some people and hyperactivity in sensitive children.

**The Kabuliwalla *Rabindranath Tagore***

- The story is about pure love between five-year-old Mini and a Afghani Vendor Rehman despite of their age gap and lack of common language they share bond like a father and daughter.

**The Eyes Are Not Here *Ruskin Bond***

- The story gives a moral that it is better to be real person than to fake yourself.

**My Lost Dollar *Stephen Leacock***

- The moral of the story is that small or big, one should return the money owed to others. Also, Honesty should be there in the world.

**A Psalm of Life *H. W. Longfellow***

- The poem highlights the natural grace and beauty in the verse, and also has simple themes like spirit of joy, faith and goodness of life.

**O Captain! My Captain! *Walt Whitman***

- The poem sa an elegy, written to mourn the death of Abraham Lincoln, the 16<sup>th</sup> president of US. It highlights that victory comes with a price.

**The Quality of Mercy *William Shakespeare***

- The poem is in the form of speech delivered by Portia for mercy in favor of Antonio. The passage extols the power of mercy, which is seen as a divine attribute.

**Father Returning Home *Dilip Chitre***

- The poem focuses on the theme of alienation or estrangement experienced by the aged in their twilight years.

**The World is Too Much with Us. *William Wordsworth***

- The poem is in the form of sonnet. In which Wordsworth criticizes the world of the First Industrial Revolution for being Materialism and distancing itself from nature

	Marathi
Code	Course Outcome
Marathi CO P1	<p>After successfully completing this course, students will be able to understand various types of prose and poetry as discussed below:</p> <p><b>महात्मा जोतिबा फुले समाजसुधारक की क्रांतिकारक</b></p> <ul style="list-style-type: none"> <li>• फुले यांचे स्वातंत्र्यपूर्व कार्य आणि विचारांची ओळख एक नागरिक या नात्याची जबाबदारीची जाणीव</li> </ul> <p><b>या देशाला काय देऊ शकतो डॉक्टर- एपीजे अब्दुल कलाम</b></p> <ul style="list-style-type: none"> <li>• प्रत्येक व्यक्तीचे देशासाठी असलेले कर्तव्य काय तसेच डॉक्टर कलाम यांच्या कार्याची ओळख</li> </ul> <p><b>अंधश्रद्धांचा महापौर- डॉक्टर नरेंद्र दाभोळकर</b></p> <ul style="list-style-type: none"> <li>• शोषण फसवणूक करणाऱ्या अंधश्रद्धाळू विचारांशी संघर्ष करण्याची प्रेरणा वैज्ञानिक दृष्टिकोनाची जागृती करण्याची जाणीव झाली.</li> </ul> <p><b>डॉ. आंबेडकरांचा स्रीविषयक दृष्टिकोन -डॉ. भगवान ठाकूर</b></p> <ul style="list-style-type: none"> <li>• स्त्रियांच्या सार्वभौम विकासाचा व तिच्या उन्नतीचा दृष्टिकोन कसा असावा याचे दर्शन झाले तसेच डॉक्टर आंबेडकर यांचे कार्य देशपातळीवर चे कार्य काय याविषयीची माहिती मिळाली</li> </ul> <p><b>पावर ऑफ हॅपी थॉट्स विचार नियम</b></p> <ul style="list-style-type: none"> <li>• निर्मळ मन, प्रशिक्षित शरीर, उपजिविका लक्ष, दीर्घायुष्य, चांगले मित्र, सर्जनशीलता वगैरे सर्व विचार नियमाने मिळू शकतात याचे ज्ञान मिळाले</li> </ul>
Marathi CO P2	<p><b>श्रीचा शैक्षणिक दृष्टिकोन डॉक्टर शोभा कडू</b></p> <ul style="list-style-type: none"> <li>• शिक्षणाविषयीचा तात्विक विचार</li> </ul> <p><b>विज्ञान व तंत्रज्ञान जागृतीपर्व -डॉक्टर रघुनाथ माशेलकर</b></p> <ul style="list-style-type: none"> <li>• श्रवण मनन आणि चिंतन या तीन पायऱ्यांनी ज्ञान प्राप्ती होते.</li> </ul> <p><b>विज्ञान व तंत्रज्ञान जागृतीपर्व डॉक्टर रघुनाथ माशेलकर</b></p> <ul style="list-style-type: none"> <li>• जागतिक पातळीवर भारताचे अवकाश उड्डाणाचे सामर्थ्य माहिती झाले.</li> </ul> <p><b>महात्मा बसवेश्वर डॉक्टर अशोक मेनकूदळे</b></p> <ul style="list-style-type: none"> <li>• सामाजिक पातळीवर व्यक्ती विशेष जीवन व कार्याची ओळख आणि परिचय</li> </ul> <p><b>राष्ट्रसंत तुकडोजी आधुनिक परिप्रेक्ष्य -डॉक्टर श्रीकांत तिडके</b></p> <ul style="list-style-type: none"> <li>• समाजाविषयीची आस्था व जागृती व्यक्तिपरिचय व प्रेरणा</li> </ul>

**गाडगेबाबांचे अखेरचे कीर्तन**

- लोकशिक्षण आणि लोकसेवेचे महत्त्व पटले अज्ञान आणि अंधश्रद्धा कायम नष्ट करण्यासाठी लोकजागृती किती गरजेचे आहे ह्याची जाणीव झाली.

	Hindi
Code	Course Outcome
Hindi CO P1	<p><b>After successfully completing this course, students will be able to understand various types of prose and poetry as discussed below:</b></p> <p style="text-align: center;"><b>यज्ञ निबंध</b></p> <ul style="list-style-type: none"> <li>• मेरे विद्यार्थी यह सीखेंगे की यज्ञ सेवार्थ है जिससे परम संतोष की प्राप्ति होती है !</li> </ul> <p style="text-align: center;"><b>बड़े घर की बेटी</b></p> <ul style="list-style-type: none"> <li>• मेरे विद्यार्थी यह सीख लेंगे की नारी जाति के आधार पर नहीं अपितु संस्कार के आधार पर बड़ी होती है!</li> </ul> <p style="text-align: center;"><b>बुधिया रेखा चित्र</b></p> <ul style="list-style-type: none"> <li>• मेरे विद्यार्थियों को यह ज्ञान होगा कि मातृत्व सेवा ही संसार की सबसे बड़ी सेवा है !</li> </ul> <p style="text-align: center;"><b>समय काटने वाले निबंध</b></p> <ul style="list-style-type: none"> <li>• विद्यार्थियों को रिटायर्ड लोग कैसे रहते हैं और उनकी जीवन शैली कैसी रहती है उनकी समस्या है क्या रही थी इनके बारे में उनको ज्ञान प्राप्त होगा. कोशिश करेंगे!</li> </ul> <p style="text-align: center;"><b>शिवाजी का सच्चा स्वरूप एकांकी</b></p> <ul style="list-style-type: none"> <li>• विद्यार्थियों को द छत्रपति शिवाजी महाराज इन के उदात्त चरित्र का दर्शन होगा</li> </ul> <p style="text-align: center;"><b>हम भ्रष्टन के भ्रष्ट हमारे</b></p> <ul style="list-style-type: none"> <li>• प्रस्तुत पाठ से विद्यार्थियों को भ्रष्टाचार की वजह से देश की जो दयनीय हालत है उसके बारे में जानकारी मिलेगी</li> </ul> <p style="text-align: center;"><b>रहीम के दोहे</b></p> <ul style="list-style-type: none"> <li>• विद्यार्थी जानेंगे की हिंदी साहित्य की अमूल्य निधि है!</li> </ul> <p style="text-align: center;"><b>एकता कविता</b></p> <ul style="list-style-type: none"> <li>• विद्यार्थियों को यह परम ज्ञान प्राप्त होगा कि एकता की भावना हर कठिनाइयों का सामना करने की शक्ति देती है!</li> </ul> <p style="text-align: center;"><b>ताज कविता</b></p> <ul style="list-style-type: none"> <li>• प्रस्तुत पाठ से मेरे विद्यार्थियों को मानवतावादी विचारों को अपने जीवन में अपनाए का महत्व समझता है !</li> </ul> <p style="text-align: center;"><b>जनता जगी हुई है</b></p> <ul style="list-style-type: none"> <li>• प्रस्तुत कविता से मेरे विद्यार्थी जीवन में हमेशा सजग रहने का संदेश लेंगे .</li> </ul>



**Hindi  
CO P2**

**आचरण की सभ्यता निबंध**

- विद्यार्थियों को यह नया ज्ञान होगा कि आचरण की सभ्यता अधिक ज्योतिषमति होती है ! आचरण की सभ्यता को प्राप्त करके एक कंगाल आदमी भी राज्यों के दिलों पर राज कर सकता है!

**उधार मांगना भी एक कला है**

- विद्यार्थियों को यज्ञ ज्ञान होगा कि मान और अपमान दोनों बराबर है !

**बकुल फिर आना कहानी**

- प्रस्तुत कहानी से विद्यार्थियों को नारी जीवन की असहायता का ज्ञान होगा
- **सर्बिया संस्मरण पृथ्वीराज की आंखें एकांकी तुल्य कविता**
- विद्यार्थियों को सर्बिया के जीवन चरित्र के बारे में जानकारी प्राप्त हुई!

**खून का रिश्ता**

- प्रस्तुत कहानी से विद्यार्थियों को सत्य का सहज रूप में दर्शन होगा
- **पृथ्वीराज की आंखें एकांकी**
- स्तुति पाठ में पृथ्वीराज का जीवन चरित्र तथा पराक्रम का गुणगान किया है!

**वात्सल्य वर्णन कविता**

- प्रस्तुत कविता से बाललीला का हृदय एवं मर्मस्पर्शी वर्णन विद्यार्थियों को ज्ञात होगा
- **जाग तुझको दूर जाना कविता**
- विद्यार्थियों को अमूल्य ज्ञान प्राप्त होगा कि संकल्प के लिए कोई और विकल्प नहीं होता

**दान कविता**

- प्रस्तुत कविता से मानव द्वारा मानव की निर्मम उपेक्षा का वर्णन किया गया है की जानकारी विद्यार्थियों को होगी

**नया सूर्य कविता**

- प्रस्तुत पाठ से विद्यार्थियों के मन में राष्ट्रपिता इनके प्रति आदर उत्पन्न होगा कविता से

	<b>Mathematics</b>
<b>Code</b>	<b>Course Outcome</b>
<b>Mathematics CO P1</b>	<p><b>After successful completion of this course students will be able to perform / analyze/ understand</b></p> <p style="text-align: center;"><b>Algebra and Trigonometry</b></p> <ul style="list-style-type: none"> <li>• The relation between circular function and also they can separate real and imaginary parts of circular and hyperbolic functions of complex variables.</li> <li>• The different types of series. Also they can solve the examples of series.</li> <li>• The introduction about Quaternion, they will learn the basic concepts about quaternion equality, addition, multiplication and complex conjugate of quaternion.</li> <li>• Relation between roots and coefficient. They can do transformation of equation by different methods.</li> <li>• Students can find rank of matrix. They can find eigen value, eigen vector and characteristic equation of matrix. They can prove different theorems on matrix</li> </ul>
<b>Mathematics CO P2</b>	<p><b>Differential and Integral Calculus</b></p> <ul style="list-style-type: none"> <li>• The concept of limit of functions and they can find out limit point. Students will get familiar with concept of Continuity of function. By using this continuity of function they can solve the example on that.</li> <li>• The concept of Differentiation, problems on differentiation and also successive differentiation. Leibnitz's theorem.</li> <li>• Work done by force of an application for line element, vector differential operator like Divergence and curl. Also the concept of a selodian.</li> <li>• The Rolle's Theorem, Lagrange's mean value theorem. Cauchy mean value theorem, Taylor's and Maclaurin's series.</li> <li>• Integration of forms. The concept of Reduction formulae and concept Quadrature and Rectification.</li> </ul>
<b>Mathematics CO P3</b>	<p><b>Differential Equations: Ordinary and Partial</b></p> <ul style="list-style-type: none"> <li>• Students will learn ordinary Differential equation. Also the order and degree of differential equation as well as different methods of solving first order ordinary differential equation.</li> <li>• The methods for solving second order ordinary differential equation. The examples on second order ordinary differential equations.</li> <li>• Problems on reduction of order, transformation of equation by changing dependent and independent variables.</li> <li>• The knowledge of Partial differential equation, PDE and different methods of solving PDE.</li> </ul>

	<ul style="list-style-type: none"> <li>• Methods for solving PDE of second order and higher degree.</li> </ul>
<b>Mathematics</b> <b>CO P4</b>	<b>Vector Analysis and Solid Geometry</b> <ul style="list-style-type: none"> <li>• Vectors and difference between Collinear vector and Coplanar vector, examples on vectors.</li> <li>• Curves, Frenet- Serret formula, the Normal Plane, Rectifying plane and Osculating plane.</li> <li>• The divergence and curl, Line element, work done and problem on work done.</li> <li>• The equation of sphere and its problems. Radical planes.</li> <li>• The cone and cylinder, equation of cone and cylinder and the types of cylinder.</li> </ul>
<b>Mathematics</b> <b>CO P5</b>	<b>Advanced Calculus</b> <ul style="list-style-type: none"> <li>• Concept of sequence, positivity theorem and sandwich theorem. Monotone's Convergence and bounded and unbounded sequences.</li> <li>• Series, examples on series, the Cauchy's integral test, examples on Cauchy's integral test. Abel test, Root test and Dirichlet's test.</li> <li>• Limit and Continuity of function of two variables. Concept of algebra of limit and Continuity. Taylor's theorem and can solve example on that.</li> <li>• Concept of maxima and minima, maximum and minimum point, stationary point. Lagrange's multiplier and Jacobians.</li> <li>• The concept of Double Integral. Additive property, Linear property and order property. Using the change of order of integration they can solve the examples.</li> </ul>
<b>Mathematics</b> <b>CO P6</b>	<b>Partial Differential Equations</b> <ul style="list-style-type: none"> <li>• The concept of divisibility, division algorithm. GCD and LCM of integers, properties of GCD, examples of GCD, LCM of more than two integer the relation between GCD and LCM. Apply the Euclidean Algorithm to find the GCD of given any two integer.</li> <li>• Difference between prime number and composite number, how to identify prime numbers. Learns method of representing any positive integer into power prime factorization. Apply Prime factorization method to solve the examples of GCD and LCM . The concept of Fermat number, distinguish Fermat number and Prime Number. The concept of Diophantine Equation and apply it in solving some real life examples(Coding theory and cryptography).</li> <li>• The concept of congruence modulo. The properties of congruence in solving problems such as simple divisibility test to check whether a given number is divisible by another number , finding remainder of given number dividing by particular number. The concept of linear congruence, solution of linear congruence exist or not by understanding the concept of</li> </ul>

	<p>existence of its solution.</p> <ul style="list-style-type: none"> <li>• The knowledge of congruence modulo in solving problems based on Chinese remainder theorem.</li> <li>• The concept of arithmetic functions. They can use Euler's Phi function to find number of relatively prime integers less than or equal to given positive integer. They can compute total number of divisors of given number using tau function, the sum of all the positive divisors of given positive integer using sigma function. Wilson theorem, Euler's Theorem, Fermat Little theorem. <ul style="list-style-type: none"> <li>• The order of integer modulo and then will be able to compute the primitive roots.</li> </ul> </li> <li>• Consequence to third unit now student can apply the concept of congruence over the polynomial. the examples based on quadratic polynomial congruence, existences of solution of quadratic polynomial through theorem that introduce in this unit, concept of residue in solving problems based on quadratic residue.</li> </ul>
<p><b>Mathematics CO P7</b></p>	<p><b>Laplace Transforms and Fourier Series</b></p> <ul style="list-style-type: none"> <li>• The group and its related information.</li> <li>• Verify axioms of group for given set and binary operation define on it, whether given set is group or not. Learn the properties of group. Explain the concept of subgroup. Define cyclic group. Students can find generator in cyclic group, also how many generator does the given cyclic group had. Familiar with concept of abelian group. Student understood that every cyclic group is abelian but converse not true by giving counter example. permutation group. Also can express any permutation in a product of cycle form. Students can find the order of permutation, inverse of permutation. Students can verify whether given permutation even / odd permutation.</li> <li>• Coset and normal subgroups with example.</li> <li>• Lagrange theorem and give the counter example for to prove converse is not true, the normal subgroups with some characterization theorems on normal subgroup.</li> <li>• Quotient group using normal subgroup. Learns the properties quotient group for given group (abelian, cyclic etc.)</li> <li>• Concept of homomorphism, isomorphism they can show whether given mapping is homomorphism, one-to-one, onto and isomorphism, properties under isomorphism preserved by group structure. Apply Fundamental theorem of homomorphism to show isomorphism of two groups, find kernel of homomorphism. Apply second and third isomorphism theorems for solving examples.</li> </ul>

	<ul style="list-style-type: none"> <li>• Ring in which two binary operations needed satisfying certain axioms. They can state and apply properties of ring understand the definition of Commutative ring , ring with unity, zero divisor. Concept of integral domain and field. They can compare that every Field is an integral domain but converse is not true further they can explain in what condition converse is true. Concept of subfield, prime field. examples based on ring, field integral domain.</li> <li>• Concept of ideal ( right or left) subset of a ring is ideal or not . The concept of maximal ideal , principal ideal and maximal ideal and prime ideal of a given ring . formation of the quotient ring from ideal. Homomorphism of quotient ring.</li> <li>•</li> </ul>
<p><b>Mathematics</b> <b>CO P8</b></p>	<p><b>Mechanics</b></p> <ul style="list-style-type: none"> <li>• Constraints and degree of freedom. with the D'Alembert's Principle. Also Lagrange's equation of motion and the examples on Lagrange's Equation of motion.</li> <li>• Central force field and properties of central force, the Areal velocity. Also the knowledge of how the Areal velocity is conserved. The differential equations of orbit. Kepler's Laws.</li> <li>• Functional Variation, stationary value at extreme points.</li> <li>• The concept of Himalton's equation. They can find the Himalton's equation for conservative and non-conservative system. Routh's procedure. The principle of action least.</li> </ul> <p>Rigid body, type of rigid body motion also how the rigid body will move in translatory motion. Rotation in the plane.</p>
<p><b>Mathematics</b> <b>CO P9</b></p>	<p><b>Analysis</b></p> <ul style="list-style-type: none"> <li>• <b>Riemann Integral:</b> Terms, definitions and theorems of Riemann Integral.. The properties of integrable functions.</li> <li>• <b>Improper Integrals:</b> Improper integral and differences between proper and improper integrals. Beta and Gamma function.</li> <li>• <b>Analytic Functions:</b> Analytical function, Harmonic and Conjugate function. The relations among them. Construction of Analytic function, examples of Analytical function, Harmonic and Conjugate functions.</li> <li>• <b>Conformal Mapping:</b> The knowledge of conformal mapping. Terms, definitions and theorems on bilinear transformation, parabolic transformation, Elliptic and hyperbolic transformation, loxodromic transformation.</li> <li>• <b>Metric spaces:</b> metric spaces and complete metric spaces, terms, definitions and theorems on neighborhood, open and closed sets, boundary point, interior point, isolated point. Examples based on metric spaces and complete metric spaces, to prove the theorems based on open sets, closed sets, neighborhood. Cantor's Intersection theorem</li> </ul>

<p><b>Mathematics</b> <b>CO P10</b></p>	<p><b>Modern Algebra</b></p> <ul style="list-style-type: none"> <li>• <b>Legendre's Function</b> : The basic conceptual part of Legendre's equation , polynomials function , generating function &amp; recurrence formulae for <math>P_n(x)</math> with examples and they can apply Legendre's function and Legendre polynomials in the determination of wave functions of electrons in the orbits of an atom and in the determination of potential functions in the spherically symmetric geometry.</li> <li>• <b>Bessel Functions</b> : Bessel functions and they can apply Bessel functions to solve in 3D wave equation at a given (harmonic) frequency.</li> <li>• <b>Fourier Series</b> : Represent periodic functions using Fourier Series.</li> <li>• <b>Laplace transform</b> : The applications of Laplace transform in daily life and can apply to solve electric circuit problems. Ordinary differential equations using Laplace transform.</li> </ul> <p><b>Fourier Transform</b> : The concept of Fourier transform and will be able to Analyze the spectral characteristics of signals using Fourier analysis</p>
<p><b>Mathematics</b> <b>CO P11</b></p>	<p><b>Linear Algebra</b></p> <ul style="list-style-type: none"> <li>• <b>Vector Spaces:</b> Vector spaces, subspaces, linear dependence and linear independence, examples on vector spaces. The given vectors are linear dependent or linear independent. The knowledge of Basis and dimension of vector space.</li> <li>• <b>Linear Transformation:</b> Terms, definitions and theorems on linear transformation. The given mapping is linear or not. the knowledge of Range and kernel of a linear transformation. The range and kernel of any linear transformation. isomorphism of vector spaces, matrix with a linear map. Matrix algebra, rank and nullity of a matrix, eigen values and eigen vectors of a matrix.</li> <li>• <b>Dual Spaces:</b> The knowledge of dual spaces, bidual spaces and annihilator of a subspace, examples on annihilator. Canonical mapping, adjoint of a linear transformation, transpose of a linear transformation, the examples based on this transformation.</li> <li>• <b>Inner product spaces:</b> Terms, definitions and theorems on Inner product spaces. identification orthogonal vectors. The knowledge of orthogonal set, orthonormal set and orthogonal complement. Gram-Schmidt orthogonal process, Bessel's inequality. Examples on Gram-Schmidt orthogonal process.</li> <li>• <b>Modules:</b> The knowledge of modules, the properties of modules. Sub modules, improper sub modules, proper sub module, irreducible module, quotient modules and cyclic modules. Homomorphism of modules. Isomorphism theorems, correspondence theorem and fundamental theorem on finitely generated unital modules over Euclidean rings</li> </ul>

<p><b>Mathematics</b> <b>CO P12</b></p>	<p><b>Graph theory</b></p> <ul style="list-style-type: none"> <li>• <b>Graph</b> : The basic concepts of graphs, directed graphs, and weighted graphs. Identifying edges and vertices. Finding of the degree of a vertex. Express and prove handshaking lemma.</li> <li>• <b>Trees in Graph</b> : Concept of tree in graph and able to define the bipartite graphs &amp; basic properties of bipartite graphs particularly in trees. Concepts of graph theory in practical situations</li> <li>• <b>Fundamental circuits in Graph</b> : The concept of Fundamental circuits, Cutsets, some properties of cutsets, plane graph and theory. Explains planar graph notion. Proves Euler formula. Explains dual graphs.</li> <li>• <b>Vector in Graph</b> : Vector space associated with a graph, Eulerian and Hamiltonian graphs. Graph theory based tools in solving practical problems.</li> <li>• Incidence matrix, Submatrix , Circuit matrix, Fundamental circuit matrix B, Rank of B, an application to a switching.</li> </ul>
---	--

	<b>Microbiology</b>
<b>Code</b>	<b>Course Outcome</b>
<b>Microbiology CO P1</b>	<p><b>After successfully completing this course, students will be able to perform/analyze/understand:</b></p> <p><b>Fundamentals of Industrial Microbiology</b></p> <ul style="list-style-type: none"> <li>• Historical aspects of microbes and their importance as well as application in day to day life.</li> <li>• Differentiation of the microbes on the basis of their characteristics and apply the classification scheme for identification.</li> <li>• Demonstration of the structure of prokaryotic and eukaryotic cell.</li> <li>• Different types of microscopes and staining techniques.</li> <li>• Comparison and designing of different nutritional media for microbial growth.</li> </ul>
<b>Microbiology CO P2</b>	<p><b>General and Applied Microbiology</b></p> <ul style="list-style-type: none"> <li>• Application of the knowledge of bacterial growth in industrial productions and determination of the growth of bacteria.</li> <li>• The nature, structure, general properties and replication of viruses as well as the knowledge of interferons along with the application of concept of microbial control methods for prevention against infections.</li> <li>• Formulate different microbial products using production strains of microorganisms.</li> <li>• Evaluate microbe- host relationship in nature, humans and plants.</li> </ul>
<b>Microbiology CO P3</b>	<p><b>Molecular Biology and Genetic Engineering</b></p> <ul style="list-style-type: none"> <li>• Concept of gene, replication of DNA, different modes of replication, enzyme involved, DNA repair mechanism, concept of genetic code and central dogma of protein synthesis.</li> <li>• Gene regulation mechanism, types of mutation, genetic suppression, and molecular basis of spontaneous and induced Mutation.</li> <li>• Mechanism of Genetic recombination, Transfer of genetic material in prokaryotes by Transformation, Transduction, and Conjugation.</li> <li>• Tools of genetic Engineering, Basic techniques of genetic engineering, enzyme for gene splicing, DNA manipulating enzymes and vectors.</li> <li>• Techniques of genetic engineering including Isolation of Genomic and plasmid DNA from bacteria, analysis of Fragment size, and introduction of spliced DNA into host, Identification of transform cells, Selection of clones, gene mapping, gene sequencing, and Construction of Gene library.</li> <li>• Applications of Genetic Engineering in several fields of biotechnology include, Healthcare, agricultural, Environmental and Industrial biotechnology.</li> </ul>
<b>Microbiology CO P4</b>	<p><b>Medical Microbiology</b></p>



	<ul style="list-style-type: none"> <li>• Epidemiology its classification and scope, different types and modes of Infection, transmission , process of infection, pathogenicity, virulence, Microbial virulence factors, normal flora of human body along with control of communicable diseases.</li> <li>• The Concept of Immunology, Organs of immune systems, Innate and Acquired immunity, Immune responses and Hypersensitivity.</li> <li>• Various serological procedures in medical microbiology, Concept of antigen, factors of determining antigenicity, bacterial antigens, structure and function of antibodies and antigen antibody reactions.</li> <li>• It provide morphology, cultural characters, biochemical properties, antigenic structures, pathogenesis, laboratory diagnosis and prophylaxis of <i>S. aureus</i>, <i>Cl. tetani</i>, <i>S. typhi</i>, <i>M .tuberculosis</i>, <i>Pallidum</i>, <i>V. cholera</i>.</li> <li>• Other pathogenic bacteria , Viruses, Protozoa, Fungi</li> <li>• Antimicrobial chemotherapy, ideal chemotherapeutic agent, antibacterial agents, antiviral agents, antifungal agents, Basic mechanism of antibiotic action, antimicrobial susceptibility testing, CLSI, MIC, Disc diffusion, agar dilution, broth dilution.</li> </ul>
<p><b>Microbiology</b> <b>CO P5</b></p>	<p><b>Environmental Microbiology and Bioinstrumentation</b></p> <ul style="list-style-type: none"> <li>• Scheme of different microbial associations like positive association, mutualism, commensalism, synergism, negative association, antagonism, competition and parasitism along with air microbiology which includes atmosphere, different microorganism in air, techniques for microbial analysis of air, and air-borne disease along with control measures.</li> <li>• Microbiology of soil, rhizosphere, decomposition of plant and animal residue, formation of compost, humus, process of biological nitrogen fixation, biogeochemical cycling of carbon, nitrogen, Sulphur, and phosphorus along with the application of soil microbes as the bio fertilizers and bio pesticides.</li> <li>• Water microbiology, planktons, and types of planktons, factors affecting the growth of planktons, methods of enumeration, beneficial and harmful activities of planktons and eutrophication and its control.</li> <li>• Assessment of water quality and treatment which includes significance of bacteriological analysis of water, collection and handling of water samples from various sources, indicator of excretal fecal pollution, MPN, IMViC, MFT technique and ICMR and WHO bacteriological standard of drinking water.</li> <li>• Water treatment, self-purification of water, slow and rapid sand filters along with methods of chlorination of water, sewage water treatment, composition of sewage, municipal sewage water treatment plant , preliminary , primary , secondary treatment, anaerobic sludge, domestic sewage treatment by Inhofe tank, septic tank, concept COD, BOD, and biogas production.</li> </ul>

	<ul style="list-style-type: none"> <li>• The knowledge about various instruments in the field of Biosciences like UV - IR spectroscopy, Paper – Gel Electrophoresis, Paper – TLC Chromatography along with Isotopic tracer Techniques.</li> </ul>
<p><b>Microbiology</b> <b>CO P6</b></p>	<p><b>Industrial Fermentation, Food Microbiology and Metabolism</b></p> <ul style="list-style-type: none"> <li>• The general fermentation, scope of industrial microbiology and biotechnology, industrially important microorganism , production strains, screening procedures, scale up process, inoculum buildup, general layout of fermentation plant, raw material , antifoam agents, sterilization of media, detection and assay of fermentation products.</li> <li>• Industrial production of ethyl alcohol, beer, and wine, acetone butanol production from corn, citric acid production and vinegar production using from Firing’s procedure.</li> <li>• Industrial production of baker’s yeast, single cell protein, production of penicillin, bacterial and fungal amylase production with the production of vitamin B-12.</li> <li>• Milk microbiology along with the composition and types of milk, sources as well as types of microorganism in milk, different pasteurization technique, LHT, HTST, UHT along with the preparation of concentrated milk and milk powder, fermented milk products like butter and cheese.</li> <li>• Food microbiology. sources of contamination of fresh food, microbial spoilage of food, different food preservation techniques, preparation of fermented food like idlis, pickles, and sauerkraut along with food poisoning and indicators of food contamination as per WHO.</li> <li>• It provide knowledge about nature, classification, and definition of enzymes along with different terminologies like active site, substrate, coenzyme, cofactors, prosthetic group, activation energy, isoenzymes, allosteric enzyme, inhibitors, and immobilized enzymes.</li> </ul>

<b>Physics</b>	
<b>Code</b>	<b>Course Outcome</b>
<b>Physics CO P1</b>	<p><b>After successful completion of this course, students will be able to perform/analyze/understand:</b></p> <p style="text-align: center;"><b>Mechanics Properties of Matter, wave and Oscillation</b></p> <ul style="list-style-type: none"> <li>• Kepler's laws and Newtons laws of planetary motion and its effect on gravity</li> <li>• The motion of rigid bodies, the moment of inertia of various regular shaped bodies like ring, Hollow sphere, solid sphere, cylinder and bar about their different axes and also about their angular and liner moment.</li> <li>• The Linear and Angular simple harmonic oscillations, also about the simple pendulum, compound pendulum, resonance.</li> <li>• The superposition of two SHM, Interference, Lissajous figures, standing waves and production and detection of ultrasonic waves and their applications.</li> <li>• The Elasticity its properties, the Beam, Cantilever loaded at centrally, Twisting couple, Torsional pendulum.</li> <li>• Kinetics of moving fluids and its flow viscosity. Also studies about surface tension and its properties.</li> </ul>
<b>Physics CO P2</b>	<p style="text-align: center;"><b>Kinetic Theory ,Thermodynamics and Electric Current</b></p> <ul style="list-style-type: none"> <li>• Ideal gas equation i.e. <math>PV=RT</math>. The motion of gas molecule their inter molecular attraction between the gas molecules, the behaviors of gas molecule in free space.</li> <li>• The laws of thermodynamics i.e. Zero<sup>th</sup>, First, Second and Third laws of thermodynamics and there relations. The reversible and irreversible process, Carnot heat engine thermodynamical scale of temperature.</li> <li>• The liquefication of gas depending on the nature of gas used like hydrogen, helium and its method. Maxwell's thermodynamically relations</li> <li>• The motion of charge particle in transverse electric and magnetic field. Motion of charge particle in through electron gun, discharge tube, mass spectrograph and cyclotron.</li> <li>• The simple circuit which contain source and resistance in series and parallel analyzed with the help of Ohm's law. The aim of network analysis is to find out the different values of current voltage in any branch of network. Ballistic Galvanometer.</li> <li>• The function which obeys the sine law, waves form of sinusoidal waves, j-operator. Resonance in circuit in series and parallel, bandwidth. Transformer and its type.</li> </ul>
<b>Physics CO P3</b>	<p style="text-align: center;"><b>Electrodynamics, Solid State Electronic Device, special theory relativity and atmosphere and geophysics</b></p> <ul style="list-style-type: none"> <li>• Concrete base for Electrodyanamics which includes mathematical base with electrostatics contain motion of charge in electric field and Amperes law, magentostatics and maxwells equations to understand time varying fields which is coming in Master degree.</li> <li>• Why and how the changing magnetic flux and changing current induces emf, wave equation and pointing vector.</li> </ul>

	<ul style="list-style-type: none"> <li>• Information of the Diode from its origin to the LED and different rectifiers</li> <li>• The complete information of Transistor from its origin to the Operational Amplifiers. By understanding the deep concept transistor and Op-Amp student may designed and developed different Amplifiers circuits</li> <li>• Information of Inertial frame of reference. The relative velocity of the body, why moving length appears to less than stationary body and why clock of life ticks slow in space than on Earth. The famous mass -energy relation</li> <li>• Information of parts of Earth, composition of Atmosphere, radiation in Atmosphere and Cause of Earthquake and Earthquake recording system.</li> </ul>
<b>Physics CO P4</b>	<p style="text-align: center;"><b>Optic , Laser and renewable energy sources</b></p> <ul style="list-style-type: none"> <li>• Information of lens and interference. outcome of this course is to provide skill to developed equivalent focal length of the lens to reduce the weight and thickness of lens. Interference phenomenon and pattern from thin films and Newtons ring.</li> <li>• Diffraction of light. Diffraction why and how it is happened. understand the different diffraction setups as Fresnel and Fraunhofer. And understand the working principle of grating to determine resolving power and wavelength of monochromatic light.</li> <li>• Information about polarization of light. Outcome of this unit for the students are to understand optic axis, how unpolarized light is polarized by using calcite, Tormaline crystal. Understand phenomenon of quarter and half wave plate and understand how light is elliptically and circularly polarized.</li> <li>• Information about the LASER. It gives necessary condition to achieved LASER. Understand the energy level diagram and some examples of production of Helium-Neon, Ruby, Semiconductor LASERs.</li> <li>• Fibre Optics. It helps to understand fibre optic cable and total internal reflection, its use in fibre optics communication.</li> <li>• Renewable energy sources. Storage of solar energy and Photovoltaic solar system.</li> </ul>
<b>Physics CO P5</b>	<p style="text-align: center;"><b>Quantum mechanics, Atomic , molecular and Nuclear physics, electronics</b></p> <ul style="list-style-type: none"> <li>• Historical aspects of the development of quantum mechanics, the differences between classical and quantum mechanics.</li> <li>• The central concepts and principles in quantum mechanics, such as the Schrodinger equation &amp; its application, wave function, statistical interpretation, and the uncertainty principle</li> <li>• Describe theories explaining the structure of atoms and the origin of the observed spectra. List different types of atomic spectra. The observed dependence of atomic spectral lines on externally applied electric and magnetic fields.</li> <li>• Nuclear properties and decay</li> <li>• The basic concepts and use of transistor for various applications Use special function transistor for different applications. Built and design transits or amplifier.</li> <li>• Develop logic circuits for various applications in real life. Design and develop oscillators</li> </ul>

	and multi vibrators.
<b>Physics CO P6</b>	<p><b>Statistical Mechanics and Solid state physics</b></p> <ul style="list-style-type: none"> <li>• The probability of any type of events. They are able to interpret different types of events. The concept of phase space and its volume.</li> <li>• Different types of particles and statistics and can easily distribute bosons, fermions and classical particles among energy levels.</li> <li>• After studying Fermi Dirac statistics, students have learnt to deal with much electron system. Identify crystal structure.</li> <li>• How property/ processing relationships are developed and applied for different type of materials behavior or electron in various field.</li> <li>• Categories the conductor, insulators and semiconductor, materials become a magnet. Types of magnetic materials. The behaviour of magnetic materials in various temperatures.</li> <li>• New emerging areas of science and technology like Super conductivity and nanotechnology.</li> </ul>

	<b>Zoology</b>
<b>Code</b>	<b>Course Outcome</b>
<b>Zoology CO P1</b>	<p><b>After successful completion of this course students will be able to perform / analyze/ understand</b></p> <p style="text-align: center;"><b>Life and diversity of Non-Chordata</b></p> <p>After successfully completing this course, students will be able perform/ analyze/ understand</p> <ul style="list-style-type: none"> <li>• Origin and classification of Non-Chordata, kingdom Animalia, general characters of Phylum Protozoa and human diseases, their causes, symptoms and clinical measures, and Plasmodium vivax</li> <li>• Anatomy, physiology, characteristics, and habitats of animals under Phylum Porifera and Coelenterata, Scypha/ Sycon, and Metridium</li> <li>• Anatomy, physiology, characteristics, and habitats of Fasciola hepatica and Ascaris lumbricoides</li> <li>• Anatomy, physiology, characteristics, and habitats of Phylum Annelida (Cattle Leech) and Phylum Arthropoda (Cockroach)</li> <li>• Anatomy, physiology, characteristics, and habitats of Phylum Mollusca (Pilaglobosa) and Phylum Echinodermata (Asterias)</li> <li>• Anatomy, physiology, characteristics, and habitats of Phylum Hemichordata (Balanoglossus), Corals and coral-reefs, and Helminths</li> </ul>
<b>Zoology CO P2</b>	<p style="text-align: center;"><b>Cell and developmental biology</b></p> <ul style="list-style-type: none"> <li>• General organization, structures, theories, and functions of Prokaryote and Eukaryote Cells</li> <li>• Ultra-structure and functions of different cell organelles and co-relation and all the metabolic activities performed by these organelles</li> <li>• Genetic material, chromosomes (Polytene and Lamp brush), and ultra-structure and functions of nucleus and nucleolus</li> <li>• The process and types of cell Division and Gametogenesis</li> <li>• Embryonic developments in Amphibians and Birds and development and significance</li> <li>• Placentation in mammals, types and functions of placenta, types and significance of parthenogenesis, regeneration in invertebrates and vertebrates, and stem cells and related research</li> </ul>
<b>Zoology CO P3</b>	<p style="text-align: center;"><b>Life and diversity of Chordata and concept of evolution</b></p> <ul style="list-style-type: none"> <li>• Origin of Chordata, relation of protochordates (amphioxus), fishes (Scoliodon)</li> <li>• General characters, classification, and structure of class amphibia (Rana tigrina) and reptilia (Calotes versicolor) and Snake venom and anti-venom</li> <li>• General characters, classification, morphology, respiratory system, and urinogenital system of Aves with special reference to Pigeon along with flight adaptations and migration in birds.</li> </ul>

	<ul style="list-style-type: none"> <li>• Primitive mammals (Prototheria and Metatheria) and morphology of mammalian endocrine glands</li> <li>• Meaning and scope of evolution, fossils and fossilization, evidences of evolution from connecting links like Peripatus and Archaeopteryx.</li> <li>• Theories of evolution, speciation and modern concept of organic evolution, population genetic, and types of evolution</li> <li>• Adaptive radiations in mammals and evolution of man</li> </ul>
<b>Zoology CO P4</b>	<p style="text-align: center;"><b>Advanced genetics and animal ecology</b></p> <ul style="list-style-type: none"> <li>• Laws related to hereditary and genes</li> <li>• Types, characteristics, and factors affecting linked genes and crossing over</li> <li>• Sex determination and their related theories and important genetic disorders</li> <li>• Genetic screening and parental diagnosis and counselling</li> <li>• Ecological factors, properties of water, temperature, and light as well as their problems and effects on animals</li> <li>• The concepts of basic genetics, chromosomes, genetic disorders, biochemical alterations due to the gene mutations, ecology and ecosystem</li> </ul>
<b>Zoology CO P5</b>	<p style="text-align: center;"><b>Animal physiology and Economic zoology</b></p> <ul style="list-style-type: none"> <li>• The structure of different types of respiratory organs in animals, their mechanism and types of respiratory pigments. They can able to understand the transportation of gases like O<sub>2</sub> and CO<sub>2</sub>. Students will able to understand the mechanism of respiration in different animals of vertebrates. The can understand about respiratory pigments like Haemoglobin, haemocyanin, haemoerythrin, chlorocrucion. They also undertand the neurophysiological control of respiration.</li> <li>• The types of muscles, structure and chemical coordination of muscles. Muscles mechanism and muscles physiology will understand</li> <li>• Coordination of nervous system and types of neuron will be understood by the students. The complicated mechanism of nerve cell, nervous system and neuro-secretary hormones and their role will understood by the students.</li> <li>• Chemical coordination of endocrine gland, physiological structure, role of their hormones and disorder will be studied.</li> <li>• Details structures and mechanism of Reproductive organs and their structure will discuss and understood by students. Osmoregulation and thermoregulation of vertebrates will elaborate to students</li> <li>• Ecological importance of zoological practices and importance of different types of insects will understand by students. Ecological importance of Insects, pest and other vertebrates also understand. Students will became aware about Entemological practises like Apiculture, Sericulture Aqaculture has good economic values. Culture practices and different type of aquaculture methods will understand by students, which will be beneficial</li> </ul>

	for future practices
<b>Zoology CO P6</b>	<p style="text-align: center;"><b>Molecular biology and biotechnology</b></p> <ul style="list-style-type: none"> <li>• Genetic material by proves by various genetic experiments. Students can understand about DNA which is a genetic material. Other genetic material like RNA and Mitochondrial DNA</li> <li>• DNA replication, its types and experiments carried out by various Genetics experts. Students can understand about gene concept, one gen one enzyme hypothesis and concepts of Cistron, Muton and Recon. They can also understand about Genetics diseases and types of gene</li> <li>• Genetic code is important factors in Gene and Genetics that will understand by students. Properties of genetic code, protein synthesis mechanism in Eukaryotes and Prokaryotes will understand by students</li> <li>• Mutation theory explained by Devries and different types of mutation can understood by students. Types of Chromosomal and gene mutation explained and understand by students. DNA repairing, PCR and other blotting techniques explained to the students</li> <li>• Genetic engineering and biotechnology are the advanced field of biology will explained in details about gene cloning, vectors, hybridoma technology and practical application of biotechnology will understand by them</li> <li>• Immunology, their types and production of immune cell discussed here and students can aware about immune system. Antigen, antibody mechanism, cell mediated, innate, adaptive immunity and role of enzymes will understand by students. Various immunological techniques will understand by students</li> </ul>



## PG Programme Outcome

After successful completion of PG programme, students would be able to develop:

- **Deep subject knowledge and intellectual breadth:** Apply the subject knowledge to find solutions of real-world problems.
- **Professional ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the standard practices.
- **Creative & critical thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, check out the degree to which these assumptions are accurate and valid, and look at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
- **Innovation, research and problem solving:** Identify, formulate, review research literature, and analyze complex problems reaching substantiated and innovative conclusions. Design solutions for complex problems with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. Use research-based knowledge and research methods to provide valid conclusions. Demonstrate the knowledge of and need for sustainable development.
- **Team work and communication skills:** Function effectively as an individual, as a member or leader in diverse teams, and in multidisciplinary settings. Present/communicate research at national/international level, write effective articles, reports and design documentation, make effective presentations, and give and receive clear instructions. Communicate disciplinary knowledge to the community and broader public.
- **Professionalism and leadership readiness:** Demonstrate personal accountability and effective work habits, e.g., punctuality, working productively with others, and time as well as workload management. Demonstrate integrity and ethical behavior, act responsibly with the interests of the larger community in mind, and to learn from his/her mistakes. Use the strengths of others to achieve common goals, and use interpersonal skills to coach and develop others. Assess and manage his/her emotions and those of others; use empathetic skills to guide and motivate; and organize, prioritize, and delegate work.
- **Lifelong learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.
- **Competence for digital world:** Prepare well for living, learning and working in a digital society; Create, select, and apply appropriate techniques, resources, and modern ICT tools to complex activities with an understanding of the limitations; Use existing digital technologies ethically and efficiently to solve problems, complete tasks, and accomplish goals. Demonstrate effective adaptability to new and emerging technologies.
- **Global Citizenship:** Act with an informed awareness of global issues and engage in initiatives that encourage equity and growth for all.

## M.Sc Programme Specific Outcomes

<b>Biochemistry</b>	<p><b>After successful completion of this program, students will be able to perform/ analyze /understand:</b></p> <ul style="list-style-type: none"> <li>• Biomolecules and analytical techniques, advance Enzymology, Bioenergetics and biological oxidation</li> <li>• Clinical biochemistry, Endocrinology, neurochemistry, cell biology, bioinformatics, and biostatistics and research methodology.</li> <li>• Basics and applied immunology, fermentation technology and recombinant DNA technology.</li> <li>• Cell physiology, Molecular biology, plant biochemistry nutrition and reproduction.</li> </ul>
<b>Botany</b>	<p><b>After successful completion of this program, students will be able to perform/ analyze /understand:</b></p> <ul style="list-style-type: none"> <li>• Cell biology, diversity of alga, bryophytes, plant development and reproduction.</li> <li>• Molecular biology, diversity of microbes and fungi , Plant physiology and metabolism.</li> <li>• Diversity of pteridophytes and gymnosperms.</li> <li>• Plant tissue culture and bioinformatics.</li> </ul>
<b>Chemistry</b>	<p><b>After successful completion of this program, students will be able to perform/ analyze /understand:</b></p> <ul style="list-style-type: none"> <li>• Inorganic, organic, physical chemistry and modern method of separations.</li> <li>• Co-ordination, optical methods and environmental chemistry.</li> <li>• Industrial and analytical chemistry.</li> </ul>
<b>Computer Science</b>	<p><b>After successful completion of this program, students will be able to perform/ analyze /understand:</b></p> <ul style="list-style-type: none"> <li>• Digital system and microprocessor, C# operating system and computer network.</li> <li>• Java Programming, data structures, software engineering, computer constructions and discrete mathematical structures.</li> <li>• Data mining and ware housing, computer graphics, client server computing, theory of computation, distributed operating system.</li> <li>• Artificial intelligence, design and analysis of algorithm network security and mobile communications.</li> </ul>
<b>Mathematics</b>	<p><b>After successful completion of this program, students will be able</b></p>

	<p><b>to perform/ analyze /understand:</b></p> <ul style="list-style-type: none"> <li>• Real analysis, Advance algebra, complex analysis and topology</li> <li>• Measure and integration theory</li> <li>• Functional analysis and classical mechanics</li> <li>• Partial and differential equations</li> </ul>
<b>Microbiology</b>	<p><b>After successful completion of this program, students will be able to perform/ analyze /understand:</b></p> <ul style="list-style-type: none"> <li>• Physiology , photosynthesis, environmental microbiology and microbial techniques</li> <li>• Computer application, biostatics, enzyme technology and extremophiles.</li> <li>• Molecular biology, virology, fermentation technology and immunology.</li> <li>• Biotechnology, clinical virology, microbial technology and medical microbiology</li> </ul>
<b>Physics</b>	<p><b>After successful completion of this program, students will be able to perform/ analyze /understand:</b></p> <ul style="list-style-type: none"> <li>• Understand the basic concepts of physics particularly concepts in classical mechanics, quantum mechanics, statistical mechanics, electrodynamics and electronics to appreciate how diverse phenomena observed in nature follow from a small set of fundamental laws.</li> <li>• Learn how to perform experiments in basic as well as advanced areas of Physics such as Nanomaterials, Condensed Matter Physics, Electronics and Photonics.</li> <li>• Develop Analytical and integrative problem-solving methodologies through research-based learning.</li> <li>• Pursue research careers, careers in academics, in industries in physical science and in allied fields.</li> </ul>
<b>Zoology</b>	<p><b>After successful completion of this program, students will be able to perform/ analyze /understand:</b></p> <ul style="list-style-type: none"> <li>• Structure and functions of chordates and non- chordates.</li> <li>• Gene differentiation and gametes biology, Molecular biology, Endocrinology, environment and ecology.</li> <li>• Molecular cytogenetics, Entomology, Animal physiology and fisheries</li> <li>• Biochemistry, enzymology, Biostatistics.</li> </ul>

**Course Outcomes: M.Sc**

<b>P.G Biochemistry</b>	
<b>Code</b>	<b>Course Outcomes</b>
<b>Biochemistry CO P1</b>	<p><b>After successful completion of this course, students will able to perform/analyze/understand:</b></p> <p style="text-align: center;"><b>Biomolecules</b></p> <ul style="list-style-type: none"> <li>• The structure, types, and classification of essential and non-essential amino acids along with the structural levels of organization of proteins, denaturation, and sequencing.</li> <li>• The types of carbohydrates, along with their reactions and properties. They will also learn the structure, storage, and functions of some important conjugated carbohydrates in nature.</li> <li>• The nomenclature, structure, and characterization of lipids and fats accompanied by their biological significance with special emphasis on steroid compounds.</li> <li>• The nucleic acids: DNA and RNA. It will also provide theoretical knowledge about structure and sequencing of DNA and RNA.</li> <li>• The importance of different porphyrins in living organisms along with the structures of important porphyrins.</li> </ul>
<b>Biochemistry CO P2</b>	<p style="text-align: center;"><b>Analytical Techniques</b></p> <ul style="list-style-type: none"> <li>• The techniques involved in purification of biocomponents and biomolecules in animals, plants, and microbes</li> <li>• The principles, strengths, and limitations of the most important chromatographic techniques along with their applications.</li> <li>• The technical and theoretical knowledge of various electrophoretic techniques along with their design and applications</li> <li>• The basic principles of various spectroscopic techniques such as electromagnetic radiation, absorption spectrum, Beer's law and Lamberts' law and the concept of light absorbance and transmittance along with the applications of these techniques</li> <li>• Tracer and labelling techniques used in biochemistry</li> </ul>
<b>Biochemistry CO P3</b>	<p style="text-align: center;"><b>Advance Enzymology</b></p> <ul style="list-style-type: none"> <li>• The basics of enzyme kinetics and the effects of various factors on enzyme activity along with the relation of MM equation and LB plot</li> <li>• The important co-factors and metal ions and their role in enzyme action along with the structure and mechanism of allosteric enzymes</li> <li>• The enzyme action under various conditions and the effects of factors like proximity on enzyme action along with the chemistry of active centre</li> <li>• The control of enzyme catalysed biochemical reactions and the role of</li> </ul>

	<p>shuttle systems and isoenzymes</p> <ul style="list-style-type: none"> <li>• The types of reactions and mechanisms of enzyme actions and inhibition, types of inhibition reactions, and effect of inhibitors in various reactions</li> </ul>
<p><b>Biochemistry</b> <b>CO P4</b></p>	<p style="text-align: center;"><b>Bioenergetics and Biological oxidation</b></p> <ul style="list-style-type: none"> <li>• The transformation of energy within living organisms and between living organisms and their environment. It will also help in understanding redox, electron transfer reactions in biological systems, and high energy compounds</li> <li>• The mitochondrial electron transport and oxidative phosphorylation involved in generation of ATP along with factors affecting ETC</li> <li>• The factors and reactions involved in oxidative phosphorylation along with its mechanism and inhibitors</li> <li>• The mechanism and types of photo regulation and photophosphorylation</li> <li>• The photosynthetic electron transport in plants and the organelles and factors involved in photo respiration with special focus on location and mechanism of energy transfer</li> </ul>
<p><b>Biochemistry</b> <b>CO P5</b></p>	<p style="text-align: center;"><b>Clinical Biochemistry</b></p> <ul style="list-style-type: none"> <li>• The disorders related to gastric function, pancreas, and malabsorption, their methods of evaluation, and tests involved in clinical diagnosis</li> <li>• blood disorders caused due to anomalies in blood clotting factors, plasma proteins, and anemias along with the clinical significance of clearance tests</li> <li>• the disorders related to kidneys and liver, their function tests, and disease diagnosis by enzyme assays</li> <li>• the effects of various genetic factors on diseases and disorders and the human genome project and the role of mutation and multifactorial genes on disorders</li> <li>• the pathogenesis, diagnosis, effects, and treatments of important and common genetic disorders</li> </ul>
<p><b>Biochemistry</b> <b>CO P6</b></p>	<p style="text-align: center;"><b>Endocrinology and Neurochemistry</b></p> <ul style="list-style-type: none"> <li>• The role of insulin and glucagon on the metabolism of glucose along with the disorders caused by changes in the level of these hormones and diagnostic tests</li> <li>• The hormones of thyroid and parathyroid associated with the metabolism of calcium, phosphorus, and iodine. It will also give detailed insight into the disorders associated with improper functioning of the thyroid and parathyroid glands</li> <li>• The biochemistry of fertilization and the role of birth control and other factors in reproduction along with reproductive disorders</li> </ul>

	<ul style="list-style-type: none"> <li>• The neurophysiology and structures of neurons and synapse along with pre- and post-synaptic events at neuronal and neuromuscular junctions and physiology of ion channels</li> <li>• The chemistry, synthesis, storage, release and action of neurotransmitters and the changes associated with neuropeptides</li> </ul>
<b>Biochemistry CO P7</b>	<p style="text-align: center;"><b>Cell Biology</b></p> <ul style="list-style-type: none"> <li>• The structure and organization of cell membranes and receptors acting as antigens and in cell-cell recognition</li> <li>• The types of plasma membrane and the membranes of different organelles in a cell which will also help in understanding the action of drugs on cell</li> <li>• The receptors and binding of ligands to receptors to enhance cell signalling</li> <li>• The movement of muscles including cellular mobility, organization, role of ions, and energy transduction</li> <li>• The cytoskeletal system and its activity in various biochemical reaction in the body</li> </ul>
<b>Biochemistry CO P8</b>	<p style="text-align: center;"><b>Bioinformatics, Biostatistics and Research methodology</b></p> <ul style="list-style-type: none"> <li>• This course will focus on the history and basics of computer system along with the major components, languages, and application software used in a computer</li> <li>• The various bioinformatics tools used to study protein and nucleotide structures with special mention to BLAST and FASTA</li> <li>• The statistical evaluation of results using various tools such as variance, dispersion, and regression and tests like chi-square and student t test</li> <li>• The methodology to study and perform research after completion of the designed research model for in biochemistry</li> <li>• The ways and techniques to write a scientific report and the use of English language to help students in publishing their research in science journals</li> </ul>
<b>Biochemistry CO P9</b>	<p style="text-align: center;"><b>Basic Immunology</b></p> <ul style="list-style-type: none"> <li>• The structure, types, and classification of various cells and organs involved in immune system</li> <li>• The immunological techniques used in the identification of various immunity components</li> <li>• The methods used for the separation and identification of cells and organs of immune system</li> <li>• The concept of immunoglobulins and their mode of action, changes due to hypersensitivity, and cell adhesion</li> </ul>
<b>Biochemistry CO P10</b>	<p style="text-align: center;"><b>Applied Immunology</b></p> <ul style="list-style-type: none"> <li>• The structure of immunoglobulins and technology involved in producing monoclonal antibodies. It will also explain the role of</li> </ul>

	<p>complement and types of hypersensitivities</p> <ul style="list-style-type: none"> <li>• The mechanism of cellular and humoral immunity and their regulation</li> <li>• The technical and theoretical knowledge of in vivo immunity to various infectious agents</li> <li>• The relation of immunity with autoimmune diseases and tumours along with conditions of immune deficiency</li> <li>• The diseases and disorders developed due to decreased immunity and response</li> </ul>
<p><b>Biochemistry</b> <b>CO P11</b></p>	<p style="text-align: center;"><b>Fermentation Technology</b></p> <ul style="list-style-type: none"> <li>• The basics of fermentation technology and the use of microbial culture and DNA recombinant technology in fermentation and basic instruments and equipment used in culture.</li> <li>• The effects of various environmental and physical factors in the process of fermentation and extraction and purification of fermented products</li> <li>• The kinetics of fermentation and analysis of rate pattern at various stages and types of fermentation</li> <li>• The design of bioreactors and the correlation of reactor design with the overall reaction and product yield after fermentation</li> <li>• The use of vectors and recombination in fermenters along with the techniques of immobilisation</li> </ul>
<p><b>Biochemistry</b> <b>CO P12</b></p>	<p style="text-align: center;"><b>Recombinant DNA Technology</b></p> <ul style="list-style-type: none"> <li>• The recombinant DNA technology will make students understand the basic and advanced techniques used in manipulating and altering DNA</li> <li>• The social and ethical perspectives of cloning and methods involved in gene synthesis and gene libraries along with insertion of DNA in living cells</li> <li>• The applications of recombinant DNA technology in different industries like medicine, agriculture, and livestock</li> <li>• The regulation of gene expression in prokaryotic cells including the concept of operons and expression vectors</li> <li>• The transcriptional, post-transcriptional, and translational regulation of gene expression under various conditions of stress</li> </ul>
<p><b>Biochemistry</b> <b>CO P13</b></p>	<p style="text-align: center;"><b>Physiology</b></p> <ul style="list-style-type: none"> <li>• The transcellular cellular signal transduction and metabolic control</li> <li>• The information transactions in eukaryotic cells and control of metabolism by endocrine and paracrine system</li> <li>• The cellular transport mechanism with respect to transporters, diffusion, and carriers</li> </ul>

	<ul style="list-style-type: none"> <li>• The different pumps and channels used in the transport of important ions and their location on the membranes of organs</li> <li>• The cell cycle and various aspects to aging and control aging</li> </ul>
<b>Biochemistry CO P14</b>	<p style="text-align: center;"><b>Advance Molecular Biology</b></p> <ul style="list-style-type: none"> <li>• The evolution of life and the structural organization of genes and their analysis and mapping</li> <li>• The replication of DNA in prokaryotes and eukaryotes with the factors and proteins involved and repair mechanisms</li> <li>• The transcription of DNA in eukaryotes and the components involved in the process of initiation, elongation, and termination of transcription</li> <li>• The characteristics of genetic code, methods to decipher the code, and natural variation in the genetic code</li> <li>• The translation of RNA to form protein, the post translational modification of proteins, and the factors involved in these processes</li> </ul>
<b>Biochemistry CO P15</b>	<p style="text-align: center;"><b>Plant Biochemistry</b></p> <ul style="list-style-type: none"> <li>• The structure, functions, and location of different organelles in a plant cell and cell wall</li> <li>• the different pathways involved in the mechanism of photosynthesis and the photosynthetic pigments</li> <li>• the pathways involved in the respiration in plants and the mechanism of generation of ATP in the same process</li> <li>• the structure of root nodule and the metabolism of nitrogen in plants</li> <li>• the different mechanisms of metabolism of sulphur</li> </ul>
<b>Biochemistry CO P16</b>	<p style="text-align: center;"><b>Plant Nutrition and Reproduction</b></p> <ul style="list-style-type: none"> <li>• The concept and different techniques of plant tissue culture and the techniques involved</li> <li>• The various aspects of flowering, reproduction, seed formation, and fruit ripening in plants</li> <li>• The hormones and their role in the regulation and metabolism in plant cell</li> <li>• The role of water and minerals in maintaining the health of plants</li> <li>• The biochemistry, mechanism, and defence of plant diseases</li> </ul>



<b>P.G Botany</b>	
<b>Code</b>	<b>Course outcomes</b>
<b>Botany CO P1</b>	<p><b>After successful completion of this course, students will be able to perform/ analyze/understand:</b></p> <p style="text-align: center;"><b>Cell biology, cytology and genetics</b></p> <ul style="list-style-type: none"> <li>• The Mendelian and non-Mendelian inheritance, quantitative genetics, molecular markers and linkage mapping.</li> <li>• Prokaryotic and eukaryotic genome-structure, gene function and regulation.</li> <li>• Epigenetics, Cytogenetics and crop evolution and the pattern of inheritance in various life forms.</li> <li>• Fundamentals for basic molecular studies.</li> </ul>
<b>Botany CO P2</b>	<p style="text-align: center;"><b>Resource utilization and conservation</b></p> <ul style="list-style-type: none"> <li>• The origin, diversification, utility and conservation strategies of natural resources.</li> <li>• It focuses the roles of various organization related to the plant sciences</li> <li>• The pattern origin, diversification and cultivation of plants in nature.</li> <li>• They are able to design the strategies for conservation of these natural resources. &amp; get acquainted with the role and functions of various organizations.</li> </ul>
<b>Botany COP3</b>	<p style="text-align: center;"><b>Biology and diversity of algae and bryophytes</b></p> <ul style="list-style-type: none"> <li>• The diversity of lower plants, their classification, structure and growth.</li> <li>• The students will develop understanding about the diversity, identification, classification and economic importance of lower plants.</li> </ul>
<b>Botany COP4</b>	<p style="text-align: center;"><b>Plant development and reproduction</b></p> <ul style="list-style-type: none"> <li>• The fundamentals and understanding of the mechanisms associated with development, differentiation and structure of various plant organs, the metabolic and physiological changes occurring in them.</li> <li>• The understanding of growth, development and reproduction in plants as well as understand the physiological and metabolic changes happening along with the environmental impact.</li> </ul>
<b>Botany COP5</b>	<p style="text-align: center;"><b>Cytogenetics and molecular biology</b></p> <ul style="list-style-type: none"> <li>• The acellular entities including infective particles comprising only protein or RNA, which are parasites of plants and/or animals and of the observations/proposals which challenge the established dogmas, such as, cell being the basic unit of life or higher plants are multicellular rather than supra cellular, and current state of knowledge about the plant cell structure and their turn over, starting from cell wall to</li> </ul>

	<p>chromatin, in relation to their functions.</p> <ul style="list-style-type: none"> <li>• The role of plant cytoskeleton and accessory proteins in major cellular processes of plants.</li> <li>• Various components of the eukaryotic nuclear and organelles genome, with special reference to their regulatory role</li> <li>• The principle mechanisms of genome replication, maintenance, function and regulation of expression.</li> </ul>
<b>Botany CO P6</b>	<p><b>Biology and diversity of microbes and fungi</b></p> <ul style="list-style-type: none"> <li>• The diversity of microorganisms including fungi, their classification, structure and growth.</li> <li>• The classification, structure, role and infectious cycle of microbes and Fungi.</li> </ul>
<b>Botany CO P7</b>	<p><b>Plant Physiology</b></p> <ul style="list-style-type: none"> <li>• The various physiological life processes in plants</li> <li>• They will also gain about the various uptake and transport mechanisms in plants and are able to coordinate the various processes.</li> <li>• The role of various hormones, signalling compounds, thermodynamics and enzyme kinetics.</li> <li>• the various mechanisms such as channel or transport proteins involved in nutrient uptake in plants.</li> </ul>
<b>Botany CO P8</b>	<p><b>Plant Metabolism</b></p> <ul style="list-style-type: none"> <li>• The phenomenon of metabolism of primary and secondary metabolites and their role in plants.</li> <li>• They are upgraded in analytical skills and instrumentation</li> </ul>
<b>Botany CO P9</b>	<p><b>Biology and diversity of pteridophytes and gymnosperms</b></p> <ul style="list-style-type: none"> <li>• The morphology, anatomy, reproduction and evolution in Pteridophytes and Gymnosperms.</li> <li>• The students develop the basic understanding of important characteristics, anatomy, reproduction and evolution along with economic importance of these two groups.</li> </ul>
<b>Botany CO P10</b>	<p><b>Taxonomy of angiosperms</b></p> <ul style="list-style-type: none"> <li>• The systematic position of Genera's, Species and , Families.</li> <li>• The knowledge about plant nomenclature.</li> </ul>
<b>Botany CO P11</b>	<p><b>Advanced plant physiology and biochemistry-II</b></p> <ul style="list-style-type: none"> <li>• It will also reveal the study about Regulation and mode of secondary metabolites Senescence and programmed cell death &amp; Stress Physiology.</li> </ul>

	<ul style="list-style-type: none"> <li>• Chemical structure, Types &amp; functions of Carbohydrates &amp; amino acids.</li> <li>• They will Know about Plant pathogens and plant diseases, its control by Genetic Engineering, Senescence in plants, Mechanism of biotic and abiotic stress tolerance, HR and SAR</li> </ul>
<b>Botany CO P12</b>	<p style="text-align: center;"><b>Applied Mycology-I</b></p> <ul style="list-style-type: none"> <li>• The Fungal Symbiosis, Medical Mycology, Industrial Mycology, Enzymes &amp; Role of microorganisms in Biodegradation of Organic waste.</li> <li>• Morphology &amp; structure of Fungi &amp; their role in Agriculture.</li> </ul>
<b>Botany CO P13</b>	<p style="text-align: center;"><b>Plant Ecology</b></p> <ul style="list-style-type: none"> <li>• The concept, types, development and functions of various ecosystems and their communication.</li> <li>• The various environmental factors governing these ecosystems are also clearly understood.</li> </ul>
<b>Botany CO P14</b>	<p style="text-align: center;"><b>Environmental ecology</b></p> <ul style="list-style-type: none"> <li>• The factors leading to Environmental degradation, their reasons and their impact on the environment.</li> <li>• This knowledge can help to form strategies for conservation and sustainable management under the given legislative measures.</li> </ul>
<b>Botany CO P15</b>	<p style="text-align: center;"><b>Plant biotechnology</b></p> <ul style="list-style-type: none"> <li>• Concepts, tools and techniques related to <i>in vitro</i> propagation of plants.</li> <li>• Different methods used for genetic transformation of plants, use of <i>Agrobacterium</i> as a vector for plant transformation, components of a binary vector system.</li> <li>• Various case studies related to basic and applied research in plant sciences using transgenic technology.</li> <li>• Principles and methods used for phenotypic, genetic and molecular analysis of transgenic plants.</li> </ul>
<b>Botany CO P16</b>	<p style="text-align: center;"><b>Genetic Engineering</b></p> <ul style="list-style-type: none"> <li>• Basic principles and modern age applications of recombinant DNA technology.</li> <li>• Learning molecular and technical skills along with applications of the instrumentation.</li> </ul>

	<ul style="list-style-type: none"><li>• Designing/conducting experiments and analyzing experimental data.</li><li>• Ethics of Recombinant DNA Technology.</li></ul>
--	---

<b>P.G Computer Science</b>	
<b>Code</b>	<b>Course outcome</b>
<b>Computer Science CO P1</b>	<p><b>After successful completion of these course students will able to perform/ analyze/understand:</b></p> <p style="text-align: center;"><b>Digital System and Microprocessor</b></p> <ul style="list-style-type: none"> <li>• Digital Systems and Microprocessor: Representation of integers and floating point nos., Boolean algebra, Karnaugh Maps don't care conditions in K-map.</li> <li>• Logic families: classification and characteristics, TTL, ECL, MOS, CMOS, their comparison, Combinational logic design using MSI chips: Multiplexers, Demultiplexers/ Decoders, Digital comparator; parity generator/checker; code converters, Priority encoder.</li> <li>• Design of Arithmetic circuits: Half Adder, half subtractor, full adder, full subtractor, parallel binary adder, subtraction using 1's and 2's compliment schemes, controlled parallel adder, ALU IC 74181.</li> <li>• Flip Flops: construction and working. Shift registers and Counters;; Counters: asynchronous counter designs, synchronous counter, UP/DOWN counters, lock out in counters.</li> <li>• Overview of microcomputer system, evolution of microprocessors, architecture of 8086 microprocessor, pin diagram, signal description, register organisation, concept of pipelining, memory segmentation, memory address generation, modes of operation of 8086.</li> <li>• Stack structure, interrupts in 8086 microprocessor, interrupt responses, Interrupt Vector Table, H/W and S/W interrupt processing; Interfacing, interfacing of keyboards, interfacing of displays, interfacing if ADC and DAC, address mapping.</li> </ul>
<b>Computer Science CO P2</b>	<p style="text-align: center;"><b>.Net Technologies and C#</b></p> <ul style="list-style-type: none"> <li>• Understanding the .net: The C# environment: origins of .net technology, .net framework, the common language runtime, framework base classes, user and program interfaces, visual studio .net, .net languages, benefits, c# and .net</li> <li>• Overview of C#; Literals, variables and data types, operators, expressions, Decision making and branching, looping, methods in c#, Array handling, string manipulation, structures and enumerations,</li> <li>• Classes and objects: Principle of OOP, Access modifiers, constructors, destructors, Nesting of classes; Inheritance and Polymorphism: multilevel inheritance, hierarchical inheritance, overriding, hiding methods, abstract methods and classes, sealed classes and methods; Interfaces.</li> <li>• Operator overloading: unary, binary, comparison, Delegates and events; Console I/O operations: console class, console input- output, formatted output. Errors and Exceptions: types of errors, exceptions, exception handling codes, multiple catch statements, exception hierarchy, catch handler, finally statement, nested try blocks.</li> <li>• Multithreading in c#: Introduction, System, File Manipulation: Managing File System, Moving, copying, deleting files, Reading, writing to files, Reading Drive</li> </ul>

	<p>information, File Security.</p> <ul style="list-style-type: none"> <li>• Data Access with .Net: ADO.net overview, Database connections, commands, the Data Reader, the DataSet class, populating a DataSet, persisting a DataSet.</li> </ul>
<p><b>Computer Science</b> <b>CO P3</b></p>	<p style="text-align: center;"><b>Operating System</b></p> <ul style="list-style-type: none"> <li>• Introduction, Services, Types, Uses of O.S. Interface, Graphical User Interface; System Calls; System Programs; Operating System Structure: , System Boot.</li> <li>• Process Management: Process Concept, Process States, Process Control Block, Process Scheduling: Schedulers, Context Switch; Operations on Process: Creation, Termination, Inter Process Communication; Threads: Concept, Benefits; CPU Scheduling: Burst Cycle, Types of Scheduling, Scheduler, Dispatcher, Scheduling Criteria, Scheduling Algorithms: FCFS, SJF, Priority Scheduling, Round-Robin.</li> <li>• Process Synchronization and Deadlocks, Prevention, Avoidance and Detection; Recovery from Deadlock.</li> <li>• Memory Management, Logical and Physical Address Space, Swapping, Contiguous Allocation, Dynamic Storage Allocation, Page Replacement Algorithms: FIFO, Optimal Page Replacement, LRU, Second-Chance Page Replacement; Thrashing, I/O Interlock.</li> <li>• File System: File: Concept, Attributes, Operations; File Organization and Access. Protection: Access Control and Permissions. File System Structure, Allocation Methods, Free Space Management. Disk. Structure, Disk Scheduling Algorithms: FCFS, SSTF, SCAN, C-SCAN, LOOK. Disk Management, Swap Space Management, RAID: Concept. I/O Systems: I/O Hardware, Interrupts, DMA, Application I/O Interface, Kernel I/O Subsystem.</li> <li>• Distributed File System: Concept, Naming and Transparency, Remote File Access. Embedded Operating Systems.</li> </ul>
<p><b>Computer Science</b> <b>CO P4</b></p>	<p style="text-align: center;"><b>Computer Networks</b></p> <ul style="list-style-type: none"> <li>• Digital Communication: Advantages; Data Transmission: Modes: Parallel, Serial: Asynchronous, Synchronous, Isochronous; Transmission Media: Guided and unguided; Modulation: Amplitude, Phase Shift, Frequency, QAM; Multiplexing: FDM, WDM, TDM, STDM, CDM; Switching: Circuit, Message, Packet; Delays in Packet Switched Network, Packet Loss; Network Reference Models: OSI: Layered Architecture and Services, TCP/IP: Layered Architecture and Services</li> <li>• Application Layer: Principles of Application Layer Protocols; Processes: Client-Server Model, Socket Interface; Services required by Application Layer; HTTP: Introduction, RTT, HTTP Handshake, types of HTTP Connections, HTTP Messages, Authentication and Cookies; FTP: Service Model, FTP Commands; Electronic Mail; SMTP; DNS: Services and working</li> <li>• Transport Layer: Transport-Layer Services and Principles; Multiplexing and Demultiplexing Applications; Connectionless Transport – UDP; Principles of Reliable of Data Transfer (RDT); Stop-and-wait and Pipelined protocols; GBN protocol; Connection-Oriented Transport: TCP; Flow Control; Principles of Congestion Control; Approaches towards Congestion Control;</li> </ul>

	<p>TCP Congestion Control</p> <ul style="list-style-type: none"> <li>• Network Layer, Routing Algorithms: Classifications; Hierarchical Routing; Internet Protocol, IP Addressing, Routing in the Internet.</li> <li>• Data Link Layer, Error Detection and Correction; Multiple Access Protocols and LANs; LAN Addresses and ARP; Ethernet; Hubs, Bridges and Switches; Wireless LANs: IEEE 802.11; The Point-to-Point Protocol; ATM, X.25 and Frame Relay.</li> <li>• Network Security and Management, Secured Communication, Threats ,Network Management Architecture; Internet Network Management Framework; SMI, MIB, SNMP.</li> </ul>
<p><b>Computer Science</b> <b>CO P5</b></p>	<p style="text-align: center;"><b>Java Programming</b></p> <ul style="list-style-type: none"> <li>• Introduction to java, Java development tools, Java and WWW, Java applications, java building elements: Identifiers, Keywords, variables, constants, operators. Data types and type casting and type conversion. Control Structures: Simple if, If.. else, switch statement, Loop structure : For , Do. while, while , loop control using break and continue.</li> <li>• Objects and classes: class variable, instance variable, class methods, Access specifier, access modifiers. Methods: main method, creating methods, calling methods, overloading methods, abstraction, recursion. Object: Initialization of object using constructors, parameterized constructor, Dynamic Memory allocation, Garbage collection. Passing objects to methods.</li> <li>• Packages: creating and importing packages, Arrays.</li> <li>• Applet: Graphics class, AWT class hierarchy, Frames, Layout managers, components, containers. Color class, Font class.</li> <li>• Error and Exception class, Error handling routine. Thread class, Runnable interface, states, priority and synchronization. Java I/O classes, File handling.</li> <li>• Button, Label, TextField, TeatArea, Choice, List, CheckBox, CheckBox Group, Dialog Boxes, Menu, Multiple Windows, Event handling: Event Delegation model, Adapter classes, Event classes, Event Listener Interfaces, Handling Mouse and Keyboard events.</li> </ul>
<p><b>Computer Science</b> <b>CO P6</b></p>	<p style="text-align: center;"><b>Data Structures</b></p> <ul style="list-style-type: none"> <li>• Types of Data Structures, Linear &amp; Nonlinear data structures, Arrays. Linked List : Concept , Operations : Insert, Delete, Traversal, Static implementation using arrays.</li> <li>• Push and Pop operations, Stack implementation using array, Stack applications, Infix to Postfix conversion of expression, Expression evaluation, Recursion. Queues: Introduction, Insert and Delete operations, Queue implementation using array, Types –Priority Queue, Circular queue, , applications, CPU Scheduling Algorithms FCFS , Round Robin algorithm, Stacks and Queues as Linked Lists</li> <li>• Terminology and Concepts , Binary Tree Representation, Static implementation using arrays , Linked representation, Binary Search Tree, Searching: Sequential binary tree searches.</li> </ul>

	<ul style="list-style-type: none"> <li>• Searching and Sorting Concept and need, Techniques, Linear search, Binary search, Indexed sequential search, Sorting, Concept and Need, Performance criteria, Bubble sort, Insertion Sort, Selection Sort, Shell Sort, Quick Sort, Heap Sort, Merge Sort.</li> <li>• Terminology and concepts, Graph Representation: Adjacency matrix, Adjacency list, Adjacency multi-list, Traversals: Depth first and Breadth first.</li> <li>• Indexing: B-tree indexing, Multilevel indexing, B+ tree, Hashing, Collision processing, Bucket hashing, Dynamic hashing, Linear hashing, Extendible hashing, Tries.</li> </ul>
<p><b>Computer Science CO P7</b></p>	<p style="text-align: center;"><b>Software Engineering</b></p> <ul style="list-style-type: none"> <li>• Characteristics of System, Elements and Types of System: Physical or Abstract Systems, Open or Closed Systems, Man-made Information Systems; Subsystem. System Analyst: Role; Skills: Interpersonal, Technical; Information Gathering Tools (Fact Finding Techniques); Feasibility Study.</li> <li>• Introduction to Software Engineering: Definition and Characteristics of Software; Software Application Domains; Software Engineering: Definition, Layered Model.</li> <li>• Software Process Framework; Umbrella Activities. Process Models: SDLC (Waterfall); Incremental; Evolutionary Models: RAD, Prototyping, Spiral; Concurrent Development Model; Components based Development Model. Agility: Agile Process: Assumptions, Agility Principles, Human Factors. Software Engineering Practice: Essence of Practice, Core Principles, Communication Principles, Planning Principles, Modeling Principles, Construction Principles, Deployment Principles.</li> <li>• Requirements Engineering: Requirements Engineering Tasks: Inception, Elicitation, Elaboration, Negotiation, Specification, Validation. Requirements Management; Steps in Requirements Engineering. Requirements Analysis: Objectives; Requirements Modeling Approaches: Scenario-Based Modeling: Use-Case; Class Models: E-R Diagram, Class Diagrams; Flow Oriented Modeling: DFD, CFD; Behavioral Models: State Diagram, Sequence Diagrams.</li> <li>• Software Design: Design Process and Quality; Design Concepts: Abstraction, Architecture, Modularity, Information Hiding, Functional Independence, Refinement. Component Level Design: Component-Definition; Object-oriented View, Traditional View, Cohesion, Coupling. Designing Traditional Components: Graphical Design – Notations (Flow Chart), Tabular Design – Notations (Decision Table), Program Design Language (Structured English or Pseudocode). User Interface Design: Rules; Interface Design Models; Interface Analysis.</li> <li>• Software Quality, Garvin’s Quality Dimensions; McCall’s Quality Factors; ISO 9126 Quality Factors. Software Quality Assurance: Elements, Goals, ISO 9001-2000 Quality Standards. Software Metrics. Metrics for Specification Quality, Design Model. Object-Oriented Design, User-Interface Design Metrics, Metrics for Source Code, Metrics for Testing, Metrics for Maintenance.</li> <li>• Software Testing: Need, Verification and Validation, Unit Testing, Integration Testing, Validation Testing, System Testing, Debugging, Test Characteristics. White Box Testing: Flow Graph Notations, Test Cases, Control Structure Testing.</li> </ul>



	Black Box Testing: Graph-based Testing Methods, Equivalence Partitioning, Boundary Value Analysis, Orthogonal Array Testing.
<b>Computer Science CO P8</b>	<p style="text-align: center;"><b>Discrete Mathematical Structures</b></p> <ul style="list-style-type: none"> <li>• Mathematical logic: Introduction, statements and notations, connectives – negation, conjunction, disjunction, Statement formulas and truth tables, conditional, bi-conditional, well formed formulas, Tautologies, Equivalence of formulas, Duality law, Tautological implications, functionally complete sets of connectives, other connectives, Normal and principal normal forms, completely parenthesized infix and polish notations, Theory of inference for statement calculus – validity using truth table, rules of inference, consistency of premises and indirect method of proof.</li> <li>• Set theory: Basic concepts of set theory, representation of discrete structures, relations and ordering: relations, properties of binary relations in a set, relation matrix and graph of a relation, partition and covering of a set, equivalence relation, compatibility relations, composition of binary relations, Functions – composition of functions, Inverse function.</li> <li>• Algebraic Structures: Algebraic systems: Examples and general properties, Semigroups and monoids, Grammar and Languages, Polish expressions and their compilation, Groups- Definition and examples, subgroups and homomorphism, cosets and Lagrange’s theorem, Group codes – the communication model and basic notions, generation of codes by using parity checks, error recovery in group codes.</li> <li>• Lattices and Boolean algebra: Lattice as POSETs, definition, examples and properties, Lattice as algebraic systems, sublattices, Direct product and homomorphism, Special lattices, Boolean algebra - definition and examples, subalgebra, Direct product and homomorphism, Boolean functions, representation and minimization of Boolean Finite state machines.</li> <li>• Graph theory: Basic concepts of graph theory – definitions, paths, reachability and connectedness, matrix representation, Storage representation and manipulation of graphs- trees, representation and operations, list structures and graphs, Simple precedence grammars-syntax terminology, a view of parsing, notion and use of precedence relations, formal definition of precedence relations.</li> <li>• Fault detection in combinational switching circuits, Algorithm for generating a fault matrix, procedure for detection of faults, Finite- state acceptors and regular grammars, Turing machines and partial recursive functions.</li> </ul>
<b>Computer Science CO P9</b>	<p style="text-align: center;"><b>Compiler Construction (GIC)</b></p> <ul style="list-style-type: none"> <li>• Introduction to Compilers: Overview, typical compiler Structure, implementation. Programming Language Grammars: Elements of formal language grammars, derivation, reduction, syntax tree, ambiguity, regular grammars and expressions.</li> <li>• Scanning and Parsing Techniques: The scanner, top-down and bottom-up parsing, syntax directed translation, Symbol table organization, Hash table organization, Linked List and Tree structured symbol tables, symbol table organization for structures and records.</li> </ul>

	<ul style="list-style-type: none"> <li>• Memory Allocation: Static and dynamic memory allocation, array allocation and access, allocation for strings, structure allocation, common and equivalence allocation. Compilation of expressions.</li> <li>• Compilation of control structures: Control transfers, procedural calls, conditional execution, iteration control constructs.</li> <li>• Error detection, indication and recovery. Compilation of I/O statements: Compilation of I/O list, compilation of FORMAT list, the I/O routine, file control.</li> <li>• Code optimization: Major issues, optimizing transformations, local optimizations, program flow analysis, Global optimization, writing compilers.</li> </ul>
<b>Computer Science CO P10</b>	<p style="text-align: center;"><b>Data Mining and Data Warehousing</b></p> <ul style="list-style-type: none"> <li>• Introduction, Data Mining Functionalities, Data Preprocessing and Concept Hierarchy Generation.</li> <li>• Data Warehouse and OLAP Technology: Overview, A Multidimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, From Data Warehousing to Data Mining. Data Cube Computation and Data Generalization: Efficient Methods for Data Cube Computation, Data Generalization and Concept Description.</li> <li>• Mining Frequent Patterns, Associations, and Correlations: Basic Concepts, Efficient and Scalable Frequent Itemset Mining Methods, Mining Various Kinds of Association Rules, From Association Mining to Correlation Analysis, Constraint-Based Association Mining.</li> <li>• Classification and Prediction: Issues, Classification by Decision Tree Induction, Bayesian Classification, Rule-Based Classification, Classification by Backpropagation. Prediction: Linear Regression, Nonlinear Regression, Accuracy and Error Measures, Evaluating the Accuracy of a Classifier or Predictor.</li> <li>• Cluster Analysis: Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods, Clustering High-Dimensional Data. Mining Time-Series Data, Mining Sequence Patterns in Biological Data.</li> <li>• Graph Mining, Social Network Analysis and Multirelational Data Mining. Mining Object, Spatial, Multimedia, Text, and Web Data, Data Mining Applications, Trends in Data Mining</li> </ul>
<b>Computer Science CO P11</b>	<p style="text-align: center;"><b>Computer Graphics</b></p> <ul style="list-style-type: none"> <li>• Geometry and line generation: Introduction, points and lines, planes and coordinates, Line segments, perpendicular line segments, vectors, pixels and frame buffers, vector generation, character generation, displaying the frame buffer. Graphics primitive: Introduction, display devices, primitive operations, the Display-File Interpreter, normalized device coordinates, Display-file structure, Display control, Text line style primitives.</li> <li>• Polygon: Introduction, Polygon , Polygon representation, Entering polygon, An inside test, filling polygon, Antialiasing. Transformations: Introduction, matrices, scaling transformations, sin and cos, sum of angles, identifiers,</li> </ul>

	<p>rotation, homogeneous coordinates and translation, rotation about an arbitrary point, other transformations, display procedures.</p> <ul style="list-style-type: none"> <li>• Segments: Introduction, the segment table, segment creation, closing a segment, deleting a segment, renaming a segment, visibility, image transformations, saving and showing segments, other display file structures, some raster techniques, Windowing and clipping.</li> <li>• Interaction : Introduction, hardware, input devices, handling algorithm, event handling, sample devices, the detectability attributes, simulating a locator with a pick and pick with a locator, Echoing. Introduction, 3D Geometry, primitives and transformations, rotation about an arbitrary axis, parallel projection, perspective projection, The 3D viewing transformation, , special projection.</li> <li>• Hidden surfaces and lines: Introduction, back face removal, the painter algorithm, collection of polygons, remembering the style, the hidden surface check, decomposition into triangles, comparing two triangles, The minima test, Overlapping edges, containment of points, finding a point in the triangle plane, comparing of the entire triangle, establishing depth order, geometrical sorting, linked list, sorting the triangles.</li> <li>• Shading: Introduction, diffusion, illumination, point source illumination, specular reflection, transparency and shadows. Curves: Introduction, curve generation, implementation, interpolating polygons, E-splines, B-Splines and Curves.</li> </ul>
<p><b>Computer Science</b> <b>CO P12</b></p>	<p style="text-align: center;"><b>Client-Server Computing</b></p> <ul style="list-style-type: none"> <li>• Networking in Java: Basics, Socket overview, Client-Server concepts, Proxy servers, Internet addressing, Java Networking classes and interfaces, Inet Address, TCP/IP Client Sockets, URL Connection, TCP/IP Server sockets, Creating TCP client- server.</li> <li>• Java Database Connectivity: JDBC concepts, JDBC API, DriverManager, Connection, Statement and ResultSet classes with relevant methods.</li> <li>• Servlets: Structure and lifecycle of Servlets, Servlet API: basics, Various classes &amp; interfaces. Servlet requirements, writing. Running and debugging of Servlets, Concepts of Cookies, State and session management with Servlet API. Server side includes and request forwarding. Servlet chaining. Jdbc Servlets.</li> <li>• JavaScript Overview, Variables, Operators, Data Types, Control Statements, Functions and Objects, The Window Object: Dialog Boxes, Status Bar Messages, Window Manipulations; The Document Object: Writing to Documents, Dynamic Documents, The Form Object: Working With Form Elements and Their Properties The String and RegExp Objects, Dates and Math object</li> <li>• Remote Method Invocation (RMI): Object serialization in Java, Concept of remote object, Architecture of RMI application, Java RMI package, classes &amp; Interfaces, Client-Server application using RMI, RMI Servlets, RMI-JDBC Servlets.</li> <li>• Introduction to JSP; Simple JSP concepts, Request-time expressions.</li> </ul>

	Advanced JSPs: Scripts. conditionals, loops, Try/ Catch. Concept of Beans, Properties, Bean instances & serialization; Bean Scopes, Writing Beans, Introspection, Beans & Scriptlets.
<b>Computer Science CO P13</b>	<p style="text-align: center;"><b>Distributed Operating System(GIC)</b></p> <ul style="list-style-type: none"> <li>• Introduction to distributed systems, hardware and software concepts, design issues. Communication in distributed systems.</li> <li>• Synchronization in distributed systems, prevention, and distributed dead lock detection.</li> <li>• Processes and processors in distributed systems: Threads, system, models, processor allocation, scheduling in distributed system, fault tolerance and real time distributed systems.</li> <li>• Distributed file systems: Distributed file systems design, distributed file system implementation, trends in distributed file systems. Distributed shared memory: What is shared memory, consistency models, page based distributed shared memory, shared variable, distributed shared memory, object based DSM.</li> <li>• Introduction, objects and capabilities in AMOEBA, Process Management in AMOEBA, Memory Management, Communication in AMOEBA. The AMOEBA servers: The Bullet Server - Interface and Implementation, The Directory Server – Interface and Implementation, The Replication Server, The Run Server, The Boot Server, The TCP/IP Server, Other Servers.</li> <li>• Introduction, Process management in MACH, Memory management, communication, UNIX emulation in MACH. Introduction to DCE threads, RPC's, Time service, directory service, security service, distributed file system.</li> </ul>
<b>Computer Science CO P14</b>	<p style="text-align: center;"><b>Theory of Computation</b></p> <ul style="list-style-type: none"> <li>• Strings, alphabets and languages, Graphs and trees, Inductive proofs, set notations, relations, Finite automata and regular Expression. Deterministic finite automata, equivalence between NFA and DFA, Conversion of NFA to DFA.</li> <li>• Regular set and regular expression, Two way finite automata, finite automat with output, Applications of finite automata. Equivalence of RE and FA, Inter conversion, pumping lemma, closure property of regular sets, Regular grammars, Right linear and Left linear grammar, equivalence between Regular linear grammar and FA inter conversion between RE and RG.</li> <li>• Context free grammar, derivation trees, Chomsky Normal Form, Greibach Normal Form. Push Down Automata: Definition, model, acceptance of CFL, equivalence of CFL and PDA , Interconversion, Enumeration of properties of CFL.</li> <li>• Turing Machine model, Design of turing machine, computable languages and function, construction, Modifications of Turing machine, Church's Hypothesis.</li> <li>• Chomsky Hierarchy of languages, Linear bounded automata and context sensitive languages, Introduction of DCFL and DPDA, Decidability of problems.</li> </ul>

	<ul style="list-style-type: none"> <li>• Properties of recursive &amp; non recursive enumerable languages, universal turing machine, post correspondence problem, introduction to recursive function theory.</li> </ul>
<b>Computer Science CO P15</b>	<p style="text-align: center;"><b>Artificial Intelligence and Expert Systems</b></p> <ul style="list-style-type: none"> <li>• Prolog Programming: Introduction, structure of language, cut, fail, recursion, lists and complex structures, interactive programming, expert system in prolog.</li> <li>• Definition of AI, AI technique, tic-tac-toe, pattern recognition, level of the model, criteria for success, problems and problem spaces, defining the problems, production systems, control strategies, heuristic search, problem characteristics, decomposition of problems, solution steps, predictability, absolute and relative solutions.</li> <li>• Basic problem solving methods, matching indexing with variables, heuristic functions, weak methods, problem reduction, constraints satisfaction, means-ends analysis, analysis of search algorithms.</li> <li>• Game Playing: Minimax search procedure, adding alphabeta cutoffs, additional refinements, waiting for quiescence, secondary search, using book moves limitations.</li> <li>• Knowledge representation using predicate logic: representing simple facts in logic, augmenting the representation, structural representation of knowledge: some common knowledge structures, choosing the level of representation, finding the right structure as needed, declarative representation.</li> <li>• Natural Language Understanding, General concepts of implementation of AI systems. Introduction to pattern recognition. Rule based systems, semantics of CFL, semantic network, frames, frame kit. Application, introduction to knowledge engineering, artificial neural network: introduction, learning: single and multilayer networks</li> </ul>
<b>Computer Science CO P16</b>	<p style="text-align: center;"><b>Design and Analysis of Algorithms</b></p> <ul style="list-style-type: none"> <li>• Algorithm, writing algorithms in SPARKS, structured program, analyzing algorithms, Divide and conquer: The general method, Binay Search, Finding minimum and maximum, merge sort, quick sort, selection sort, Strassen's matrix multiplication.</li> <li>• Greedy Method, Optimal storage on tapes, Job sequencing with deadlines, Optimal merge patterns, minimum spanning trees, Single source shortest path. Dynamic programming: method, multistage graph, all pair shortest paths, Optimal binary search trees, 0/1 knapsack , Travelling salesperson problem, flow shop scheduling.</li> <li>• Basic Search and Traversal techniques, Back tracking : General method, 8-queens problem, sum of subsets, Hamiltonian cycles.</li> <li>• Branch and bound: General method, 0/1 knapsack problem, Travelling salesperson, efficiency considerations, Algebraic simplification and transformations: General method, evaluation and interpolation, fast Fourier transform, modular arithmetic.</li> <li>• Lower bound theory: comparison trees for sorting and searching, Oracle and</li> </ul>

	<p>adversary arguments, techniques for algebraic problems, some lower bounds and parallel computation.</p> <ul style="list-style-type: none"> <li>• NP-Hard and NP-Complete problems: basic concept, cook's theorem, NP-Hard graph problem, NP-Hard scheduling problem, NP-Hard code generation problem.</li> </ul>
<p><b>Computer Science CO P17</b></p>	<p style="text-align: center;"><b>Network Security</b></p> <ul style="list-style-type: none"> <li>• Terminology, Notation, Networking Security Attacks, Layers And Cryptography, Authorization, Tempest, Keys, Viruses, Worms, Trojan Horses, Multilevel Model of Security, Legal Issues.</li> <li>• Cryptography: Introduction, Breaking an Encryption Scheme, Types of Cryptographic Function.</li> <li>• Authentication: Overview of Authentication System, Password-based Authentication, Address-based Authentication, Cryptographic Authentication Protocols, Keys, Trusted Intermediaries, Authentication of People, Security Handshake Pitfalls: Login Only, Mutual Authentication, Integrity / Encryption for Data, Mediated Authentication, Performance Considerations.</li> <li>• Standards: Kerberos V4: Tickets, Kerberos V5: ASN.1, Names, Delegation of Rights, Ticket Lifetimes, Key Versions, Optimizations of Cryptographic Algorithms, Real Time Communication Security,</li> <li>• E-mail Security: Distribution Lists, Store and Forward, Security Services for E-Mail, Establishing Keys, Privacy, Authentication of Source, Message Integrity, Non Repudiation, Message Flow Confidentiality, Anonymity, Containment. PEM and S/MIME, PGP.</li> <li>• Firewalls, Security Systems: Netware V3, Netware V4, Microsoft Windows Security. Web Issues: URLs/URIs, HTTP, Cookies. Web Security Problems.</li> </ul>
<p><b>Computer Science CO P18</b></p>	<p style="text-align: center;"><b>Mobile Communications</b></p> <ul style="list-style-type: none"> <li>• Mobile Communication; Frequencies, Signals, Antennas, Signal Propagation, Multiplexing, Modulation, Spread Spectrum, Cellular System.</li> <li>• Medium Access Control Comparison of S/T/F/CDMA. Telecommunication Systems(GSM, DECT, TETRA, UMTS and IMT-2000).</li> <li>• Satellite Systems. Broadcast Systems: Overview, Cyclical Repetition of Data, Digital Audio Broadcasting, Digital Video Broadcasting, Convergence of Broadcasting and Mobile Communications.</li> <li>• Wireless LAN: Infrared Versus Radio Transmission, Infrastructure and Adhoc Network, IEEE 802.11, HIPERLAN, Bluetooth.</li> <li>• Layers: Mobile Network Layer: Mobile IP, DHCP, Mobile Transport Layer: Traditional TCP, Classical TCP improvements, TCP over 2.5/3G Wireless Networks.</li> <li>• Support For Mobility: File Systems, World Wide Web, Wireless Application Protocol, i-Mode, SyncML, WAP2.0.</li> </ul>
<p><b>Computer Science CO P19</b></p>	<p style="text-align: center;"><b>Digital Image Processing</b></p> <ul style="list-style-type: none"> <li>• Definition, Origins of X-ray Imaging, Ultraviolet Band, Visible and Infrared Bands, Microwave Band, and Radio Band Imaging; Fundamental Steps,</li> </ul>

	<p>Components of an Image Processing System</p> <ul style="list-style-type: none"> <li>• Digital Image Fundamentals, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, A Simple Image Formation Model; Image Sampling and Quantization; Basic Relationships Between Pixels; Linear and Nonlinear Operations.</li> <li>• Image Enhancement in the Spatial Domain, Enhancement Using Arithmetic/Logic Operations; Basics of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods</li> <li>• Image Enhancement in the Frequency Domain, Homomorphic Filtering; Implementation, Inverse Fourier Transform Using a Forward Transform Algorithm, Need for Padding, Convolution and Correlation Theorems, The Fast Fourier Transform;</li> <li>• Image Restoration, Noise Models, Only Spatial Filtering: Mean, Order-Statistics, and Adaptive Filters; Periodic Noise Reduction by Frequency Domain Filtering: Bandreject, Bandpass, and Notch Filtering, Geometric Mean Filter; Geometric Transformations: Spatial Transformations, Gray-Level Interpolation.</li> <li>• Color Image Processing: Color Fundamentals, Color Models; Pseudocolor Image Processing; Full-Color Image Processing, Color Transformations: Formulation, Color Complements, Color Slicing, Tone and Color Corrections. Morphological Image Processing, Some Basic Morphological Algorithms.</li> <li>• Image Segmentation, Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Use of Boundary Characteristics for Histogram Improvement and Local Thresholding, Thresholds Based on Several Variables; Region-Based Segmentation: Region Growing, Region Splitting and Merging.</li> </ul>
<p><b>Computer Science CO P20</b></p>	<p><b>Software Testing (GIC)</b></p> <ul style="list-style-type: none"> <li>• Testing: Introduction and Outline.</li> <li>• Introduction to test outline to test cases, creating test cases, documentation short cuts, introduction to using tables and spreadsheets, sample application, Documenting test cases.</li> <li>• Other types of tablets, State machines, test case table with multiple inputs, decision tables, applications with complex data, managing tests, testing object-oriented software, comparison, System testing example, Unit testing of Classes.</li> <li>• Testing Web Applications: Introduction, sample application, functional and usability issues, configuration and compatibility testing, reliability and availability, security testing, database testing, post implementation testing.</li> <li>• Reducing the No. of test cases: Introduction, prioritization guidelines, priority category scheme, Risk analysis, interviewing to identify problem areas, combination schemes, tracking selected test cases.</li> <li>• Creating Quality Software: Introduction, development environmental infrastructure, software testing environment, software testing tools, applying software standards to test documentation.</li> </ul>





	<b>P.G Chemistry</b>
<b>Code</b>	<b>Course Outcomes</b>
<b>Chemistry CO P1</b>	<p><b>After successful completion of this course, students will able to perform/ analyze / understand :</b></p> <p style="text-align: center;"><b>Inorganic Chemistry</b></p> <ul style="list-style-type: none"> <li>• The Structural rationalization of molecules by VSEPR theory.</li> <li>• The structure, bonding and properties in coordination compounds by VBT, CFT, MOT.</li> <li>• The stability of metal complexes by the use of formation constants and to calculate thermodynamic parameters from them.</li> <li>• The structure and bonding in metal carbonyls and metal nitrosyl.</li> <li>• To draw character table and point groups</li> <li>• The Crystal Field Theory to understand the magnetic properties and the colour of coordination compounds.</li> <li>• The Boron hydrides &amp; Metal Cluster.</li> </ul>
<b>Chemistry CO P2</b>	<p style="text-align: center;"><b>Organic Chemistry</b></p> <ul style="list-style-type: none"> <li>• The fundamentals of reaction mechanisms and can propose mechanism on the basis of evidences.</li> <li>• The mechanism of nucleophilic substitution, Aromatic Nucleophilic and Electrophilic and elimination reactions.</li> <li>• The fundamentals of aromaticity in organic chemistry.</li> <li>• The knowledge about separation and isolation of stereoisomers.</li> <li>• The molecular rearrangements.</li> <li>• The importance of chiral/asymmetric synthesis.</li> </ul>
<b>Chemistry CO P3</b>	<p style="text-align: center;"><b>Physical Chemistry-I</b></p> <ul style="list-style-type: none"> <li>• The concept of quantum Mechanics, Variation theorem and its application.</li> <li>• The eigen functions for angular momentum, eigen value of angular momentum. Pauli exclusion principle. Russel-Saunders terms &amp; coupling schemes.</li> <li>• The influence of different parameters on rate of reactions.</li> <li>• The concept of activation energy and its effects on the rates of chemical reactions.</li> <li>• The Classical Thermodynamics and Non equilibrium Thermodynamics.</li> <li>• The characteristics of radioactive decay, theory of a band g decay process and different types of reactors.</li> </ul>
<b>Chemistry CO P4</b>	<p style="text-align: center;"><b>Modern Methods of Separation</b></p> <ul style="list-style-type: none"> <li>• The role of analytical chemistry in science and different sampling processes.</li> <li>• The Various analytical tests used for rejection of data.</li> <li>• skills in advanced methods of separation and analysis Chromatography, Ion Exchange, Solvent Extraction.</li> </ul>

	<ul style="list-style-type: none"> <li>• The principle and applications of GC and HPLC techniques.</li> <li>• The laboratory safety and war-fare agents.</li> </ul>
<b>Chemistry CO P5</b>	<p style="text-align: center;"><b>Co-ordination Chemistry</b></p> <ul style="list-style-type: none"> <li>• The term symbol for ground and excited state of <math>d^n</math> configuration.</li> <li>• The electronic spectra and comment on geometry of complexes.</li> <li>• The magnetic behaviour and the factors affecting the magnetic properties of coordination compounds.</li> <li>• Overview of Bioinorganic chemistry and understand the biological role of alkali metal ions, ligands, ion transport across the membrane.</li> <li>• The structure and biochemical function of haemoglobin, myoglobin and Vitamin B12.</li> <li>• About different inorganic reaction, their mechanism and the factors affecting.</li> </ul>
<b>Chemistry COP6</b>	<p style="text-align: center;"><b>Organic Chemistry-II</b></p> <ul style="list-style-type: none"> <li>• The Mechanistic and stereo chemical aspects of addition reaction (to <math>C=C</math>), Free radical reactions and molecular rearrangements.</li> <li>• The importance of photochemistry and Pericyclic Reactions.</li> <li>• The stereochemistry of products of pericyclic reactions.</li> <li>• The basis of green chemistry and appreciates the importance of solvent free synthesis.</li> <li>• The adverse effect of chemicals on the environment.</li> </ul>
<b>Chemistry CO P7</b>	<p style="text-align: center;"><b>Physical Chemistry-II</b></p> <ul style="list-style-type: none"> <li>• The Chemical kinetics of complex reactions, chain reactions and fast reactions.</li> <li>• About configuration and conformation of macromolecules and their number and mass average molecular weight.</li> <li>• Construction of M.O. by LCAO for <math>H_2^+</math> ion, Calculation of energy levels from wave functions.</li> <li>• The Debye-Huckel-Onsager treatment and its extension.</li> <li>• The</li> <li>• types of corrosion, corrosion inhibitors, Corrosion monitoring. and prevention methods.</li> <li>• The Maxwell-Boltzmann distribution law Fermi-Dirac statistics, distribution law and applications to metals. Bose-Einstein statistics - distribution law and application to helium.</li> </ul>
<b>Chemistry CO P8</b>	<p style="text-align: center;"><b>Optical Methods and Environmental Chemistry</b></p> <ul style="list-style-type: none"> <li>• The Spectrophotometry and Colorimetry students can comment on the composition of coloured complexes.</li> <li>• The importance of different analytical techniques and its applications.</li> <li>• The sources of water, air, soil and radiation pollution and its effect on environment.</li> <li>• The techniques of analysis of the different pollutants.</li> </ul>
<b>Chemistry CO P9</b>	<p style="text-align: center;"><b>Spectroscopy-I</b></p> <ul style="list-style-type: none"> <li>• About the basic concepts and theories of microwave</li> <li>• Spectroscopy, IR, NMR and electronic spectroscopy</li> <li>• The NOE in NMR, FT-IR, 2D NMR COSY NOESY, HETCOR- DEPT techniques.</li> </ul>

	<ul style="list-style-type: none"> <li>• An ability to calculate UV <math>\lambda_{\text{max}}</math> value of compounds.</li> <li>• The spectra and find out the correct structure of compounds as an application of spectroscopy</li> <li>• The carbon NMR spectroscopy and can comments on different types of carbon.</li> <li>• The principle, theory instrumentation and the fragmentation process of mass spectrometry and can analyse mass spectrum.</li> </ul>
<b>Chemistry CO P10</b>	<p style="text-align: center;"><b>Analytical Chemistry</b></p> <ul style="list-style-type: none"> <li>• The concept of thermogravimetry, factors affecting thermograms and applications of thermogravimetry.</li> <li>• The importance of conductometry and coulometry with their principal of analysis.</li> <li>• About the procedures for electro analytical techniques in polarography, voltammetry, amperometry and its applications in analytical chemistry.</li> <li>• An idea about Chemical sensors, biosensors and their applications.</li> <li>• About the spectrophotometry in the quantitative estimation of biological macromolecules.</li> </ul>
<b>Chemistry CO3S P11</b>	<p style="text-align: center;"><b>Organic Chemistry (Organic Synthesis-I)</b></p> <ul style="list-style-type: none"> <li>• The various methods employed for reactions like oxidation, reduction, carbocyclic and heterocyclic ring formation etc. .</li> <li>• The novel reactions and reagents in organic synthesis.</li> <li>• About the different name reactions and modern methods of synthesis.</li> <li>• The Umpolung concept and its synthetic applications as well as the importance of Phosphorus, and sulphur ylide, and Enamines</li> <li>• The formation of C-C bond by disconnection approach.</li> </ul>
<b>Chemistry CO P12</b>	<p style="text-align: center;"><b>Analytical Chemistry</b></p> <ul style="list-style-type: none"> <li>• The different types of classification of Carbohydrates, Lipids, and Proteins</li> <li>• The Sequence determination, structure and synthesis of bio-polymers like proteins, nucleic acids and sugars.</li> <li>• The natural pigment, hormones and vitamins.</li> <li>• About Alkaloids and terpenoids.</li> <li>• The Structure elucidation and synthesis, deficiency syndromes of various vitamins.</li> </ul>
<b>Chemistry CO P13</b>	<p style="text-align: center;"><b>Spectroscopy-II</b></p> <ul style="list-style-type: none"> <li>• A deep insight into the various spectroscopic methods used for the characterization of organic compounds and Inorganic Compounds, such as Mossbauer Spectroscopy and ESR Spectroscopy, Raman and photoelectron spectroscopy</li> <li>• About X-ray Diffraction, Electron and Neutron Diffraction</li> <li>• The surface characterization by spectroscopy and microscopy, (SEM/TEM). atomic force microscopy (AFM).</li> <li>• To elucidate the structure of compounds by analyzing the spectral data.</li> <li>• Students can determine oxidation state from mossbauer spectroscopy.</li> </ul>

<b>Chemistry</b> <b>CO P14</b>	<p><b>General Analytical Chemistry</b></p> <ul style="list-style-type: none"> <li>• The principle and methods of neutron activation analysis (NAA) and isotopic dilution analysis (IDA).</li> <li>• The concept of Molecular photo fluorescence and phosphorescence spectrometry.</li> <li>• The chemical analysis of food and Analysis of Cosmetics, Composition of Deodorant and antiperspirants.</li> <li>• The radiochemical methods of Analysis</li> <li>• The optical methods and flow injection Analysis.</li> </ul>
<b>Chemistry</b> <b>CO P15</b>	<p><b>Organic Chemistry (Organic Synthesis: II)</b></p> <ul style="list-style-type: none"> <li>• The concept of Retrosynthetic analysis and can disconnect large molecules and can give synthons for it.</li> <li>• About Synthesis of some complex molecules by Retrosynthetic analysis.</li> <li>• The synthesizing organic compounds students can protect and deprotect the functional group.</li> <li>• The use phase transfer catalysts.</li> <li>• The novel reactions and reagents in organic synthesis. 3.To acquire knowledge about the reagents which causes oxidation in various compounds.</li> <li>• The nomenclature rules for Heterocyclic compounds and get knowledge of synthesis of heterocyclic compounds.</li> </ul>
<b>Chemistry</b> <b>COP16</b>	<p><b>Industrial Chemistry</b></p> <ul style="list-style-type: none"> <li>• The role of antibiotics in everyday life.</li> <li>• About the structures of polymers and dyes and how to synthesize.</li> <li>• The different classes of agrochemicals and pesticides.</li> <li>• The General aspects of drug and how to design the drugs.</li> <li>• The pharmacodynamics (action of drug on human body) and pharmacokinetics (action of body on drug) of different classes of drugs which are used by us in daily life.</li> <li>• The Synthesis, mode of actions of antibiotics, antimalarials, anti-inflammatory, antipyretics, analgesics Antitubercular &amp; antileprotic, Anesthetics, Antihistamine Cardiovascular.</li> </ul>

	<b>P.G Mathematics</b>
<b>Code</b>	<b>Course Outcomes</b>
<b>Mathematics CO P1</b>	<p><b>After successful completion of this course, students will be able to analyse/perform/understand:</b></p> <p style="text-align: center;"><b>Real Analysis</b></p> <ul style="list-style-type: none"> <li>• Riemann Stilettoes integral and illustrate the properties of integration and differentiation.</li> <li>• The sequence, series and uniformly convergence of series by different Test.</li> <li>• The statement and prove of important theorems.</li> <li>• The Taylors, Inverse function and Implicit function theorems to solve the problems.</li> <li>• The differentiation to find out the maximum and minimum value of functions.</li> </ul>
<b>Mathematics CO P2</b>	<p style="text-align: center;"><b>Advance Abstract Algebra</b></p> <ul style="list-style-type: none"> <li>• Normal subgroup, normal series: Gain knowledge of normal subgroups, permutation group, normal series, solvable group and nilpotent group.</li> <li>• Structure theorem of groups: Learns structure theorems on finitely generated abelian groups. Apply the sylows first, second and third theorems.</li> <li>• Some special groups, groups of order <math>p^2</math>, <math>pq</math>.</li> <li>• Ideals and Homomorphism: To simplify algebraic expression, using the commutative , associative and distributive properties. Define and illustrate the concept of ideals.</li> <li>• The sum and product of ideal can define. Can find Maximal and prime deals of ring .</li> <li>• Unique Factorization domain And Euclidean Domain: Familiar with concept of Unique factorization domain, Euclidean domain and compare both.</li> <li>• The Principal ideal domain and find relations between PID, ED, UFD by solving examples.</li> <li>• Modules and Vector space: Apply the concept and properties of group, rings to module.</li> </ul>
<b>Mathematics CO P3</b>	<p style="text-align: center;"><b>Complex Analysis</b></p> <ul style="list-style-type: none"> <li>• The concepts Complex numbers and their properties and operations with Complex number.</li> <li>• Evaluating limits and checking the continuity of complex function</li> <li>• The differentiability and Analyticity of functions.</li> <li>• Evaluate Complex integrals and applying Cauchy integral.</li> <li>• How complex numbers provide a satisfying extension of the real numbers.</li> </ul>

<p><b>Mathematics</b> <b>CO P4</b></p>	<p style="text-align: center;"><b>Topology I</b></p> <ul style="list-style-type: none"> <li>• The concept of cardinal and ordinal number.</li> <li>• The concept of topological space.</li> <li>• Connectedness and compactness, and prove related theorems.</li> <li>• The concept of the countability axioms.</li> <li>• The regular completely regular and normal space.</li> <li>•</li> </ul>
<p><b>Mathematics</b> <b>CO P5</b></p>	<p style="text-align: center;"><b>Differential Geometry(opt.)</b></p> <ul style="list-style-type: none"> <li>• The geometric quantities such as length, curvature, and torsion associated to planar and spatial curves, surfaces of revolution</li> <li>• The isoperimetric inequality and the Family of curves.</li> <li>• The Define, use, and articulate the differences between normal curvature, geodesic Curvature.</li> <li>• The State, applies, and proves parts of the Gauss-Bonnet theorem.</li> <li>• The Gauss Bonnet theorem and its implication for a geodesic triangle. TO understand Differential manifolds.</li> </ul>
<p><b>Mathematics</b> <b>CO P6</b></p>	<p style="text-align: center;"><b>Measure and Integration Theory</b></p> <ul style="list-style-type: none"> <li>• The basic concepts of measure and integration theory.</li> <li>• The measure and outer measure, extension of measure.</li> <li>• The theory on the basis of examples of application.</li> <li>• Transferable skills such as ability to use abstract methods to solve problems and ability to use a wide range of references and critical thinking.</li> <li>• The LP uniqueness of extension and derived proof of some theorems.</li> </ul>
<p><b>Mathematics</b> <b>CO P7</b></p>	<p style="text-align: center;"><b>Advance Linear Algebra and field theory</b></p> <ul style="list-style-type: none"> <li>• To Construct, or give examples of, mathematical expressions that involve vectors, matrices, and linear systems of linear equations.</li> <li>• To solve problem to find minimal polynomial, Evaluating whether matrices are</li> <li>• Diagonalizable and express matrix in Jordan canonical form.</li> <li>• Quadratic Forms of matrices: Finding, rank signature and index of given quadratic form of matrix. Describing eigenvalues of matrix student can able to tell given matrix will be positive definite, negative definite or semi-definite matrix. Explain and learn some properties and theorems with example on quadratic forms.</li> <li>• Algebraic Extension of Field: Explain the fundamental concepts of field extensions.</li> <li>• The concept of irreducible polynomial and reducible polynomial with their properties</li> <li>• How to analyze, prove and explain theorems on algebraic extension and algebraically closed fields</li> </ul>

	<ul style="list-style-type: none"> <li>• Normal and Separable extension: Define and explain concept of splitting field. Construct structure of field using irreducible polynomial .Find dimension and basis of splitting field consequently learn normal extension separable</li> <li>• Extension. Learn basics of finite fields.</li> <li>• Galois Theory and its application to classical problems: Demonstrate capacity for mathematical reasoning through analyzing, proving and explaining concepts from field extensions and Galois Theory. Demonstrate accurate and efficient use of field extensions and Galois Theory</li> </ul>
<b>Mathematics CO P8</b>	<p style="text-align: center;"><b>Integral Equation</b></p> <ul style="list-style-type: none"> <li>• The linear Volterra and Fredholm integral equations using appropriate methods.</li> <li>• The relationship between integral and differential equations and transform one type into another.</li> <li>• How to Formulate and solve initial and boundary value problems for the heat</li> <li>• And wave equations in spherical and cylindrical coordinates.</li> <li>• The iterate kernel and Resolvent kernel of Volterra, Fredholm integral equation.</li> <li>• The Application of integral equation and greens function to solve ordinary differential equation.</li> </ul>
<b>Mathematics CO P9</b>	<p style="text-align: center;"><b>Topology II</b></p> <ul style="list-style-type: none"> <li>• The concept of product topology and quotient topology.</li> <li>• The complete metric space and prove the related theorems.</li> <li>• The concept of product spaces, tichonov topology and prove the related theorems.</li> <li>• The concepts such as point wise convergence and uniform convergence of topology.</li> <li>• The theorems like the urysohn'slemma, urysohn'smetrization theorems.</li> <li>• The Definition and illustration the Riemannian Curvature.</li> </ul>
<b>Mathematics CO P10</b>	<p style="text-align: center;"><b>Riemannian Geometry (opt.)</b></p> <ul style="list-style-type: none"> <li>• The types of Christoffel's symbol and calculate the Christoffel's symbol of different line element.</li> <li>• How to Derive and apply the equation of geodesic curve.</li> <li>• The key results on Riemannian geometry, their curvature and their geodesics and give rigorous and detailed proofs of them.</li> <li>• Compute the Einstein's tensor for static and non-static spherically symmetric RW-spacetime, Bianchi identity.</li> </ul>
<b>Mathematics</b>	<b>Functional Analysis I</b>

<p><b>CO P11</b></p>	<ul style="list-style-type: none"> <li>• How functional analysis uses and unifies ideas from vector spaces, the theory of metrics, and complex analysis.</li> <li>• Fundamental theorems from the theory of normed and Banach spaces, including the Hahn-Banach theorem, the open mapping theorem and the closed graph theorem.</li> <li>• The role of Inner product space.</li> <li>• Ideas from the theory of Hilbert spaces to other areas.</li> <li>• The fundamentals of spectral theory, and appreciate some of its power.</li> </ul>
<p><b>Mathematics CO P12</b></p>	<p style="text-align: center;"><b>Advance Mechanics</b></p> <ul style="list-style-type: none"> <li>• To Derive the Lagrange's equation and Hamilton principle.</li> <li>• The concept of Legendre's transformation and apply to derived the Hamilton's Equation.</li> <li>• The concept of canonical transformation and Poisson's Identity</li> <li>• The Caley Klein parameters. Most importantly they have studied the rigid body motion.</li> <li>• Perturbation Theory</li> </ul>
<p><b>Mathematics CO P13</b></p>	<p style="text-align: center;"><b>Operations Research</b></p> <ul style="list-style-type: none"> <li>• Financial decision making problems by using linear programming technique.</li> <li>• The graphical solution of linear programming problem by different method.</li> <li>• Skill and technique of problem solving.</li> <li>• The knowledge and understanding of Queuing system</li> <li>• Defination and illustration of Game and strategies.</li> <li>•</li> </ul>
<p><b>Mathematics CO P14</b></p>	<p style="text-align: center;"><b>Fluid Dynamics I ( opt.)</b></p> <ul style="list-style-type: none"> <li>• Appreciation properties of fluids.</li> <li>• Euler's equation, Bernoulli's equation and the case of steady motions under conservative body forces.</li> <li>• Mass, momentum and energy conservation to flows</li> <li>• Milne- Thomson Circle theorem</li> <li>• The concept of elements of thermodynamics and explain Entropy Maxwell's Thermodynamics relation.</li> </ul>
<p><b>Mathematics CO P15</b></p>	<p style="text-align: center;"><b>General Relativity ( Opt)</b></p> <ul style="list-style-type: none"> <li>• The fundamental principles of the general theory of relativity, Field Equations. The equivalence principles inertial frames and time dilation.</li> <li>• The Schwarzschild Exterior and its isotropic form. Classical test of general relativity</li> </ul>



	<ul style="list-style-type: none"> <li>• The Schwarzschild interior solution. Can derive Eddington's form of Schwarzschild solution. The Field of charged mass point. The boundary condition of Schwarzschild solutions The Gravitational collapse of spherical body, non-spherical rotating body, dust like sphere. Derivation of Kerr metric.</li> <li>• Mathematical description of gravitational waves in context of Einstein's relativity.</li> </ul>
<b>Mathematics CO P16</b>	<p style="text-align: center;"><b>Functional Analysis II</b></p> <ul style="list-style-type: none"> <li>• Definition and illustration the concept of reflexivity of Hilbert space.</li> <li>• The fundamentals of spectral theory, and appreciate some of its theorems.</li> <li>• The concept of compact linear operators on normed space. Spectral properties of compact linear operators.</li> <li>• Definition and illustration concept of self adjoint linear operators and explain its spectral properties.</li> <li>• Definition and illustration of the projection operator</li> </ul>
<b>Mathematics CO P17</b>	<p style="text-align: center;"><b>Partial differential equations</b></p> <ul style="list-style-type: none"> <li>• Classification of partial differential equations into Linear equation, Semi linear, Quasi-linear and nonlinear equations. Complete integral by Charpits method and also find the particular integral, singular integral</li> <li>• Genesis of PDE and transformation into Canonical forms.</li> <li>• Classification of Second order PDE and derivation of one dimensional wave equation</li> <li>• The Dirichlet problem, Neumann problem and problem for half plane.</li> <li>• Simple eigen value problems of Sturm-Liouville type. Derivation of the Heat conduction problem and prove Kelvin's inversion theorem.</li> </ul>
<b>Mathematics CO P18</b>	<p style="text-align: center;"><b>Numerical Analysis</b></p> <ul style="list-style-type: none"> <li>• Demonstration of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.</li> <li>• Numerical methods to obtain approximate solutions to mathematical problems.</li> <li>• Methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations and the solution of differential equations.</li> <li>• Several errors and approximation in numerical methods.</li> <li>• Methods to solve Curve Fitting and Interpolation questions and its related techniques.</li> </ul>
<b>Mathematics</b>	<b>Fluid Dynamics II</b>

<p><b>CO P19</b></p>	<ul style="list-style-type: none"> <li>• Scientific method strategies to fluid mechanics to analyse qualitatively and quantitatively the problem situation, propose hypotheses and solutions.</li> <li>• The compressibility effects in real fluids and derived the one, two, three dimensional wave equation.</li> <li>• Defination and illustration of Viscous Flow, application to solve problems.</li> <li>• Concept of Magneto hydrodynamics and derived Maxwell's electromagnetic field equation</li> <li>• The knowledge of boundary layer and application to solve problems</li> </ul>
<p><b>Mathematics CO P20</b></p>	<p style="text-align: center;"><b>Relativistic Cosmology (Optional)</b></p> <ul style="list-style-type: none"> <li>• Derivation De-sitter model and Einstein Field equation with cosmological term. De-sitter model, there derivatives, properties and comparison with the actual universe.</li> <li>• The cosmological principle, Hubble's law, Weyls Postulate and Steady State Cosmological Models.</li> <li>• The motion of particle and light rays in R-W model</li> <li>• How the Friedman-Robertson-Walker metric is an exact solution to the Einstein equations.</li> <li>• The key ideas behind cosmology and the expanding universe</li> </ul>

	<b>P.G Microbiology</b>
<b>Code</b>	<b>Course Outcome</b>
<b>Microbiology CO P1</b>	<p><b>After successful completion of this course, student will perform / analyze/ understand:</b></p> <p style="text-align: center;"><b>Microbial Techniques</b></p> <ul style="list-style-type: none"> <li>• The biological relevance of pH and buffers with reference to ionization of amino acids, proteins, non-protein protoplasmic component, and metabolic reactions.</li> <li>• The principle laws of adsorption and emission of radiation along with techniques of UV-visible, infra-red spectrophotometry, fluorescence, flurometry, flame photometry, NMR and ESR.</li> <li>• Isotopic tracer techniques, labelling detection and measurement of isotopes and kinetics of radioactive disintegration.</li> <li>• The principles, strengths, and limitations of the most important chromatographic techniques along with their applications.</li> <li>• The technical and theoretical knowledge of various electrophoretic techniques along with their design and applications.</li> </ul>
<b>Microbiology CO P2</b>	<p style="text-align: center;"><b>Microbial enzymology</b></p> <ul style="list-style-type: none"> <li>• Classification of enzymes by IUB nomenclature system with their catalytic activity.</li> <li>• The isolation purification, homogeneity test along with constitutive, inducible, marker enzymes.</li> <li>• The enzyme kinetics, effect of various parameters on enzyme catalysis, MM equation, LB plot and bi-substrate enzyme kinetics.</li> <li>• The effect of inhibitor and activator on enzyme catalysis, kinetics of reversible enzymes and mechanism of action of lysozymes.</li> <li>• The theoretical knowledge of mechanism of enzyme action with enzyme and substrate specificity, chemistry of active centers and factors affecting catalysis.</li> </ul>
<b>Microbiology CO P3</b>	<p style="text-align: center;"><b>Microbial physiology and photosynthesis</b></p> <ul style="list-style-type: none"> <li>• The structure and functions of biological membranes, active, passive transport systems, carrier model and ATPase function.</li> <li>• The transformation of energy within living organisms and between living organisms and their environment. It will also help in understanding redox, electron transfer reactions in biological systems, and high energy compounds.</li> <li>• Bacterial and mitochondrial respiration along with enzymes involved in redox reactions and proton translocation.</li> <li>• The oxidative phosphorylation, mitochondrial electron transport and</li> </ul>

	<p>generation of ATP along with coupling mechanism.</p> <ul style="list-style-type: none"> <li>• The microbial photosynthesis systems PS I and PS II and electron transport system, CO<sub>2</sub> fixation, an-oxygenic, oxygenic, halo bacterial photosynthesis.</li> </ul>
<b>Microbiology CO P4</b>	<p style="text-align: center;"><b>Environmental Microbiology</b></p> <ul style="list-style-type: none"> <li>• Environmental microbiology along with concept of biosphere, food chain, ecosystem, community, homeostasis and ecosystem management and sustainable development.</li> <li>• The biogeochemical cycling of nitrogen and biological nitrogen fixation with biochemistry of nitrate reduction.</li> <li>• The biogeochemical cycling of phosphorus, carbon, sulfur and selenium.</li> <li>• Biochemistry and microbiology of acid mine drainage, ecological succession and biotransformation of pesticides.</li> <li>• The concept of biodegradation and bioleaching.</li> </ul>
<b>Microbiology CO P5</b>	<p style="text-align: center;"><b>Biostatistics, Bioinformatics and Computer Applications</b></p> <ul style="list-style-type: none"> <li>• Component of application of biostatistics along with measures of central tendency and dispersion.</li> <li>• Statistical problems related with test of significance, probability, correlation, regression with vital statistics.</li> <li>• The basics of computer system along with the major components, languages, and application software used in a computer.</li> <li>• The various bioinformatics tools used to study protein and nucleotide structures with biological data bases.</li> <li>• The application of bioinformatics in protein structure predictions, software used in bioinformatics and scope of bioinformatics.</li> </ul>
<b>Microbiology CO P6</b>	<p style="text-align: center;"><b>Enzyme Technology</b></p> <ul style="list-style-type: none"> <li>• The basics of enzyme kinetics and the effects of various factors on enzyme activity along with the mechanism of action of lysozymes.</li> <li>• The control of enzyme catalyzed biochemical reactions and the role of multi enzyme complexes and metabolic regulation.</li> <li>• The isoenzymes, allosteric and covalently modulated regulatory enzymes.</li> <li>• compartmentation and immobilization of enzymes and their kinetics with enzyme probes.</li> <li>• Immobilization of microbial enzyme, enzyme engineering with their application and importance.</li> </ul>

<b>Microbiology</b> <b>CO P7</b>	<p style="text-align: center;"><b>Microbial Metabolism</b></p> <ul style="list-style-type: none"> <li>• The carbohydrate metabolism including EMP, HMP, ED pathways along with TCA cycle.</li> <li>• The aerobic metabolism of C1 compounds.</li> <li>• The nucleotide metabolism including biosynthesis and catabolism with inhibitors of nucleotide synthesis.</li> <li>• Microbial metabolism of aromatic compounds and lipid metabolism.</li> <li>• The assimilation of inorganic nitrogen, biosynthesis and catabolism of amino acids.</li> </ul>
<b>Microbiology</b> <b>CO P8</b>	<p style="text-align: center;"><b>Environmental Microbiology and Extremophiles</b></p> <ul style="list-style-type: none"> <li>• The recalcitrant organic compound and concept of bio magnification.</li> <li>• Eutrophication and its management. The causes of eutrophication and its impact on environment.</li> <li>• The study of extremophiles, their role in environment and their types. It will also focus on learning the applications of extremophiles in various applied sectors.</li> <li>• The different water treatment processes, knowledge of water distribution systems and concept of indicator organisms. Importance of water microbiology and various processes involved in water treatment.</li> <li>• The waste water management, its treatment, methane production, application of sewage along with nitrate and sulfate reduction</li> </ul>
<b>Microbiology</b> <b>CO P9</b>	<p style="text-align: center;"><b>Molecular Biology</b></p> <ul style="list-style-type: none"> <li>• The structure of nucleosides, nucleotides, and polynucleotides. Importance of nucleic acid in living system. Reactions of purines and pyrimidines.</li> <li>• The DNA replication mechanisms in eukaryotes, prokaryotes and phages along with DNA repair mechanism.</li> <li>• The mechanism of genetic recombination, transformation, transduction, conjugation. It will also focus on genetic and molecular organization in genome and gene mutation.</li> <li>• Protein synthesis by transcription and translation in prokaryotes and eukaryotes along with the factors and enzymes involved in post transcriptional and post translational process.</li> <li>• The concept of gene regulation in prokaryotes by operon concepts and eukaryotes by regulation at transcriptional, translational level and by gene rearrangement.</li> </ul>
<b>Microbiology</b> <b>CO P10</b>	<p style="text-align: center;"><b>Virology</b></p> <ul style="list-style-type: none"> <li>• The concept of viruses, their origin and evolution general properties, morphology, characteristics, viral assay, viral genetics and nomenclature of viruses. It will also include replication of viruses and mechanism of DNA</li> </ul>

	<p>and RNA synthesis.</p> <ul style="list-style-type: none"> <li>• Epidemiology, pathogenesis, and laboratory diagnosis of viral infections. It will also help in understanding the concept of interferons and antiviral agents.</li> <li>• The laboratory diagnosis of viral infections using various techniques such as microscopy, cultivation of viruses by animal inoculation, chick embryo and tissue culture and serology detection of viral proteins and genetic material.</li> <li>• The structure, pathogenesis, laboratory diagnosis and immunology of various viruses such as pox virus, herpes viruses, adenoviruses, and picorna viruses.</li> <li>• The structure, pathogenesis, laboratory diagnosis and immunology of various viruses such as orthomyxo virus, paramyxovirus, arbovirus, hepatitis virus.</li> </ul>
<p><b>Microbiology CO P11</b></p>	<p style="text-align: center;"><b>Fermentation Technology</b></p> <ul style="list-style-type: none"> <li>• The basics of fermentation technology such as batch and continuous fermentations and the use of various types of fermenters various instruments and equipment used in fermentation industries.</li> <li>• The production of various antibiotics such as penicillin, streptomycin and tetracycline and various anticancer drugs such as interferons, anthracycline and L- asparaginase. Students also learn about various biotechnological applications for the production of vaccines, steroids, hormones and diagnostic kits.</li> <li>• The production of fermented foods and beverages such as cheese, yoghurt, dahi, fermented oriental food, mycotoxin, single cell proteins and whisky.</li> <li>• The production and preservation of fermented foods such as soya souse, sauerkraut, sausages, and baker yeast. It will also help to learn the application of microbial enzymes in food industries and quality assurance in industries.</li> <li>• The biomass production with the help of various bacteria and fungus using different processes. It also helps to learn about importance, sources, desirable characteristics, benefits of probiotics and prebiotics consumption.</li> </ul>
<p><b>Microbiology CO P12</b></p>	<p style="text-align: center;"><b>Immunology</b></p> <ul style="list-style-type: none"> <li>• The basic immunology such as immune system, cell types and organs, specific and non-specific immune mechanisms and immune response such as primary, secondary and immunological memory.</li> <li>• Antigen, antibody, and their various reactions. It will also help to learn about structure and functions of immunoglobulins.</li> <li>• Clinical immunology such as complement system, cell mediated immunity, classical and alternate pathways and functions. Hypersensitivity, immune</li> </ul>

	<p>deficiency diseases. vaccines such as conventional, peptide, subunit and genetically engineered vaccines.</p> <ul style="list-style-type: none"> <li>• Immuno biotechnology and hybridoma technology includes immunization of animals, isolation of stimulated spleen cells.</li> <li>• Monoclonal antibodies their detection and application.</li> </ul>
<b>Microbiology CO P13</b>	<p style="text-align: center;"><b>Biotechnology</b></p> <ul style="list-style-type: none"> <li>• Various enzymes used in recombinant DNA technology and vectors.</li> <li>• genes cloning in prokaryotes and eukaryotes using various methods like isolation of gene, gene transfer, selection and screening of recombinant DNA.</li> <li>• Cloning strategies such as cloning from m-RNA and genomic DNA. Gene their probes, banks, libraries and mapping of gene, polymerase chain reaction and gene amplification.</li> <li>• The concept and different techniques of plant tissue culture and the techniques involved.</li> <li>• The applications of biotechnology in various fields such as agricultural, plants, animal improvement, enzymes, protein engineering and drug designing.</li> </ul>
<b>Microbiology CO P14</b>	<p style="text-align: center;"><b>Clinical Virology</b></p> <ul style="list-style-type: none"> <li>• The contribution of various scientists in the field of plant virology and different plant viruses with their structure, classification, replication, life cycle and epidemiology.</li> <li>• About the life cycle, structure and replication of various bacteriophages such as Ox 174 phage, T4 phage, lambda phage, QB phage, mud phage, and O6 phage.</li> <li>• The oncogenic viruses and difference in their genetic material such as DNA and RNA containing tumor viruses.</li> <li>• Retroviruses such as HIV viruses.</li> <li>• Viruses and non-viral particles such as viroid's and prions.</li> </ul>
<b>Microbiology CO P15</b>	<p style="text-align: center;"><b>Microbial Technology</b></p> <ul style="list-style-type: none"> <li>• The knowledge of isolation, maintenance and handling of industrially important microbial cultures. Students will be able to understand the industrial production of important microbial metabolites and products.</li> <li>• Fermentation of various amino acids from different sources and production of industrially important enzymes.</li> <li>• The knowledge about various enzymes and their applications in different industries. This will also focus on the concept of biosensors and bioreactors.</li> <li>• The production of biogas using the different types of microorganisms and also the production of biofuel, bioethanol, and biodiesel.</li> </ul>

	<ul style="list-style-type: none"> <li>• The concept of bio-fertilizers, bio-pesticides, biotechnology their production and application.</li> </ul>
<b>Microbiology CO P16</b>	<p style="text-align: center;"><b>Medical Microbiology</b></p> <ul style="list-style-type: none"> <li>• The concept of various pathogenic bacteria and their laboratory diagnosis such as <i>Staphylococci</i>, <i>Streptococci</i>, <i>Mycobacterium tuberculosis</i> and <i>M. leprea</i>.</li> <li>• The concept of various pathogenic bacteria and their laboratory diagnosis such as <i>Escherichia</i>, <i>Klebsiella</i>, <i>Proteus</i>, <i>Salmonella</i>, <i>Shigella</i>.</li> <li>• The different pathogenic fungi and their laboratory diagnosis.</li> <li>• The different parasites and their laboratory diagnosis.</li> <li>• The clinical microbiology in which students will learn about different diseases and infections cause by different types of microorganisms.</li> </ul>



	<b>P.G Physics</b>
<b>Code</b>	<b>Course Outcome</b>
<b>Physics CO P1</b>	<p><b>After completion of this course, students will able to perform/ analyze /understand:</b></p> <p><b>Mathematical Physics</b></p> <ul style="list-style-type: none"> <li>• Introduction of the fundamental ideas of the functions of complex variables and develop</li> <li>• Fundamental concepts of Complex Analysis.</li> <li>• Find out the solution of the first-order and second-order differential equation by successive calculation.</li> <li>• Bessel differential equation : Bessel's function of third kind, generating function, orthogonality of Bessel's function.</li> <li>• Also solving matrices and Laplace transformation.</li> </ul>
<b>Physics CO P2</b>	<p><b>Classical Mechanics</b></p> <ul style="list-style-type: none"> <li>• Lagrangian and Hamiltonian approach since classical mechanics ;</li> <li>• the classical background of Quantum mechanics and get familiarized with Poisson brackets and Hamilton -Jacobi equation;</li> <li>• Kinematics and Dynamics of a rigid body in detail and ideas regarding Euler's equations of motion;</li> <li>• Theory of small oscillations in detail along with the basis of Free vibrations etc.</li> </ul>
<b>Physics CO P3</b>	<p><b>Quantum Mechanics-I</b></p> <ul style="list-style-type: none"> <li>• The student will be well-versed in Linear vector spaces, Hilbert space, concepts of basis and operators, and bra and ket Notation.</li> <li>• Both Schrödinger and Heisenberg formulations of time development and their applications;</li> <li>• Theory of angular momentum and spin matrices, orbital angular momentum, and Clebsh - Gordan Coefficient;</li> <li>• Space-time symmetries and conservation laws, theory of identical particles;</li> <li>• Theory of scattering and calculation of scattering cross-section, optical theorem, Born approximation, partial wave analysis ,etc.</li> </ul>
<b>Physics CO P4</b>	<p><b>Computational Methods and Programming</b></p> <ul style="list-style-type: none"> <li>• A strong base in Python language regarding different data types such as lists, sets, dictionaries, etc.</li> <li>• It helps to understand the arrays and matrices and enables data visualization.</li> </ul>

	<ul style="list-style-type: none"> <li>• It gets a wide knowledge of numerical methods in computational Physics that can be used to solve many problems which do not have an analytic solution.</li> <li>• Introduction to programming and study of logic, elementary information about digital computer principles, compilers interprets and operating system, flow charts.</li> <li>• Formats and format statements, list directed and formatted input and output statements, assignment statement.</li> </ul>
<b>Physics</b> <b>CO P5</b>	<p style="text-align: center;"><b>Electrodynamics-I</b></p> <ul style="list-style-type: none"> <li>• The relationship between electrical charge, electrical field, electrical potential, and magnetism.</li> <li>• Calculate the magnitude and direction of the magnetic field for symmetric current distributions using the Law of Biot-Savart and Ampere's Law.</li> <li>• Students have gained a clear understanding of Maxwell's equations and electro magnetic boundary conditions.</li> <li>• Charge distribution in finite region, multipole expansion of potential and fields.</li> <li>• Time varying fields, displacement current, faraday induction.</li> </ul>
<b>Physics</b> <b>CO P6</b>	<p style="text-align: center;"><b>Quantum Mechanics-II Compulsory:</b></p> <ul style="list-style-type: none"> <li>• basic knowledge about advanced techniques like approximation methods for time-independent problems like the WKB approximation ;</li> <li>• the variational equation and its application the ground state of the hydrogen and Helium atom.</li> <li>• Perturbation theory and Interaction of an atom with the electromagnetic field;</li> <li>• Relativistic Quantum Mechanics using Dirac equation, Dirac matrices.</li> <li>• The Klein Gordon equation etc</li> </ul>
<b>Physics</b> <b>CO P7</b>	<p style="text-align: center;"><b>Solid State Physics Compulsory :</b></p> <ul style="list-style-type: none"> <li>• The student is expected to have a basic knowledge of crystal systems and spatial symmetries.</li> <li>• Also able to account for how crystalline materials are studied using diffraction, including concepts like reciprocal lattice and Brillouin zones</li> <li>• It can calculate the rmaland electrical properties in the free-electron model.</li> <li>• Bloch's theorem and what energy bands are, and know the fundamental principles of semiconductors</li> <li>• Dulong and Petit Law, Lattice Specific Heat, etc.</li> </ul>
<b>Physics</b> <b>CO P8</b>	<p style="text-align: center;"><b>Network Theorems and Solid State Devices:</b></p> <ul style="list-style-type: none"> <li>• Field-Effect Transistors, their principles, and applications</li> </ul>

	<ul style="list-style-type: none"> <li>• Introduction to semiconductors, current in semiconductors such as P and N.</li> <li>• learn about LVDT, photodetectors, PV cells, etc, and their working in detail.</li> <li>• Learn about rectifiers and power supplies.</li> <li>• They will learn about Amplifiers: Classification of amplifiers, Class-A, B, AB, and C Amplifiers, Cascading of amplifiers, RC Coupled amplifiers; properties of amplifiers, etc.</li> </ul>
<p><b>Physics CO P9</b></p>	<p style="text-align: center;"><b>Lasers &amp; Laser Applications Elective Interdisciplinary:</b></p> <ul style="list-style-type: none"> <li>• Describe the requirements for a system to act like a laser.</li> <li>• Also, differentiate the various types of lasers and their means of excitation.</li> <li>• It includes the structure and properties of lasers to their performance and intended applications.</li> <li>• Laser induced fluorescence, raman scattering and its applications it also includes laser induced multi-photon processes and their application.</li> <li>• Ultra high resolution spectroscopy with lasers and its application, qualitative treatment of medical and engineering applications of lasers.</li> </ul>

<b>P.G Zoology</b>	
<b>Code</b>	<b>Course Outcome</b>
<b>Zoology CO P1</b>	<p><b>After successful completion of this course, students will be able to perform/ analyze/ understand</b></p> <p style="text-align: center;"><b>Animal Structure and Function (Non-Chordata)</b></p> <ul style="list-style-type: none"> <li>• Definition and basic concepts of biosystematics, taxonomy and classification of Non-chordates, concept of species. Different classification systems.</li> <li>• Nutrition in crustaceans and mollusca, feeding in Bryozoans. Insect flight mechanisms.</li> <li>• Organs and pigments of the respiratory system, Excretory system.</li> <li>• General organization of Nervous system Coelenterata, Annelida, Arthropoda (Crustaceans and Insects), Mollusca (Cephalopod), Echinodermata. Working of sense organs.</li> <li>• Reproductive mechanisms in nonchordates. Metamorphogenesis and molting in insects.</li> </ul>
<b>Zoology CO P2</b>	<p style="text-align: center;"><b>Animal Structure and Function (Chordata)</b></p> <ul style="list-style-type: none"> <li>• Taxonomic procedures, International code of Zoological Nomenclature (ICZN).</li> <li>• The Structure of tooth and dentition in Mammalia. General structure of mammalian skin, endoskeleton. Structure of tooth and dentition in Mammalia, Structural and functional organization of Alimentary canal and digestive glands in vertebrates, with reference to mammalian type.</li> <li>• Characteristics of Respiratory surface, Functional organization of Mammalian lungs, exchange of respiratory gases. Blood: Composition and functions, Haemopoiesis, Lymph and lymphatic system.</li> <li>• Excretory products, General structure and functions of kidneys, Osmoregulation; Functional organization of vertebrate nervous system.</li> <li>• Adaptation for echolocation in animals, Lateral line system in fishes. Electroreception, Flight adaptations in mammals, Aquatic adaptations in mammals, Adaptive radiations in mammals, Migration in birds and fishes.</li> </ul>
<b>Zoology CO P3</b>	<p style="text-align: center;"><b>Gamete Biology</b></p> <ul style="list-style-type: none"> <li>• Morphology, differentiation, functions of gametogenesis and its regulation. Spermatogenesis and its regulation, Gamete specific gene expression, Formation of semen and its composition.</li> <li>• Morphology, Endocrinology, Molecular Biology of Oogenesis and vitellogenesis-morphogen gradient, Ovulation and its regulation. Reaction of sperm, Reaction of egg, Amphimixis.</li> <li>• Creating multicellularity, Characteristics of cleavage divisions, Cleavage types: Gastrulation &amp; formation of germ layers in animals, Embryogenesis, Genomic imprinting,</li> <li>• Assisted reproduction techniques, In vitro fertilization, Multiple ovulation/super ovulations, Collection and cryopreservation of gametes, In vitro gamete maturation, Embryo sexing Y specific probes, Screening of genetic disorders, ICSI and GIFT, Cloning of animals by embryo transfer, Disadvantages of ART</li> <li>• Transgenic Animals. Procedure and Application (MS) Gene Knockout technology: Procedure and Applications. Gene therapies: Ex vivo gene therapy, In vivo gene</li> </ul>

	therapy, Antigens and antisense therapy
<b>Zoology CO P4</b>	<p style="text-align: center;"><b>Genes and Differentiation</b></p> <ul style="list-style-type: none"> <li>• The Types of Cell specification, Cell commitment and differentiation. Characteristics of differentiation, Germ cell determination in nematodes, insects and amphibians, Germ cell migration in amphibians, reptiles, mammals and birds, Organizers and evocators.</li> <li>• Axes and pattern formation in Drosophila, Amphibia and chick; Establishment of body axes in mammals and birds Proximate tissue interactions (instructive and permissive). Homeobox concept in different phylogenic groups.</li> </ul>
<b>Zoology CO P5</b>	<p style="text-align: center;"><b>Molecular Cell Biology</b></p> <ul style="list-style-type: none"> <li>• Bio membranes. Transport across cell membrane &amp; transporters. Membrane potential. Extracellular matrix: Gap junctions and connexins.</li> <li>• Cell Surface Receptors. Modes of cell signaling (autocrine, juxtacrine, paracrine and endocrine), Signaling molecules, Properties of cell surface receptors. G protein-coupled receptors that activate or inhibit adenylyl cyclase. G protein-coupled receptors that regulate ion channels. G protein-coupled receptors that activate phospholipase C.</li> <li>• Cell Signaling: Pathways of Intracellular signal transduction. Features of signal transducing systems, Second messengers, Ion channels and electrical signaling, Signal transduction by G Protein-coupled receptors, Signal transduction by receptor enzymes, JAK-STAT pathway, Smad pathway, Wnt pathway, Hedgehog pathway, Signal Transduction in vision, Gustation and Olfaction.</li> <li>• Cell cycle control, Cyclins &amp; cyclin dependent kinases (CDKs), Role of MPF, DNA replication block &amp; its removal. Cell cycle checkpoints &amp; feedback control. Regulation of CDK-Cyclin Activity, Programmed cell death (Apoptosis) - Definition, mechanism &amp; significance, Cytoskeleton, Microfilaments &amp; microtubules-structure and dynamics, Microfilaments membrane binding proteins &amp; their function. Intermediate filaments &amp; their functions, Role of microtubules in mitosis.</li> <li>• Secretory pathways: Protein synthesis in eukaryotes, Uptake into ER, Co- &amp; Post translational modifications in ER, Protein sorting in Golgi apparatus, Transport of proteins across nuclear membrane, Lysosomal assembly &amp; functions.</li> </ul>
<b>Zoology CO P6</b>	<p style="text-align: center;"><b>Tools and Techniques in Biology</b></p> <ul style="list-style-type: none"> <li>• Principles and uses of measuring instruments like Colorimeter, Spectrophotometer, etc.</li> <li>• Microscopes; Principles and application: Light, phase contrast, fluorescence, Scanning and transmission electron microscopy,</li> <li>• Cell culture techniques- Monolayer and Polylayer. Cell proliferation measurements. Cell viability testing. Cell harvesting methods. Tissue engineering</li> <li>• Cryotechniques; Cryopreservation for cells, tissue, organisms. Cryotechniques for microscopy. Freeze-drying for physiologically active substances. Molecular separation by thin layer chromatography, molecular separation by gas chromatography, high pressure liquid chromatography, ion exchange and affinity chromatography, Electrophoresis</li> <li>• Radioisotope and mass isotope techniques in biology. Sample preparation for radioactive counting. Autoradiography. Metabolic labeling. Magnetic Resonance</li> </ul>

	Imaging. Liquid scintillation spectrophotometry, Radiation dosimetry, Radioactive isotopes and half- life of isotopes, Cerenkov radiation, Immunological techniques based on antigen-antibody interactions.
<b>Zoology CO P7</b>	<p style="text-align: center;"><b>Endocrinology</b></p> <ul style="list-style-type: none"> <li>• The Histology of vertebrate endocrine glands: Pituitary gland, Thyroid gland, Parathyroid gland, Adrenal gland, Pineal and Thymus gland, Melatonin and cancer. Melatonin and depressive disorders. Melatonin and endocrine disorders.</li> <li>• Classification of Hormones , Hormone action at cellular level and genetic level, Hormones in biological clock, Role of hormones in digestion, Hormonal regulation , Hormonal regulation of Growth and Reproduction.</li> <li>• Synthesis, transport (release) and metabolism of steroid hormones. Synthesis, transport and metabolism of T3, T4 and epinephrine, Synthesis transport and metabolism of insulin, Prostaglandins, Ecto-hormones in insects and mammals.</li> <li>• Thyroid hormones and disorders. Parathyroid hormones and disorders, Pituitary hormones and major Disorders, Adrenal Gland hormones and Disorders, Diabetes And Pregnancy, Diabetic Nerve Problems, Autoimmune diabetes, Comparative study of steroid and non-steroid hormones in reproduction.</li> <li>• Hormone replacement therapy, Risks and benefits of Hormone replacement therapy, Other hormones: Rennin, angiotensin, cytokines, Neuroendocrine mechanism in insects and crustacean metamorphosis.</li> </ul>
<b>Zoology CO P8</b>	<p style="text-align: center;"><b>Environment and Ecology (Also GIC)</b></p> <ul style="list-style-type: none"> <li>• The Environment: Physical environment; Biotic environment; Biotic and abiotic interactions. Habitat and niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement. Population ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and k selection); Diversity Index: Simpson 's index, Shannon 's index, Species interactions</li> <li>• Community ecology: Nature, structure and attributes; Levels of species diversity and its measurements; Ecological succession: Types; mechanisms; changes involved in succession; Ecosystem: Structure and function; energy flow and mineral cycling (CNP); Biogeography.</li> <li>• Environmental Pollution, Sources, nature and effects of air pollutants Monitoring and documentation; Major drivers of biodiversity change; 3.3.3. Biodiversity management approaches, 3.3.4. Economics of Biodiversity.</li> <li>• Conservation biology: Principles of conservation, Sanctuaries and National Parks, Project Tiger, Biosphere reserves. Toxicology, Metabolism &amp; effects of heavy metal salts. Formation &amp; effects of free radicals. Biochemistry of Detoxification.</li> <li>• Environmental Monitoring: IGPC ( Inter Government Policy/ Protocol for Climate change), EPA (Environmental Protection Agency), Laws, legislation pertaining to environment, Control, monitoring &amp; surveillance of environment. IPR .</li> </ul>