

## Bajaj College of Science, Wardha

### **Programme Outcomes of M.Sc. programme**

Bajaj College of Science (BCS) offers Bachelor of Science (B.Sc), Master of Science (M.Sc) and Doctor of Philosophy (Ph.D) in two science subjects mainly Chemistry and Botany. The M.Sc. degree at BCS is a specialized academic program that builds on existing strength of five science departments. The MSc offers courses that represents chemistry, zoology, botany, microbiology and mathematics through practical experiences within academic program. The integration occurs through a College - College Alumni- University partnership where academic professional (invited faculty and resource persons) are actively involved in students' education through guest lectures and mentoring experiences and by providing internship opportunities.

### **Programme outcomes (POs) of MSc program will be prepared to:**

- Demonstrate fundamental knowledge of various subjects of Botany.
- Practice professional ethics in conduct of science.
- Develop problem-solving and analytical skills.
- Able to operate and interpret the data from instrumentation.
- Able to use library sources for the academic upbringing of the selected Botany subjects.
- Demonstrate an ability to understand career opportunities in science and technology industries.

### **Programme Specific outcomes (PSOs) in M.Sc. (Microbiology) will be prepared to:**

**PSO1:** Have in depth understanding basic and applied aspects of microbiology and develop inclination towards professional goals specialized in microbiology industry.

**PSO2:** Able to formulate the research projects on microbiology and multidisciplinary fields through literature and laboratory studies.

**PSO3:** Understand microbiology as social endeavor in context to bringing about harmony with nature.

Master of Science (M.Sc.) in Microbiology-

Course outcomes

<b>Title of paper</b>	Microbial metabolism
<b>Course Code</b>	PG-MB(08)-S1-T1

After successfully completing this course, students will be able to:

**CO1:** Students will be able to correlate specific aspects of Bioenergetics and Metabolism

**CO2:** Students will be able to identify and differentiate between major classes of biological molecules like protein and Nucleic acids with its chemistry and metabolism

**CO3:** Students will be able to Gain an understanding of photosynthesis, anoxygenic photosynthesis and chemolithotrophy.

**CO4:** Students will be aware of the mechanism and types of Nitrogen and Sulphur metabolism and methanogenesis.

**CO5:** Overall the course describes the Microbial metabolism in detail

<b>Title of paper</b>	Enzymology and Techniques
<b>Course Code</b>	PG-MB(08)-S1-T2

After successfully completing this course, students will be able to:

**CO1:** Students will be able to understand general characteristics of enzymes(Terminologies) and

**CO2:** Students will learn the different mechanisms of enzyme catalysis.

**CO3:** Students will be able to Gain an understanding of enzyme kinetics and regulation

**CO4:** Students will be able to understanding the various biochemical techniques based on enzymes like biosensors

**CO5:** Overall the course describes the Enzymology and Techniques in detail

<b>Title of paper</b>	Advanced Techniques in Microbiology
<b>Course Code</b>	PG-MB(08)-S1-T3

After successfully completing this course, students will be able to:

**CO1:** Students will be able to understand the important aspects of advance biophysical techniques used in microbiology

**CO2:** Students will learn the working and principles of various instruments like electro[horess, centrifugation and chromatography

**CO3:** Students will gain knowledge of important microscopy techniques from basic to advanced one.

**CO4:** Students will be able to understand the applications of advanced technique in different aspects of life sciences .

**CO5:** This course overall gives the understanding of instrumentation in life sciences, which is needed in industry as well as research laboratories.

<b>Title of paper</b>	Membrane Structure and Signal Transduction
<b>Course Code</b>	PG-MB(08)-S1-T4

After successfully completing this course, students will be able to:

**CO1:** Students will be able to understand the important aspects of cell biology like membranes and organelles.

**CO2:** Students will learn the structure and function of membranes and organelles.

**CO3:** Students will understand the important things about cellular transport and their energetics.

**CO4:** Students will learn about the detailed concept of signal transduction.

**CO5:** This knowledge will increase students' interest in research based on cell biology and signal transduction and they can be hired on such research projects.

<b>Title of paper</b>	Microbiology Practical-I
<b>Course Code</b>	PG-MB(08)-S1-P1

After successfully completing this course, students will be able to:

**CO1:** This course explains the enzyme activity determination of important hydrolytic enzymes

**CO2:** Students will learn about the effect of different physical factors

**CO3:** Students will be able to isolate and purify the enzyme

**CO4:** Students will be able to isolate and identify Nitrogen fixing bacteria such as Azotobacter, Rhizobium etc

**CO5:** students will be able to isolate Siderophore producing bacteria.

<b>Title of paper</b>	Microbiology Practical-II
<b>Course Code</b>	PG-MB(08)-S1-P2

After successfully completing this course, students will be able to:

**CO1:** This course explains the techniques of Genetics and protein biology

**CO2:** Students will learn about Subcellular organelles and isolation of Marker enzymes.

**CO3:** The performance of various molecular techniques will be understood

**CO4:** Students will learn various techniques of protein isolation and analysis techniques

<b>Title of paper</b>	Microbial Methods for Environmental Management (MMEM)
<b>Course Code</b>	PG-MB(08)-S2-T1

After successfully completing this course, students will be able to:

**CO1:** Students will be able to understand the microbial changes induced by organic and inorganic pollutants, factors influencing the eutrophication process and control of eutrophication. Students will also know about the concept of biodeterioration, biodeterioration of woods and pharmaceutical products.

**CO2:** Students will understand the important things about the concept and consequences of Biomagnification of chlorinated hydrocarbons and pesticides.

**CO3:** Students will learn about biotransformations of metals and metalloids, mercury transformations, biotransformation of pesticides such as hexachlorobenzene.

**CO4:** Students will learn about the important branch of microbiology viz: Geomicrobiology in which they would gain detailed understanding of bioleaching of ores, leaching techniques and applications.

**CO5:** Students will understand the concept of Bioremediation, its types and applications. Biomarker gene (antibiotic and heavy metal resistance genes, ice nucleation genes), Bioreporter genes. This knowledge will be helpful for students during their research as the bioremediation approach is having great demand in research.

**CO6:** After learning this course students will be benefited by the knowledge they gain from it as it will be helpful for them in qualifying various competitive exams of government and also other environment institutes.

<b>Title of paper</b>	Microbial metabolites (MMT)
<b>Course Code</b>	PG-MB(08)-S2-T2

**CO1:** Students will be able to understand the important aspects of General account of metabolites, secondary metabolites. Classification, structure and mode of action of secondary metabolites. Plants secondary metabolites: Digitoxine, Salicylic acid, Mycotoxins-Aflatoxin, Ochratoxin, Patulin.

**CO2:** Students will gain good knowledge on the structure and function of a variety of drugs used to control the growth of microorganisms and they will understand the mechanism of action of different drugs like Aminoglycosides, Carbapenems, Microlids, Nitrofurans.

**CO3:** Students will also get knowledge on the structure and function of Hemoglobin, Myoglobin, Melanin and bile pigments. Microbial pigments: Bacteriochlorophylls, Carotenoids of prokaryotes, rhodopsin and accessory pigments (Pulcherrimin, indigoidin, voalecin) Defensive role of pigments.

**CO4:** Knowledge on role of vitamins in life, structure, function and chemistry of different vitamins : Retinol (vitamin A), Riboflavin (vitamin B2), Cyanocobalamin (Vitamin B12) and ascorbic acid (vitamin C) will help students to understand the mechanism of deficiency diseases.

**CO5:** The knowledge gained from this course will be helpful for students while facing the interviews in pharmaceutical industries.

<b>Title of paper</b>	Medical Microbiology and Parasitology (MMP)
<b>Course Code</b>	PG-MB(08)-S2-T3

**CO1:** Students will gain good knowledge on Types, stages of infection, process of infection. Mechanism of bacterial adhesion, colonization and invasion of mucous membranes of respiratory, enteric and urogenital tracts.

**CO2:** Students will also get knowledge on Morphological characteristics, Pathogenesis and Laboratory diagnosis of various pathogenic micro-organisms

**CO3:** Students will learn about pathogenic bacteria pathogenic fungi , Parasites , Helminths

**CO4:** Students will also learn about New emerging infections like Streptococcus suis; community associated Methicillin resistant *Staphylococcus aureus* (MRSA), *Bordetella pertusis*, *Clostridium difficile*, Multi drug resistant tuberculosis.

<b>Title of paper</b>	Immunology and Immunodiagnostics (IID)
<b>Course Code</b>	PG-MB(08)-S2-T4

**CO1:** Students will be able to understand the Overview of the Immune system, Cells involved in immune system, brief concept of Hematopoiesis and about immune cells.

**CO2:** Students will gain detail knowledge on Complement System, Inflammation, Cell Mediated Immunity Antibody-Dependent cell mediated cytotoxicity T-Cell dependent and T-cell independent defense mechanisms. Students will also get knowledge on Transplantation Immunology

**CO3:** Students will understand the concepts of Immunodeficiency disorders, autoimmune diseases in detail.

**CO4:** Students will learn about different immunodiagnostic techniques like Radioimmuno assay, ELISA, Immunofluorescence.

<b>Title of paper</b>	Microbiology Practical-III
<b>Course Code</b>	PG-MB(08)-S2-P1

After successfully completing this course, students will be able to:

**CO1:** students will be able to perform different staining techniques.

**CO2:** Students will learn about isolation of pathogens from clinical samples.

**CO3:** Students will learn conventional and rapid methods of isolation and identification of pathogenic bacteria, fungi and parasites

**CO4:** Students will learn Antibiotic sensitivity testing by various methods

<b>Title of paper</b>	Microbiology Practical-IV
<b>Course Code</b>	PG-MB(08)-S2-P2

After successfully completing this course, students will be able to:

- CO1:** Students will learn principles & methods of diagnostic immunology
- CO2:** students will be able to perform the immunodiffusion technique.
- CO3:** students will be able to perform the technique of immunoelectrophoresis.
- CO4:** Students will be able to perform the technique of Enzyme linked immunosorbent assay (ELISA)

<b>Title of paper</b>	Molecular Biology and Genetics
<b>Course Code</b>	PG-MB(08)-S3-T1

Students will be able to after completion of the course of the following

- CO1:** Students will be able to understand the Repair in Replication and Recombination
- CO2:** Students will be able to understand the gene expression by transcription and translation process
- CO3:** Students will gain the knowledge of the process of gene expression viz: Transcription, Post transcription modification and translation.
- CO4:** Students will understand the important things about various types of DNA repair mechanisms in eukaryotes and prokaryotes.
- CO5:** Students will learn about the detailed concepts of operon systems in bacteria viz: Lac operon in E.coli and its regulation.
- CO6:** Students will also gain detailed knowledge on gene mapping by using conjugation, transduction and transformation. They will also know about bacteriophages and transposons and retroposons.

<b>Title of paper</b>	Recombinant DNA technology and Nanotechnology
<b>Course Code</b>	PG-MB(08)-S3-T2

Students will be able to after completion of the course of the following

- CO1:** Students will be able to understand the important aspects of rDNA technology like cloning, gene sequencing, and other molecular tools.
- CO2:** Students will learn the important molecular techniques like polymerase chain reaction.
- CO3:** Students will also be able to understand important things about nanobiotechnology and its applications.
- CO4:** Students will also learn about tissue culture and stem cell technology.
- CO5:** This knowledge will increase students' interest in research based on molecular biology and in nanobiotechnology. Knowledge of rDNA technology and genetics will offer an opportunity for students to work in various molecular biology laboratories as a research person.

<b>Title of paper</b>	Microbial Diversity, Evolution and Ecology (MDEE) - I
<b>Course Code</b>	PG-MB(08)-S3-T3

Students will be able to after completion of the course

**CO1:** Students will be able to understand the evolutionary processes and theories based on evolution.

**CO2:** Students will learn the important molecular techniques for determining the evolutionary relationships viz: 16S rRNA..

**CO3:** Students will get detailed knowledge on diversity of microorganisms.

**CO4:** Students will also learn about Archaeobacteria and its autotrophy

**CO5:** This knowledge will help students in their practicals and they can have an idea on classification of microbes, taxonomy and phylogeny.

<b>Title of paper</b>	Bioinformatics (BIF) - I
<b>Course Code</b>	PG-MB(08)-S3-T4

Students will be able to after completion of the course of the following

**CO1:** Students will be able to understand the basic concepts of computer organization, Internet, Browser, Homepage, Web applications.

**CO2:** Students will learn the important aspects of databases and its types.

**CO3:** Students will also get detailed knowledge on phylogenetics .

**CO4:** Students will also learn about genomics and gene recognition.

**CO5:** This knowledge will be helpful while working on research projects. Students can get a job opportunity as a data analyst in research institutes and also in bio software developer companies

<b>Title of paper</b>	General Microbiology (GM)
<b>Course Code</b>	PG- MB (08) - S3-T4-FC1

Students will be able to after completion of the course of the following

**CO1:** Students will be able to understand the basic concepts of bacteria, fungi, protozoa, and algae.

**CO2:** Students will be able to learn about various methods of staining to visualize the microorganisms.

**CO3:** Students will learn about basic nutritional requirements of microorganisms and also about the growth of microbes.

**CO4:** Students will understand how to control the growth of bacteria by using different microbiocidal and microbiostatic agents.

**CO5:** Students will learn about bacteriological analysis of water and they will be able to judge the quality of water.

**CO6:** This knowledge will help students in their practical's and they can have a idea on classification of microbes. As they are the students of other subjects and they know very little about microbiology, this course will help them to learn about the topic and they can also use this knowledge in their M.Sc. projects which can lead to interdisciplinary research.

<b>Title of paper</b>	Drugs and Disease Management (DDM)
<b>Course Code</b>	PG- MB (08) - S3-T4-FC1

Students will be able to after completion of the course of the following

**CO1:** Students will be able to understand the history and mechanism of action of various drugs.

**CO2:** Students will learn in detail about antifungal agents.

**CO3:** Students will learn in detail about antitubercular agents.

**CO4:** Students will learn in detail about antiprotozoal agents.

**CO5:** They will also get knowledge on mechanism of drug resistance in microbes.

**CO6:** After learning this course student will be able to work on research projects based on drug microbe interaction and this knowledge of drugs will also help students to qualify various competitive exams like drug inspector etc.

<b>Title of paper</b>	Microbiology Practical-V
<b>Course Code</b>	PG-MB(08)-S3-P1

Students will be able to after completion of the course of the following

**CO1:** Students will be able to isolate genomic and plasmid DNA

**CO2:** Students will be able to amplify and restrict the DNA

**CO3:** Students will get the knowledge of bacterial transformation and cloning

**CO4:** Students will understand the basics of mutation

<b>Title of paper</b>	Microbiology Practical-VI
<b>Course Code</b>	PG-MB(08)-S3-P2

Students will be able to after completion of the course of the following

**CO1:** Students will be able to design the plant tissue culture media.



- CO2:** Students will be able to isolate a single cell from intact plant organs.
- CO3:** Students will be able to determine the starch in plant tissue.
- CO4:** Students will be able to do the phytochemical analysis (qualitative detection) of plant
- CO5:** Students will be able to microscopically identify the cultured cells.

<b>Title of paper</b>	Virology (VIR)
<b>Course Code</b>	PG-MB(08)-S4-T1

- CO1:** Students will learn in detail about Brief outline on discovery of viruses (Origin and evolution), Terminology, Differentiation with other groups of microorganisms.
- CO2:** The course also covers detailed knowledge on Morphology and structure of viruses (size and shape/symmetry). Chemical composition of viruses (viral capsid, spikes, envelopes and types of viral nucleic acids). Assay of Viruses etc.
- CO3:** Students will also understand about bacterial viruses which includes Bacteriophages- Structural organization; life cycle (Extracellular phase; attachment, penetration of nucleic acid, transcription, translation, replication, maturation and release of phage particles) of  $\Phi$ X174, T4, lambda, M13 etc.
- CO4:** Students will also learn about life cycle, pathogenesis and laboratory diagnosis of plants and animal viruses which is very important for them as sometimes they have to work on research projects related to plants and animal diseases.
- CO5:** Students will also learn about diagnosis & antiviral drugs.

<b>Title of paper</b>	Microbial Fermentation Technology (MFT)
<b>Course Code</b>	PG-MB(08)-S4-T2

- CO1:** Students will learn in detail about Bioreactors, its types, etc.
- CO2:** The course also covers detail knowledge on Growth kinetics and Monod's Model, Substrate accelerated death, specific growth rate, stringent response, Ntr and Pho system, growth limiting substrate, maintenance energy, growth yield and product formation
- CO3:** Students will also understand about downstream processes: types of processing units and systems, Storage and packaging methods.
- CO4:** Course also covers information about scale up and downstream processes.
- CO5:** Course also includes important methods for production of valuable products viz: Biofuels, antibiotics, organic acids, and also food and healthcare products.

<b>Title of paper</b>	Microbial Diversity, Ecology and Biostatistics (MDEB) – II
<b>Course Code</b>	PG-MB(08)-S4-T3-EL2

**CO1:** Students will understand in detail about concepts of Microbial Ecosystems, Population, communities, homeostasis, Diversity indices, dominance indices, information statistics indices, Shannon index, Brillouin Index, Learn about genetic structure of population & Hardy-Weinberg Law

**CO2:** Students will learn about different microbial interactions like Competition, coexistence, syntrophy, commensalism, Mutualism, predation, parasitism, antagonism.

**CO3:** Students will understand the concept of sustainable development.

**CO4:** Students will learn methods of sampling, Collection & Presentation of statistical data, Standard deviation, phylogenetic clustering. This will help them to handle the data collected during their research work.

<b>Title of paper</b>	Vaccines and Delivery system ( VD )
<b>Course Code</b>	PG-MB(08)-S4-T4

**CO1:** Students will learn the important aspects of Vaccines such as Definition and discovery of vaccines. Active and passive prophylactic measures.

**CO2:** Students will also learn about the Contents and immunization schedule of important vaccines viz: BCG, Hepatitis vaccine, Influenza vaccine, Polio vaccine (Inactivated, live attenuated ), DPT MMR etc.

**CO3:** Students will also learn about the Advanced vaccines viz: HIV vaccines, Herpes simplex viral vaccines etc.

**CO4:** This course also covers important aspects of the Drugs & vaccines delivery system.

<b>Title of paper</b>	Microbiology Practical-VII
<b>Course Code</b>	PG-MB(08)-S4-P1

**CO1:** Students will learn how to Isolate viruses from water sources.

**CO2:** Students will learn how to carry out microbiological examinations of food samples.

**CO3:** This course also covers Production of penicillin in the lab and its estimation.

**CO4:** Students will understand Determination of microbial reaction kinetics in a fed batch system.

**CO5:** Students will perform experiment on determination of the parameters of oxygen transfer.

**CO6:** Students will also learn about how to Immobilize Enzymes.

<b>Title of paper</b>	PROJECT WORK
<b>Course Code</b>	PG-MB(08)-S4-PJ

After completion of project work students will gain/able to:

**CO1:** Students will learn how to do literature survey and to plan

**CO2:** Students will learn how to locate a problem

**CO3:** Students will perform research work on various topics that will impart deeper knowledge of facts & methods in Microbiology / life science.

**CO4:** Students will be capable of contributing to research and development work.

**CO5:** Students will be able to plan and use adequate methods to conduct qualified tasks in given frameworks

**CO6:** Students will be able to clearly present and discuss the conclusions as well as the knowledge and arguments that form the basis for these findings. They will learn to evaluate their work.

**Programme Specific outcomes (PSOs) in M.Sc. (Chemistry) will be prepared to:**

**PSO1:** Have in depth understanding basic and applied aspects of chemistry and develop inclination towards professional goals specialised in chemistry industry.

**PSO2:** Able to formulate the research projects on chemistry and multidisciplinary fields through literature and laboratory studies.

**PSO3:** Understand chemistry as social endeavor in context to bringing about harmony with nature.

**Master of Science (M.Sc.) in Chemistry-**

Course outcomes

<b>Title of paper</b>	Inorganic Chemistry
<b>Course Code</b>	PG-CHE(02)-S1-T1

After successfully completing this course, students will be able to gain understanding of:

**CO1:** Importance of various theories in determining the stereochemistry and bonding of various molecules.

**CO2:** Magnetic and electronic properties of complexes for structure elucidation.

**CO3:** Structure and reactivity of boranes.

**CO4:** Validate the role of bioinorganic chemistry in every day action.

<b>Title of paper</b>	Organic Chemistry
<b>Course Code</b>	PG-CHE(02)-S1-T2

After successfully completing this course, students will be able to gain an understanding of:

**CO1:** Fundamental knowledge of reactive intermediate, chemical bonding & aromaticity.

**CO2:** 3-D aspects of organic molecules.

**CO3:** Aliphatic nucleophilic substitution reaction.

**CO4:** Aromatic nucleophilic and electrophilic substitution reactions.

<b>Title of paper</b>	Physical Chemistry
<b>Course Code</b>	PG-CHE(02)-S1-T3

After successfully completing this course, students will be able to:

**CO1:** Derive the Maxwell's relations and understand third law of thermodynamics and related concepts.

**CO2:** Understand various concepts related to systems with variable compositions such as chemical potential, fugacity etc

**CO3:** Realize application of phase rule to study of some important one, two and three component systems.

**CO4:** Understand the concept of number and mass average molecular mass of macromolecules and their methods of determination.

**CO5:** Learn modern concepts and theories of reaction dynamics.

<b>Title of paper</b>	Analytical Chemistry
<b>Course Code</b>	PG-CHE(02)-S1-T4

After successfully completing this course, students will be able to:

**CO1:** Express the role of analytical chemistry in science.

**CO2:** Explain the fundamentals of analytical chemistry and steps of a characteristic analysis.

**CO3:** Compare & express qualitative and quantitative methods.

**CO4:** Evaluate the analytical data in terms of statistics.

**CO5:** Understanding fundamentals of Separation techniques like Chromatography & solvent extraction.

**CO6:** Explain the theoretical principles and important applications of classical analytical methods within titration (acid/base titration, complexometric titration, redox titration, precipitation titration), and various techniques within gravimetric methods.

**CO7:** Explain the theoretical principles of selected instrumental methods colorimetry & Spectrophotometry.

<b>Title of paper</b>	Inorganic Chemistry Practical
<b>Course Code</b>	PG-CHE(02)-S1-P1

After successfully completing this course, students will be able to:

**CO1:** Synthesize various inorganic compounds, purify and characterize them.

**CO2:** Perform qualitative and quantitative analysis of different compounds and mixtures.

**CO3:** Appreciate the procedure for inorganic analysis.

<b>Title of paper</b>	Physical Chemistry Practical
<b>Course Code</b>	PG-CHE(02)-S1-P2

After successfully completing this course, students will be able to:

**CO1:** Learn the determination of important quantities of liquids such as volume contraction on mixing and activation parameters of viscous flow.

**CO2:** Understand the determination of the critical micelle concentration (CMC) of a given surfactant and molecular mass of a polymer.

**CO3:** Know how to determine heat of dilution and also study effect of impurity on CST in phenol-water systems.

**CO4:** Understand determination of distribution coefficient, know how to construct the phase diagrams of two components system, find the mutual solubility of glycerol-*m*-toluidine.

**CO5:** Be able to determine rate constant, equilibrium constant and order of various reactions.

**CO6:** Learn to employ conductometry, potentiometry and pH metry for different studies.

<b>Title of paper</b>	Inorganic Chemistry
<b>Course Code</b>	PG-CHE(02)-S2-T1

After successfully completing this course, students will be able to gain knowledge of:

**CO1:** Reaction mechanism governing the substitution reaction substitution and electron transfer reactions in transition metal complexes.

**CO2:** Structure and bonding in metal carbonyls and metal nitrosyls.

**CO3:** Occurrence of metal-metal bonds in metal clusters and its significance.

<b>Title of paper</b>	Organic Chemistry
<b>Course Code</b>	PG-CHE(02)-S2-T2

After successfully completing this course, students will be able to gain understanding of:

**CO1:** Various reactions involved in addition to C-C and C-O multiple bond.

**CO2:** Basic concepts in molecular rearrangement & elimination reaction.

**CO3:** Types and mechanism of free radical reactions.

**CO4:** Principles and advantages of green chemistry.

<b>Title of paper</b>	Physical Chemistry
<b>Course Code</b>	PG-CHE(02)-S2-T3

After successfully completing this course, students will be able to:

**CO1:** Derive the wave functions for particle in three dimensional box and hybrid orbitals: understand the concept of degeneracy and solve related numericals.

**CO2:** Understand faradic-nonfaradic processes, thermodynamics of cell, electrochemical potentials and some important fuel cells.

**CO3:** Realize important aspects related to decay kinetics and nuclear reactors.

**CO4:** Learn the basics of solid state chemistry and gain some understanding of crystal defects and nonstoichiometry.

**CO5:** Know the important concepts of statistical thermodynamics with preliminary idea of Maxwell Boltzmann, Bose Einstein, Fermi Dirac statistics.

**CO6:** Derive important adsorption isotherms as well as realize some important aspects of micelles.

<b>Title of paper</b>	Analytical Chemistry
<b>Course Code</b>	PG-CHE(02)-S2-T4

After successfully completing this course, students will:

**CO1:** Be able to plan for sampling and understand how different sampling methods can be used in speciation studies.

**CO2:** Be familiar with Stoichiometric and sub-stoichiometric reactions and calculations.

**CO3:** Understand the theoretical principles of modern separation techniques Gas chromatography & HPLC.

**CO4:** Get introduced to new separation method Supercritical fluid chromatography.

**CO5:** Get knowledge of the theoretical principles of modern analytical techniques AAS.

**CO6:** Realize the theoretical principles of electroanalytical techniques Polarography & Ampereometry.

<b>Title of paper</b>	Organic Chemistry Practical
<b>Course Code</b>	PG-CHE(02)-S2-P1

After successfully completing this course, students will gain an understanding of:

**CO1:** Separation and analyze the different component mixtures of simple organic compounds.

**CO2:** Purification, Crystallization, and different Distillation processes.

**CO3:** How to calculate a limiting reagent, yield, and percent yield

**CO4:** Synthesis using substitution and condensation reactions.

**CO5:** Single step & multistep synthesis.

<b>Title of paper</b>	Analytical Chemistry Practical
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<b>Course Code</b>	PG-CHE(02)-S2-P2
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After successfully completing this course, students will gain an understanding of:

**CO1:** Performing classical analytical experiments, and make observations and assessments of important factors that could affect the analytical result.

**CO2:** Use of digital tools MS-Excel to present chemical analytical work.

**CO3:** Understanding of methods for calibration and sampling applied to quantitative analysis.

**CO4:** Understanding the application of analytical methods based on titrations, separations, electrochemical measurements, and spectroscopy at an introductory level.

<b>Title of paper</b>	Special I-Organic Chemistry
<b>Course Code</b>	PG-CHE(02)-S3-T1

After successfully completing this course, students will:

**CO1:** Gain the knowledge of about theory/principal of photochemistry, types of photochemical reactions and its applications in organic synthesis.

**CO2:** Understand the basis of pericyclic reactions, its types and applications in chemistry.

**CO3:** Learn the synthesis and synthetic applications of oxidizing agents in organic chemistry.

**CO4:** Learn the synthesis and applications of reducing agents in organic chemistry.

**CO5:** Understand the chemistry of some phosphorous, sulphur, silicon and boron compounds with respect to its preparation, synthetic applications and stereochemistry.

<b>Title of paper</b>	Special II-Organic Chemistry
<b>Course Code</b>	PG-CHE(02)-S3-T2

After successfully completing this course, students will:

**CO1:** Gain the knowledge of classification, occurrence, structure determination, stereochemistry and synthesis of terpenoids and porphyrins.

**CO2:** Understand the role, classification, structure determination, stereochemistry, synthesis and biosynthesis of some alkaloids and prostaglandins.

**CO3:** Learn the chemistry of steroids and plant pigments.

**CO4:** Recognize the classification, structure and chemistry of some carbohydrates.

**CO5:** Understand the chemistry of amino acids, proteins and peptides.



<b>Title of paper</b>	Elective- Environmental Chemistry-I
<b>Course Code</b>	PG-CHE(02)-S3-T3

After successfully completing this course, students will gain an understanding of:

**CO1:** Biosphere, Lithosphere, Hydrosphere and Atmosphere, Ecological principles- aspects of ecology, classification, types of ecosystems 3-D aspects of organic molecules.

**CO2:** Origin, physico-chemical properties of water.

**CO3:** Composition of the atmosphere, temperature, stratospheric ozone, green house effect, green house gases.

**CO4:** Chemical and mineralogical composition of soil, classification of soil, types of soil- saline and alkaline, physical properties.

<b>Title of paper</b>	Elective- Polymer Chemistry-I
<b>Course Code</b>	PG-CHE(02)-S3-T3

After successfully completing this course, students will:

**CO1:** Be abreast with basic concept, raw materials, nomenclature and classification of polymers of polymers.

**CO2:** Understand types of polymerization with their mechanisms.

**CO3:** Realize concepts of polymer molar mass and important methods of determination.

**CO4:** Gain an understanding of important physical characteristics of polymers

**CO5:** Have the knowledge about synthesis and application of some commercial and functional polymers

<b>Title of paper</b>	Elective- Medicinal Chemistry-I
<b>Course Code</b>	PG-CHE(02)-S3-T3

After successfully completing this course, students will:

**CO1:** Be abreast with basic concept related to drug design.

**CO2:** Understand important aspects of pharmacokinetics and pharmacodynamics.

**CO3:** Realize mode of action and synthesis of some common diuretics, analgesics and antipyretics.

**CO4:** Gain an understanding of synthesis and uses of important cardiovascular drugs and antineoplastic agent

**CO5:** Have the knowledge about synthesis and action of common psychoactive drugs, coagulants and anti-coagulants

<b>Title of paper</b>	Spectroscopy
<b>Course Code</b>	PG-CHE(02)-S3-T4

After successfully completing this course, students will:

**CO1:** Know the basic of symmetry elements and symmetry operations.

**CO2:** Learn to form multiplication table of  $C_{2V}$ ,  $C_{3V}$  and character tables of  $H_2O$  and  $NH_3$  using Great Orthogonality Theorem.

**CO3:** Apply character table in selection rules of IR, Raman and electronic spectroscopy which help them in competitive exam like NET, SET etc.

**CO4:** Understand about Microwave and Mossbauer spectroscopy.

**CO5:** Learn to solve numerical for determination of organic molecules based on IR spectral data and Raman spectroscopy.

**CO6:** Realize diffraction techniques viz. X-ray, electron and neutron diffraction.

<b>Title of paper</b>	Organic Chemistry Practical
<b>Course Code</b>	PG-CHE(02)-S3-P1

After successfully completing this course, students will gain an understanding of::

**CO1:** Quantitative estimation of vitamin "C", formaldehyde by Iodometry.

**CO2:** Quantitative estimation of phenol, amine, glucose & carbonyl compounds.

**CO3:** Isolation of organic compound (caffeine, casein, dipicrate,  $\beta$ -carotene etc.) from natural source (tea leaves, milk, tobacco, carrot etc.).

**CO4:** Qualitative analysis of Separation of the components of a mixture of three organic compounds.

<b>Title of paper</b>	Elective-Environmental Chemistry Practical
<b>Course Code</b>	PG-CHE(02)-S3-P2

After successfully completing this course, students will gain an understanding of::

**CO1:** Sampling of tap-water.

**CO2:** Determination of physico –chemical characteristics of water.

**CO3:** Determination of acidity and alkalinity.

**CO4:** Determination of DO, COD, and BOD of water sample.

**CO5:** Analysis of different water and soil samples.

<b>Title of paper</b>	Elective - Polymer Chemistry Practical
<b>Course Code</b>	PG-CHE(02)-S3-P2

After successfully completing this course, students will:

**CO1:** Be adept at synthesizing known polymers.

**CO2:** Be able to characterize the various samples of polymers.

**CO3:** Know methods of purification and fractionation of polymer.

**CO4:** Understand ways to study magnetic and electrical properties of polymers.

**CO5:** Realize thermal analysis, crystallinity, swelling and solubility parameters of polymers and dielectric behavior of polymers.

**CO6:** Be able to study kinetics of polymerization

<b>Title of paper</b>	Elective - Medicinal Chemistry Practical
<b>Course Code</b>	PG-CHE(02)-S3-P2

After successfully completing this course, students will:

**CO1:** Be able to analyze and estimate drugs by using classical as well as instrumental methods.

**CO2:** Know how to synthesize, purify and identify some common drugs.

<b>Title of paper</b>	Special I-Organic Chemistry
<b>Course Code</b>	PG-CHE(02)-S4-T1

After successfully completing this course, students will:

**CO1:** Understand the carbanion chemistry and its applications in various organic name reactions.

**CO2:** Gain the knowledge about properties, synthesis and applications of organometallic reagents of Li, Mg, Zn, Cu, Hg etc.

**CO3:** Do the applications of organometallic reagents of transition metals in organic synthesis.

**CO4:** Learn the fundamentals of advanced stereochemistry and also will be able to apply it in asymmetric synthesis.

**CO5:** Understand and apply the concept of protection and deprotection of functional groups in organic chemistry.

**CO6:** Design the organic synthesis based on retrosynthetic analysis.

<b>Title of paper</b>	Special II-Organic Chemistry
<b>Course Code</b>	PG-CHE(02)-S4-T2

After successfully completing this course, students will:

**CO1:** Gain the knowledge of enzymes, its catalysis and mechanism of action.

**CO2:** Understand the role, structures and biological functions of co-enzymes.

**CO3:** Learn the synthesis and reactions of some heterocyclic compounds.

**CO4:** Know the chemistry of nucleic acids, lipids and vitamins.

**CO5:** Understand the classification, structure and applications of some dyes and polymers.

**CO6:** Gain the knowledge of pharmaceutical chemistry with respect to classification, structure, synthesis and applications of some drugs/medicines.

<b>Title of paper</b>	Elective- Environmental Chemistry-II
<b>Course Code</b>	PG-CHE(02)-S4-T3

After successfully completing this course, students will gain an understanding of:

**CO1:** Type of pollutants and their sources, UV-visible spectrophotometry, AAS, flame photometry, XRF, ICP-AES) & chromatographic (GC and HPLC) techniques.

**CO2:** Chemistry of gaseous, liquid and solid fuels- gasoline and additives, antiknock agents.

**CO3:** Impact of toxic chemicals on enzymes, Biochemical effects of As, Cd, Pb and Hg, their metabolism, toxicity and treatment Principles and advantages of green chemistry.

**CO4:** Types and sources of soil pollution and Control of soil pollution.

<b>Title of paper</b>	Elective- Polymer Chemistry-II
<b>Course Code</b>	PG-CHE(02)-S4-T3

After successfully completing this course, students will:

**CO1:** Understand the important basic concepts of polymer chemistry.

**CO2:** Know the types and techniques of polymerization processes

**CO3:** Gain knowledge about important polymer characterization techniques.

**CO4:** Know synthesis and application of some important biomedical, inorganic, coordination and diene based polymers

<b>Title of paper</b>	Elective- Medicinal Chemistry-II
<b>Course Code</b>	PG-CHE(02)-S4-T3

After successfully completing this course, students will:

**CO1:** Understand the legal aspects related to drugs.**CO2:** Know the statistical methods for validation of results of analytical process.

**CO3:** Gain knowledge about role and few examples of antidiabetic agents, anti-viral agents, anti-malarial agents, local anti-infective drug.

**CO4:** Know important aspects of histamines and antihistamic agents, antibiotics, anthelminitics, antiamoebic drugs and anti-inflammatory drugs.

<b>Title of paper</b>	Spectroscopy
<b>Course Code</b>	PG-CHE(02)-S4-T4

After successfully completing this course, students will:

**CO1:** Know Woodward–Fiesher rules for the determination of structure determination of organic molecules by UV spectroscopy.

**CO2:** Understand basic principles and applications of photoelectric spectroscopy.

**CO3:** Learn the various concepts of  $H^1$ ,  $F^{19}$ , NMR spectroscopy and structure determination of organic molecules.

**CO4:** Understand the principle of ESR and its application to study free radicals.

**CO5:** Solve problems based on mass spectral data.

**CO6:** Application of FT- NMR, COSY, HECTOR, NOSEY, DEPT, INEPT, APT, INADEQUATE techniques.

**CO7:** Structure elucidation using combined techniques including UV, IR, NMR, and mass spectroscopy.

<b>Title of paper</b>	Organic Chemistry Practical
<b>Course Code</b>	PG-CHE(02)-S4-P1

After successfully completing this course, students will gain an understanding of::

**CO1:** Estimate and analyze the various elements quantitatively by classical techniques.

**CO2:** Analyze and to estimate the given organic compound quantitatively based on spectrophotometric /calorimetric/other instrumental techniques.

**CO3:** Do the multi step organic synthesis of various organic compounds which has synthetic /biological/industrial importance.

**CO4:** Learn the fundamentals as well as technical skills of handling the chemicals, reactions, procedures and products.

**CO5:** Elucidate the structure of unknown organic compound on the basis of various spectral data (UV, IR,  $^1H$  and  $^{13}CNMR$  and Mass).

<b>Title of paper</b>	Elective-Environmental Chemistry Practical
<b>Course Code</b>	PG-CHE(02)-S4-P2

After successfully completing this course, students will gain an understanding of::

- CO1:** Sampling of tap-water.
- CO2:** Determination of physico –chemical characteristics of water.
- CO3:** Determination of acidity and alkalinity.
- CO4:** Determination of DO, COD, and BOD of water sample.
- CO5:** Analysis of different water and soil samples.

<b>Title of paper</b>	Project
<b>Course Code</b>	PG-CHE(02)-S4-P2

After successfully completing this course, students will gain an understanding of:

- CO1:** Literature survey.
- CO2:** Collection of data, Research methodology.
- CO3:** Analysis of the results obtained.
- CO4:** Referencing methods for the dissertations.
- CO5:** Concluding the research methodology.

**Programme Specific outcomes (PSOs) in M.Sc. (Botany) will be prepared to:**

**PSO1:** Have in depth understanding basic and applied aspects of botany and develop inclination towards professional goals specialised in botany industry.

**PSO2:** Able to formulate the research projects on botany and multidisciplinary fields through literature and laboratory studies.

**PSO3:** Understand botany as social endeavor in context to bringing about harmony with nature.

**Master of Science (M.Sc.) in Botany  
Course outcomes**

<b>Title of paper</b>	<b>Microbiology, Algae, Fungi, Microscopy &amp; Centrifugation</b>
<b>Course Code</b>	PG-BOT (06)-S1-T1

After successfully completing this course, students will have the knowledge of

**CO1:** General history of Microbiology; structure, morphology, reproduction in Bacteria; morphology and reproduction of viruses like TMV, Bacteriophage; general account, ultrastructure, nutrition, reproduction, economic importance of bacteria, archaebacteria and cyanobacteria.

**CO2:** Classification, diversity, thallus organization, life cycle, economic importance of Algae (*Volvox*, *Ulothrix*, *Gracillaria*, *Padina*), Lichens and Mycorrhiza.

**CO3:** Classification, Cytology, General account, life cycle, economic importance of Fungi like *Penicillium*, *Plasmodiophora*, *Perenospora*, *Cunninghamella*, *Phyllactinia*, *Chaetomium*.

**CO4:** Principle, working, application of microscopy and microscopic techniques; preparation of molar solutions, stock solution, pH measurements and preparation of buffers; Principle and application of centrifugation techniques.

<b>Title of paper</b>	<b>Bryophytes, Pteridophytes &amp; Plant Microtechniques</b>
<b>Course Code</b>	PG-BOT (06)-S1-T2

After successfully completing this course, students will have the knowledge of

**CO1:** General Characters, classification system, ecology of Bryophytes, fossil history of Bryophytes and evolution of sporophyte, also the general account of Hepaticopsida, Anthocertopsida, Bryopsida.

**CO2:** General Characters, classification system, distribution of Pteridophytes like Psilopsida, Lycopsida, Sphenopsida and evolution of Stele.

**CO3:** Salient features of Calamitales, Life cycle of *Lycopodium*, *Osmunda*, *Marsilea*, *Ophioglossum*, *Azolla*, *Gleichenia*, *Dryopteris*, cultivation and maintenance of ornamental ferns.

**CO4:** Staining procedures, classification and chemistry of stains, reactive dyes and fluorochromes, cytogenetic techniques with smear and squash materials.

<b>Title of paper</b>	<b>Paleobotany, Gymnosperms, Spectrophotometry &amp; Chromatography</b>
<b>Course Code</b>	PG-BOT (06)-S1-T3

After successfully completing this course, students will have the knowledge of  
**CO1:** Theories of preservation of plant fossils, age determination, geological time scale; systematics, reconstruction and nomenclature of fossils; applies aspects of paleobotany.

**CO2:** Comparative morphology and evolutionary trends of Gymnosperms like Cordaitales, Caytoniales, Glossopteridales, Pteridospermales, Cycadales, Cycadeoidales.

**CO3:** General account and relationships of Gymnosperms viz Pentoxylales, Gnetales, Ephedrales, Ginkgoales, Coniferales.

**CO4:** Principle, working and application of instruments like Spectrophotometer and chromatography.

<b>Title of paper</b>	<b>Cytology, Genetics &amp; Methods To Study Cell / Tissue Structure</b>
<b>Course Code</b>	PG-BOT (06)-S1-T4

After successfully completing this course, students will have the knowledge of

**CO1:** Mendel's laws of inheritance, multiple alleles and isoalleles, gene interactions,, suppressors and pleiotropic genes; multigene families; extrachromosomal inheritance, chromatin organization.

**CO2:** Karyotype analysis and evolution, banding patterns, chromosomal aberrations, and their use in chromosome mapping; population genetics.

**CO3:** Molecular basis of gene mutations; transposable genetic elements; plant genetic resources, epigenetics.

**CO4:** Methods to study cell and tissue structure through whole mounts, peel mounts, squash preparations; Tissue preparations; preparation of thin sections.

<b>Title of paper</b>	<b>Botany Practical-I</b>
<b>Course Code</b>	PG-BOT (06)-S1-P1

After successfully completing this course, students will have the knowledge of

**CO1:** Classification, general account and identification of Algae on the basis of morphological and microscopic characters

**CO2:** Classification, general account and identification of Fungi on the basis of morphological and microscopic characters; Symptoms of bacterial and fungal disease in some diseased plants



**CO3:** Morphological and reproductive characters of Bryophytes and preparation of permanent slides.

**CO4:** Morphological, anatomical and reproductive characters of Pteridophytes and preparation of permanent micro preparations.

<b>Title of paper</b>	<b>Botany Practical-II</b>
<b>Course Code</b>	PG-BOT (06)-S1-P2

After successfully completing this course, students will have the knowledge of

**CO1:** Comparative study of vegetative and reproductive parts of Gymnosperms.

**CO2:** Permanent micro preparations, important fossil gymnosperms, handling and performing experiments using spectrophotometer and chromatography

**CO3:** Mitotic and meiotic cell divisions; effect of mutagens on cell division.

**CO4:** Preparation of Karyogram, chromosome map; fixation, preservation, clearing and maceration of plant materials.

<b>Title of paper</b>	<b>Plant Physiology, Biochemistry and Analytical Pharmacognosy</b>
<b>Course Code</b>	PG-BOT (06)-S2-T5

After successfully completing this course, students will have the knowledge of

**CO1:** Scope of Plant Physiology, pigments in plants, light harvesting system and the physiology of photosynthesis and respiration.

**CO2:** Biosynthesis and physiological effect of plant hormones; sensory photobiology; nomenclature, classification and kinetics of enzymes.

**CO3:** Water transport, solute transport and photo assimilate translocation in plants; carbohydrate metabolism, lipid metabolism, protein metabolism, amino acid metabolism, Nitrogen metabolism.

**CO4:** Identification of plants; Herbaria preparations; methods of herbal extraction; herbal preparations.

<b>Title of paper</b>	<b>Plant Development, Reproduction and Phytochemistry</b>
<b>Course Code</b>	PG-BOT (06)-S2-T6

After successfully completing this course, students will have the knowledge of

**CO1:** Plant growth kinetics and patterns of growth, seedling growth, leaf growth and differentiation, root development and phytohormones.

**CO2:** Plant development and reproduction, flower development, pollination mechanisms and vectors; development of male and female gametophyte.

**CO3:** Stages in Plant reproduction, pollen-pistil interaction, fertilization, seed development and fruit growth, growth latent life, senescence and programmed cell death.

**CO4:** Basics of Phytochemistry, active principles and methods of testing phytochemicals from some important medicinal plants.

<b>Title of paper</b>	<b>Cell, Molecular Biology- I &amp; Data Collection, Documentation &amp; Photography</b>
<b>Course Code</b>	PG-BOT(06)-S2-T7

After successfully completing this course, students will be able to

**CO1:** Illustrate that fundamental structural units, define the function of cell wall, plasma membrane, plasmodesmata.

**CO2:** Explain the organization of cell, its shape and motility, ultrastructure, organization and function of nucleus, distinguish DNA replication between prokaryotes and eukaryotes.

**CO3:** They know mechanisms of stress effect on plants, plant resistance against stresses, their acclimation and adaptation to environment. They understand structural and functional changes of photosynthetic apparatus against stresses and possibility of their elimination.

**CO4:** Exhibit clear and concise communication of scientific data in the form of tables and graphs, basic aspects of field photography.

<b>Title of paper</b>	<b>Angiosperms-I, Ethnobotany &amp; Scientific Writing</b>
<b>Course Code</b>	PG-BOT(06)-S2-T8

After successfully completing this course, students will have the knowledge of

**CO1:** The habit of the angiosperm plant body, vegetative characteristics, reproductive characteristics and plant morphology.

**CO2:** Understanding of plant morphology terminologies and identifying morphological peculiarities. Understand the systems of classification of angiosperms, nomenclature and interdisciplinary approaches. Recognize members of the major angiosperm families by identifying their diagnostic features and economic importance.

**CO3:** Understand the fundamental principles of biosystematics study, population concept, phenotypic plasticity, methods of biosystematics study, Numerical taxonomy, and cladistics in taxonomy; salient features of ICBN for plant nomenclature; definition scope and significance of ethnobotany.

**CO4:** Understand basic principles of scientific writing, argue persuasively for a research idea using references to published research, correctly use and reference source material according to journal standards and understand the publication process

<b>Title of paper</b>	<b>Botany Practical-III</b>
<b>Course Code</b>	PG-BOT(06)-S2-P3

After successfully completing this course, students will have the knowledge of

**CO1:** Practical knowledge of effect of various factors on enzyme activity, rate of reaction of enzyme, enzyme kinetics, substrate concentration activity of enzyme.

**CO2:** Methodology to determine the total carbohydrate content, pectic substances, enzymes, chlorophyll a/ chlorophyll b content and their absorption spectrum, different methods of drug adulteration and testing of herbal drugs, secondary metabolites.

**CO3:** Study of different tissue systems, meristems, vascular and cork cambium, anomalies in primary and secondary structure of stem, cytohistological zonation in the SAM, phyllotaxy, anatomical characterization of different plant leaves, etc.

**CO4:** Various practical experiments related to plant development, microsporogenesis, different pollination mechanisms, Breeding techniques, seed dormancy, testing of different drugs and to isolate active principles.

<b>Title of paper</b>	<b>Botany Practical-IV</b>
<b>Course Code</b>	PG-BOT(06)-S2-P4

After successfully completing this course, students will be able to

**CO1:** Apply a basic core of scientific and quantitative knowledge to enhance understanding of cell structure and function at the molecular level (Chromosomes, DNA, etc.)

**CO2:** Explain, critically evaluate and discuss experimental results from basic research within the field of molecular biology and biochemistry and plant stress responses.

**CO3:** Describe, Identify, classify the plant scientifically and characterize the plants morphologically, anatomically, cytologically, embryologically.

**CO4:** Prepare reference list, prepare poster and powerpoint presentations, understand the use of abbreviations, units and nomenclature in scientific writing.

<b>Title of paper</b>	<b>Plant Ecology, Conservation Biology and Herbal Cosmetics &amp; Medicines</b>
<b>Course Code</b>	PG-BOT(06)-S3-T9

After successfully completing this course, students will have the knowledge of

**CO1:** Vegetation and Community Ecology, Vegetation organization; interspecific associations, concept of ecological niche, vegetation development, Community function

**CO2:** Ecosystem organization, structure and function; primary production; ecosystem stability and ecosystem management.

**CO3:** Ecosystem conservation; IUCN general account, categories, commissions, role in conservation, Red Data Book; protected areas; coral reefs; botanical gardens.

**CO4:** Indian systems of medicines; Pharmacognosy; drug adulteration; standardization of herbal cosmetics and modern herbal cosmetics.

<b>Title of paper</b>	<b>Angiosperms-II and Plant Nursery Management</b>
<b>Course Code</b>	PG-BOT(06)-S3-T10

After successfully completing this course, students will have the knowledge of

**CO1:** General account, distinguished characters, floral variation and evolution of Angiosperm families as per Cronquist, 1968.

**CO2:** Recognize members of the major angiosperm families by identifying their diagnostic features and economic importance.

**CO3:** concept and levels of biological diversity , Role of biodiversity in ecosystem functions and stability. Major hotspot in World/India

**CO4:** Plant Nursery Management. Concept, types, infrastructure requirements, plant propagation through seeds and vegetative methods and preparation of different types of compost.

<b>Title of paper</b>	<b>Molecular Biology &amp; Plant Biotechnology</b>
<b>Course Code</b>	PG-BOT(06)-S3-T11 (Elective paper I)

After successfully completing this course, students will have the knowledge of

**CO1:** cellular and redifferentiation and totipotency, Micropropagation: Techniques in tissue culture and their application,. Organogenesis, somatic embryogenesis, Methods of preparation of synthetic seeds.

**CO2:** Can handle tools of rDNA technology, Molecular probing, Techniques of PCR

**CO3:** Vectors used in Prokaryotes & Eukaryotes, Techniques of Insertion of foreign gene into host cell and isolation of gene

**CO4:** Sequence analysis, scoring matrices and Phylogenetic tree

<b>Title of paper</b>	<b>Mycology and Plant Pathology</b>
<b>Course Code</b>	PG-BOT(06)-S3-T11 (Elective paper II)

After successfully completing this course, students will have the knowledge of

**CO1:** General characters and Classification of fungi, diversity of fungi, Root and leaf associated fungi and their importance, effect of environment on growth of fungi and kinds of mycorrhiza.

**CO2:** Dermatophytic fungi and common dermatophytes caused to human being. Aspergillosis, Industrial fungal metabolites, Antibiotics, Enzymes and organic acids.

**CO3:** Used of fungi as a food and food processing, fungal metabolites, Methods used for mushroom cultivation, Role of fungi in biodeterioration and biodegradation.

**CO4:** Different types of mushroom and growth and stages of mushroom, Edible and poisonous mushroom, nutritive value of mushroom, concept of plant diseases, Koch's postulates, growth regulators.

<b>Title of paper</b>	<b>Aesthetic botany</b>
<b>Course Code</b>	PG-BOT(06)-S3-T12

After successfully completing this course, students will have the knowledge of

**CO1:** Phytogeographical regions of india and regarding Aesthetic plants

**CO2 :** Types and styles of gardens, their main features and ornamentation, how to plan outdoor gardens

**CO3 :** Nursery production and it's long term management, problems of pests and diseases with their management techniques, Different ferns and other plants used for gardening.

**CO4:** Landscape designing of different institutions, industries and public, religious places. Different bamboo and conifers plantation methods for gardening.

<b>Title of paper</b>	<b>Botany Practical-V</b>
<b>Course Code</b>	PG-BOT(06)-S3-P5

After successfully completing this course, students will have the knowledge of

**CO1:** The need for intra- and interdisciplinary cooperation in researching different ecosystems.

**CO2:** To use highly specialized practical skills in determining environmental protection issues.

**CO3:** Plant morphology terminologies and identifying morphological peculiarities, the systems of classification of angiosperms, nomenclature and interdisciplinary approaches.

**CO4:** Establishment of models nurseries in rural areas for availability of quality planting materials, transfer knowledge of Agriculture/Horticulture in the field of agricultural research.

<b>Title of paper</b>	<b>Botany Practical-VI</b>
<b>Course Code</b>	PG-BOT(06)-S3-P6(Molecular biology and plant Biotechnology)

After successfully completing this course, students will have the knowledge of

**CO1:** Basic techniques of plant tissue culture, Agrobacterium tumefaciens mediated gene transfer in a suitable plant, raising the suspension culture using a callus, bacterial transformation and selection of transformed cells, Organogenesis and somatic embryogenesis using appropriate explants, and anther culture.

**CO2** : demonstrating the presence of a particular polypeptide by Western blotting, designing PCR primers to isolate the given gene for cloning it in the given vector,

**CO3** : performing DNA ligation and analysis on agarose gel

**CO4**: predicting a protein from a given sequence by using online tools from NCBI, sequencing of protein in the protein database, identifying genes from GeneBank by BLAST method, download the DNA and protein sequences, generating phylogenetic trees using given sequences.

<b>Title of paper</b>	<b>Botany Practical-VI</b>
<b>Course Code</b>	PG-BOT(06)-S3-P6(Mycology and Plant pathology)

After successfully completing this course, students will have the knowledge related to fungi

**CO1**:Methods of sterilization process, Used of camera lucida for imaging, Different kinds of media used for cultivation of fungi and bacteria.

**CO2**:Using different methods for exploration of fungi from different sources of material, Study of airborne fungi, phylloplane fungi, Root associated fungi, Soil associated fungi,Seed associated fungi.To detect toxicity of fungi on seed germination and seedling abnormality.

**CO3**:Different types of method used for different types of mushroom. Demonstration of koch's postulates, spore counting using haemocytometer, Estimation of enzymes, cellulose and amylase, sugar, proteins, amino acids from fungal mycelium and used culture filtrate. Detect antifungal activity.

**CO4**:Study of Mycorrhiza, Monographic study of locally available plant diseases caused by fungi,bacteria, viruses and phytoplasma, preparation of plant pathology herbarium.

<b>Title of paper</b>	<b>Cell and Molecular Biology-II</b>
<b>Course Code</b>	PG-BOT (06)-S4-T13

After successfully completing this course, students will have the knowledge of

**CO1**: Structure and function of Ribosomes, Transcription and translation in prokaryotes and eukaryotes; DNA damage and repair mechanisms.

**CO2**: Structure and function of gene; regulation of gene expression in prokaryotes and eukaryotes; epigenetic regulation

**CO3**: Genome organization in prokaryotes and eukaryotic organelles; Genetic recombination; gene mapping and chromosome mapping.

**CO4**: Mechanism and function of cell cycle and apoptosis; signal transduction in cell; techniques in cell biology like electrophoresis, immunotechniques.

<b>Title of paper</b>	<b>Plant Biotechnology &amp; Bioinformatics</b>
<b>Course Code</b>	PG-BOT (06)-S4-T14

After successfully completing this course, students will have the knowledge of

**CO1:** Recombinant DNA technology; gene cloning; DNA libraries; aim and strategies of transgenics and genetic engineering of plants.

**CO2:** Microbial genetic manipulation; bacterial transformation, selection of recombinants and transformants; basics of genomics and proteomics; DNA synthesis, sequencing and finger printing.

**CO3:** Basic concepts, principles and scope of plant tissue culture; culture media preparation; trending aspects of transgenic production.

**CO4:** The core concepts of Bioinformatics, including computational biology, database design and implementation, and probability and statistics.

<b>Title of paper</b>	<b>Molecular biology and Plant Biotechnology</b>
<b>Course Code</b>	PG-BOT(06)-S4-T15 (Elective paper I)

After successfully completing this course, students will have the knowledge of

**CO1:** Cell culture and isolation, Techniques of Cell suspension culture: techniques and maintenance of suspension culture, Isolation and purification of protoplast, culture and regeneration of protoplast. Somatic Hybridization, production of cybrids. Haploid production and Anther and pollen culture technique, monoploid and polyploid culture in-vitro.

**CO2:** Methods of gene transfer, features of different vectors and direct methods of gene transfer

**CO3:** Biotechnologically important (transgenic methods) issues of agriculture like insect resistant, herbicide resistant, Bt gene technique, biopesticides and biofertilizer and molecular farming.

**CO4:** DNA fingerprinting and marker assisted breeding molecular marker assisted selection, techniques used to study gene expression at transcription level, Northern hybridization, differential display of mRNA, ESTs, cDNA-AFLP, DNA microarrays.

<b>Title of paper</b>	<b>Mycology and plant pathology</b>
<b>Course Code</b>	PG-BOT(06)-S4-T15 (Elective paper II)

After successfully completing this course, students will have the knowledge of

**CO1:** Phytopathology with particular reference to India, epidemics and their social impacts, Alter metabolism of plants in different stress conditions, Epidemiology, research activity related to mycology and plant pathology in indian research centres.

**CO2:** Classification and general symptoms of plant diseases, Pathogenicity, Defence mechanism, Different methods used for disease control.

**CO3:** Detailed study on diseases of cereals, Vegetable crops, oilseed crops and fruit trees.

**CO4:** Detailed study on bacterial diseases of plants, Viral diseases on plants, Mycoplasma diseases on plants.

<b>Title of paper</b>	<b>Plant resources</b>
<b>Course Code</b>	PG-BOT(06)-S4-T16

After successfully completing this course, students will have the knowledge of

**CO1:** History, Origin and Distribution of food plants, Fibre, Gum and Resin yielding plants, spices and condiments, Process of food adulteration.

**CO2:** Introduction and classification of crude drugs, Plant anatomy, Evaluation of drugs, Drug adulteration.

**CO3:** Structure, Classification, Properties, Importance and plant sources of alkaloids, terpenoids, phenolics, steroids, glycosides.

**CO4:** Manufacturing of paper and wood pulp, kinds of paper and paper products. Cultivation and manufacturing of Beverages, Extraction of dyes, essential oils, Classification and cultivation of rubber.

<b>Title of paper</b>	<b>Botany Practical-VII</b>
<b>Course Code</b>	PG-BOT(06)-S4-P7

After successfully completing this course, students will have the knowledge of

**CO1:** The tools and techniques of genetic engineering DNA manipulation enzymes, genome and transcriptome analysis and manipulation tools, gene expression regulation, production and characterization of recombinant proteins.

**CO2:** Advances in biotechnology- healthcare, agriculture and environment cleanup via recombinant DNA technology.

**CO3:** To be able to grow, maintain and manipulate plant material in a laboratory setting for research and breeding purposes; design, carry out, interpret and present an original experiment in the field of plant cell and tissue culture.

**CO4:** Implement efficient alignment, assembly and clustering algorithms. Formulate and justify appropriate choices in technology, strategy, and analysis for a range of projects involving DNA, RNA, or protein sequence data.

### **Mycology and plant pathology**

After successfully completing this course, students will have the knowledge of

**CO1:** Identification of fungi, Identification of plant diseases, different stages of mushroom and their types, toxicity of seeds, Zone of inhibition in diameter.



<b>Title of paper</b>	<b>Botany Practical-VIII</b>
<b>Course Code</b>	PG-BOT(06)-S4-P8

After successfully completing this course, students will have the knowledge of **CO1**: Research techniques to perform any research projects, scientific writing, presentation of projects.

**Programme Specific outcomes (PSOs) in M.Sc. (Zoology) will be prepared to:**

**PSO1**: Have in depth understanding basic and applied aspects of zoology and develop inclination towards professional goals specialised in life science industry.

**PSO2**: Able to formulate the research projects on zoology and multidisciplinary fields through literature and laboratory studies.

**PSO3**: Understand zoology as social endeavor in context to bringing about harmony with nature.

**Master of Science (M.Sc.) in Zoology-**

**Course outcomes**

<b>Title of paper</b>	Structure and Function of Invertebrates
<b>Course Code</b>	PG- ZOO (07)- S1-T1

After successfully completing this course, students will be able to:

**CO1**: understand classical and molecular taxonomic parameters, and identify the animals on the basis of nomenclature. Students will be able to understand the ultrastructure and locomotion of Protozoa. The students will be able to classify the poriferans on the basis of different types of dermal cells and skeletal organization. The students will be able to describe the unique characters and the metamorphosis in Coelenterates.

**CO2**: gain knowledge of origin and theories of metazoan and understand and differentiate between the reproductive system of Aschelminthes and Platyhelminthes. Students can be able to classify the animals on the basis of their coelom, metamerism, symmetry and evolution of coelomate. Gain knowledge about the evolution of nephridia and their mechanism of excretion in Annelida.

**CO3**: understand the structure, affinities, and taxonomic position of *Peripatus*. To learn and understand respiratory organs in Arthropoda and difference between mechanism of gaseous exchange in Insecta and Crustacea. Study of taxonomic position and affinities of Neopilina help the students to understand the connecting link between the Annelida and Mollusca. Students will help to identify Gastropoda, Bivalvia and Cephalopoda on the basis of their neuroanatomy

**CO4:** understand gaseous exchange, nutrition, predation and locomotion also study the development, origin and metamorphosis in Echinodermata. To know the structural characteristics of Ctenophora, Rotifera, Entoprocta and Ectoprocta.

<b>Title of the Paper</b>	Biochemistry-I
<b>Course Code</b>	PG-ZOO (07)-S1-T2

After successfully completing this course, students will have the knowledge of

**CO1:** Properties of water its ionization and the basics of Acids and bases, pH scale; Classification, chemical structure and chemical properties and biological significance of Carbohydrates.; Classification, structure, function and other biological significance of lipids.

**CO2:** Classification, properties of amino acids; Protein structure and various bonds and interaction among biomolecules; structure, classification, types and properties of nucleic acids.

**CO3:** Classification and nomenclature of enzymes, chemical nature and properties of enzymes; Factors that affect enzyme activity; Active site and specificity of enzyme action in terms with Lock and Key model and Induce fit model.

**CO4:** Mechanism of Enzyme action and regulation of enzyme activity in living system; Enzyme inhibition and control of enzyme synthesis, degradation and isoenzymes.

<b>Title of paper</b>	Cell Biology and Genetics
<b>Course Code</b>	PG-ZOO(07)-S1-T3

**CO1:** understand and acquire the knowledge about structure and function of cell membrane their organelles and cytoskeleton. Gain the knowledge of cell division and cell cycle.

**CO2:** understand cell signaling, signal transduction pathways and cellular communication. To learn about the genetics of cancer.

**CO3:** understand inheritance extension of Mendelian principles and quantitative genetics. To learn the types, causes and detection of mutation.

**CO4:** gain the knowledge of structural and numerical alteration of chromosome and study of the extrachromosomal inheritance. To learn and gain the knowledge about microbial genetics and human genetics which helps to identify genetic disorders.

<b>Title of the Paper</b>	Biochemistry-II
<b>Course Code</b>	PG-ZOO (07)-S1-T4

After successfully completing this course, students will have the knowledge of

**CO1:** Cell bioenergetics with relation to first and second law of thermodynamics; internal energy, Enthalpy and Entropy; Anaerobic and aerobic pathway of glucose metabolism; gluconeogenesis; Alternate pathway of carbohydrate metabolism with respect to pentose phosphate pathway and glyoxylate cycle.

**CO2:** Beta oxidation of saturated and unsaturated fatty acids; formation of ketone bodies; mitochondrial organization, components and reactions of electron transport chain; oxidative phosphorylation and inhibitors of oxidative phosphorylation.

**CO3:** Metabolism of amino acids with respect to transamination and deamination; biosynthesis of purine and pyrimidine nucleotides; Urea cycle and its regulation; Integration between urea cycle and TCA cycle; Metabolic disorders of cycle.

**CO4:** Classes of Hormones; Mode of action of Peptide and steroid hormones; Types and significance of vitamins; Neurohormones and its mode of action with respect to Nitric oxide.

<b>Title of the Paper</b>	Zoology Practical I- Structure and Function of Invertebrates and Biochemistry-I
<b>Course Code</b>	PG-ZOO (07)-S1-P1

After successfully completing this course, students will have the knowledge of

**CO1:** the evolution of all phylum and characters of specimens of invertebrates.

**CO2:** anatomical observation and detailed explanation of digestive, nervous and reproductive system of animals.

**CO3:** study about the methods of mounting and fixation of organs of specimen and know about transverse sections, longitudinal section and whole mount of the specimens in invertebrates with the help of already available permanent slides.

**CO4:** Preparation of standard buffers and determination of pH of a solution; Determination of pKa and isoelectric pH; Titration of acids and bases; Qualitative analysis of Carbohydrate, Proteins and Urea; Colorimetric estimation of Proteins

**CO5:** Extraction of total lipids; Determination of saponification and acid values in fats; Preparation of starch from potato and its hydrolysis by salivary amylase; Effect of pH on activity of enzyme; isolation of urase and demonstration of its activity

<b>Title of paper</b>	Zoology Practical II- Cell Biology, Genetics and Advanced Reproductive Biology
<b>Course Code</b>	PG- ZOO (07)- S1-P2

**CO1:** study about the stage of metaphasic chromosome of mitosis using plant material, gain the knowledge about preparation of human karyotypes , Barr Body in human, female polytene chromosome in dipteran larvae by using photographs or pictures.

**CO2:** gain the knowledge about solving problems of genetics, study about various human genetic traits.

**CO3:** study about mitotic chromosomes and the spermatogenesis in grasshoppers, knowledge about semen analysis, sperm vitality and hypo-osmotic swelling for the assessment of normal semen.

**CO4:** learn about vaginal smear in rat.

**CO5:** will understand histology of male and female reproductive organs and accessory reproductive glands .

<b>Title of paper</b>	Structure and Function of vertebrate
<b>Course Code</b>	PG- ZOO (07)- S2-T1

**CO1:** understand the origin and ancestry of Chordata, general affinities of Cephalochordata. To know about the general characters and affinities of Dipnoi.

**CO2:** understand the comparative structure and mechanism of respiration in Pisces and Amphibia. Gain knowledge about the vertebrates integuments and appendicular skeleton. Study of the body organization and classification of Chelonia, helps to identify the various species of Chelonia

**CO3:** know the evolution and development of urinogenital organs and comparative anatomy of brain in vertebrate. To understand the characteristics of Cetacea and the study of origin of birds and their ancestry.

**CO4:** Gain knowledge about the evolution of man; help to know the changing behavior and morphology of man. The students learn and understand the comparative evolution of heart, study of sense organs and autonomous nervous system in vertebrates.

<b>Title of paper</b>	Comparative Endocrinology
<b>Course Code</b>	PG- ZOO (07)- S2-T2

**CO1:** understand the hormones and functions in Coelenterata , Helminths and Echinodermata. Students will be able to understand the structure of neurosecretory and neuroendocrine system, their hormones and function in Annelida and Mollusca

**CO2:** understand the structure and hormones of neuroendocrine system in Crustacean. Gain knowledge about the hormonal control in metamorphosis and reproduction in Crustacean and Insects; also know about the color change mechanism in Crustacea. Students will be able to know the cephalic neuroendocrine system in insects.

**CO3:** understand the structure, position and hormones of the pineal, Hypothalamus, Pituitary and Thyroid gland also know the various functions and regulation of hormones in all the metabolic processes.

**CO4:** understand the structure, hormones and regulatory mechanism of parathyroid ultimobranchial glands, Gastro-entero-pancreatic endocrine gland and Adrenal gland. To learn and understand the gonadal hormones in vertebrates, it will help to recognize the hormonal action and feedback mechanisms in reproduction.

<b>Title of paper</b>	Molecular Biology and Biotechnology
<b>Course Code</b>	PG- ZOO (07)- S2-T3

**CO1:** know the structure and types of DNA and also evaluate the  $COT_{1/2}$  and  $ROT_{1/2}$  value. To understand the molecular mechanism of prokaryotic and eukaryotic DNA replication, types of DNA damage and repair; which help to understand one of the processes of central dogma of life.

**CO2:** learn the synthesis of new messenger RNA and protein in prokaryotes and eukaryotes and its modification. Also students know the molecular machinery used for the regulation of transcription and translation. To understand the various types of Mobile DNA elements

**CO3:** learn and understand the antisense and ribozyme technology which helps to modify the molecules. By using various biotechniques, students will help to isolate and sequencing DNA. Also understand the splicing and cloning of DNA technology and Hybridization techniques. From it students will develop their research knowledge.

**CO4:** understand the application of biotechnology in various fields, and help to use in medical, agriculture, industrial and environmental procedures to make various types of useful products. By using immunobiotechnology, produces monoclonal antibodies, the technique will help the students to form various types of vaccines which will use in prevention of diseases.

<b>Title of paper</b>	Advanced Developmental Biology
<b>Course Code</b>	PG- ZOO (07)- S2-T4

**CO1:** understand the processes of implantation, structure and function of foetal membrane and placenta. Also know the placental hormones and their function during pregnancy. Students help to understand the morphogenetic, biochemical mechanism and hormonal control of metamorphosis in Amphibia.

**CO2:** gain knowledge about regeneration of organs in vertebrates. To understand the concept of mechanism and significance of apoptosis and ageing. To evaluate the process of polymorphism in insects.

**CO3:** understand and help to apply the multiple ovulation, embryo transfer technique and significance of embryonic stem cells which useful in the various advance reproductive processes. For the diagnosis of genetic disorders various types of genetical techniques are used like cloning, ICSI, GIFT etc. also make a cloning of animal by using nuclear transfer technique.

**CO4:** understand the immunocontraception and classical contraceptive techniques which will help to inhibition and termination of pregnancy. To learn and understand the types of anti-androgen and anti-spermatogenic compounds and role of mutants and transgenics in human welfare.

<b>Title of paper</b>	Zoology Practical III- Structure and Function of Vertebrates and Comparative Endocrinology
<b>Course Code</b>	PG- ZOO (07)- S2-P1

After successfully completing this course, students will have the knowledge of

**CO1:** study and gain knowledge about demonstration of Glycogen/carbohydrate by PAS reaction. DNA by Feulgen's reaction, DNA and RNA by Methyl Green Pyronin reaction, Lipid by Sudan Black-B staining, Protein by HgBP staining.

**CO2:** study about histochemical analysis of alkaline phosphatase and acid phosphatase.

**CO3:** study about biochemical estimation of Sugar by O-toluidine method, Protein by Lowrey's method, DNA by Diphenylamine method, RNA by Orcinol method, qualitative analysis of bile.

**CO4:** Separation of amino acid by two dimensional TLC and ascending and descending paper chromatography; estimation of glycine; Paper and Gel electrophoresis; Separation of proteins.

**CO5:** Demonstration of Western Blot; Isolation of DNA and RNA; Separation of DNA; Estimation of Vit C in lemon and oranges; Estimation of Urease

<b>Title of the Paper</b>	Molecular Biology, Biotechnology and Biochemistry-II
<b>Course Code</b>	PG-ZOO (07)-S2-P2

After successfully completing this course, students will have the knowledge of

**CO1:** study and gain knowledge about demonstration of Glycogen/carbohydrate by PAS reaction. DNA by Feulgen's reaction, DNA and RNA by Methyl Green Pyronin reaction, Lipid by Sudan Black-B staining, Protein by HgBP staining.

**CO2:** study about histochemical analysis of alkaline phosphatase and acid phosphatase.

**CO3:** study about biochemical estimation of Sugar by O-toluidine method, Protein by Lowrey's method, DNA by Diphenylamine method, RNA by Orcinol method, qualitative analysis of bile.

**CO4:** gain the knowledge about separation of amino acids by paper chromatography and TLC.

**CO5:** To study about the mammalian reproductive system, sperm count, different types of egg on the basis of yolk content and histology of placenta, developmental stages of live eggs of *Lymnea* or any gastropod, insects/fishes/ chick.

<b>Title of paper</b>	Parasitology and Immunology
<b>Course Code</b>	PG- ZOO (07)- S3-T1

**CO1:** understand the life cycle, mode of transmission, infection and treatment of various parasites of bacterial and viral diseases which help to identify and know the preventions from diseases. By the study of *Vibrio cholera*, *Yersinia pestis*, *Clostridium titani*, Influenza virus, Dengue virus and Hepatitis virus students will gain the knowledge about the treatment of Cholera, Plague, Tetanus, Influenza, Dengue and Hepatitis disease and apply the preventive measures in their life.

**CO2:** By the studying of life cycle, mode of transmission, infection and treatment of *Trypanosoma*, *Entamoeba*, *Leishmania*, *Wuchereria* and *Triachinella* students will help to prevent from various amoebic and worm infections. Gain knowledge about the identification of disease and appropriate treatment of the disease. To understand the toxins and antitoxins so that students will help to form a proper antidotes against the pathogens.

**CO3:** understand the immune system, gain knowledge about the term Antigens and Antibodies and its interaction, cells and organs of immune system, important role of B cell and T cell in protection of our body from foreign particles. Gain knowledge about the Major Histocompatibility complex and complement system their pathways, activation and inhibition which play most important role in the immune system.

**CO4:** know about the cytokine receptors their properties, cell mediated cytotoxic response also Hypersensitivity reactions, their types and mechanisms and know about the Autoimmunity so that students will recognized the hypersensitivity reactions and autoimmune disorders. To learn and understand the transplantation immunology and tumor immunology their advantages and complications. Understand the various immunological techniques which will help the students to identify and cure the diseases.

<b>Title of paper</b>	Animal Physiology- I (Physiology of digestion and Excretion)
<b>Course Code</b>	PG- ZOO (07)- S3-T2-SP1

**CO1:** learn understand the histology oh salivary gland and stomach ,mechanism of secretion, composition and function of saliva and gastric juice. Students gain knowledge about the histological structure of pancreas and liver also know the mechanism of their secretion and its functions.

**CO2:** gain knowledge about the histology of small and large intestine, its secretion, natural and endocrine regulation of gastro intestinal movement. To understand the gastrointestinal hormones their synthesis, chemical structure and functions. Also gain knowledge about the digestion and absorption of proteins, carbohydrates, and lipids in GI tract.

**CO3:** understand the physiology of excretion students will learn the structural and functional anatomy of kidney and mechanism of urine formation. Students gain knowledge of normal and abnormal constituents of urine and mechanism of concentration and dilution of urine

**CO4:** By studying the hormonal control of excretion students will able to understand the regulation of urine and body fluid concentration and volume and also regulate the water, electrolytes and acid base in body.To understand the physiology of nitrogen excretion in animal and condition of renal failure

<b>Title of paper</b>	Animal Physiology-II (Physiology of Circulation)
<b>Course Code</b>	PG- ZOO (07)- S3-T3-EL1

**CO1:** understand the myogenic and neurogenic heart. Also they can understand anatomy, histology and nerve innervation of the heart, heart valves. To understand about pace maker, specialized conducting fibers and blood pressure and factors affecting blood pressure.

**CO2:** gain the knowledge about cardiac cycle, electrocardiogram and cardiac output and heart sound. To understand haemodynamics and cardiac failure.

**CO3:** gain the knowledge about blood composition, blood functions also the types of blood groups and blood transfusion. Students can be able to understand blood sugars, causes and control of hypoglycemia, hyperglycemia and blood lipids, causes and control of hypolipidimia and hyperlipidemia

**CO4:** understand about plasma proteins and haemostasis, cascade of biochemical reactions involved in coagulation of blood. To learn about transport of oxygen and carbon dioxide by blood also lymph composition, formation and functions.

<b>Title of the Paper</b>	Biotechniques-I
<b>Course Code</b>	PG-ZOO (07)-S3-T4-FC1



After successfully completing this course, students will have the knowledge of

**C01:** Principles of Microscopy with respect to nature of light, wavelength, reflection, refraction; Principles and application of microscope; Light microscopy, Phase contrast microscopy and Florescence microscopy, Scanning and transmission electron microscopy and Atomic Force microscopy.

**C02:** Basic principles and application of Spectroscopy; Types of spectroscopy with reference to UV Visible, IR absorption, Raman spectroscopy; Principle and Biological application of Mass Spectroscopy; X-ray diffraction and NMR

**C03:** Principle and types of Chromatography with respect to Adsorption, Partition, Size exclusion, Ion exchange and Affinity Chromatography

**C04:** Media preparation and sterilization, inoculation and growth monitoring; fermenters and its uses; Microbial assays.

<b>Title of paper</b>	<b>Zoology Practical V- Parasitology and Immunology</b>
<b>Course Code</b>	PG- ZOO (07)- S3-P1

After successfully completing this course, students will have the knowledge of

**CO1:** study about the different types of parasitic protozoan's, helminthes, insect vectors and mouth parts of insect vectors, study of various ecto and endo parasites, life cycle of various parasites.

**CO2:** study the demonstration of Gram-positive, Gram-negative bacteria and immunoelectrophoresis.

**CO3:** study about immunological diagnosis of pregnancy.

**CO4:** gain the knowledge about preparation of tissue sections of thymus, spleen and lymph nodes, identification of T and B cells. understand the demonstration of Mast cells and Ouchterlony double diffusion (ODD), agar gel diffusion.

<b>Title of paper</b>	<b>Zoology Practical VI- Special Group- Animal Physiology</b>
<b>Course Code</b>	PG- ZOO (07)- S3-P2

After successfully completing this course, students will have the knowledge of

**CO1:** effect of pH, temperature and incubation on human salivary amylase activity. determination of clotting time, bleeding time, RBC sedimentation rate and hemoglobin concentration.

**CO2:** study about determination of protein, glucose, constituents of urine, urine crystals and estimation of serum urea in human Urine.

**CO3:** study about structure of RBC in vertebrates. understand about total leukocyte count, differential leukocyte count and erythrocyte count, blood group and haemin-crystals.

**CO4:** study about estimation of glucose, proteins, triglycerides, cholesterol, sodium, potassium, calcium, alkaline and acid phosphates in blood.

**CO5:** study about blood amino-acid separation by TLC / paper chromatography.

**CO6:** understand about histology of stomach, liver, intestine, pancreas, kidney, thyroid, pituitary, blood smear, heart, T.S. of artery and vein.

<b>Title of paper</b>	Biotechnology, Biostatistics, Ethology, Toxicology and Bioinformatics
<b>Course Code</b>	PG- ZOO (07)- S4-T1

**CO1:** understand sterilization technique, media for microbial culture, inoculation method, animal and tissue culture for the research purpose. To learn and understand centrifugation and sedimentation methods and chromatographic separation.

**CO2:** understand central tendency and dispersion, also the probability and probability distribution, sampling types, standard error and standard deviation this helps for the public health or other health sciences study using statistical software. To learn and understand neuronal control, genetic and environmental components in development of animal behavior and animal ethics.

**CO3:** gain the knowledge of introduction and scope of toxicology, classification of environmental toxicants, pesticides, fertilizers, heavy and trace metals, radioactive substances, food additives, automobile emission. To study and understand translocation of toxicants and toxicity test, types, and calculation of LC50 and LD50 also the antidotal therapy.

**CO4:** learn about introduction and scope of bioinformatics, scope of bioinformatics in research which help to know about the employment opportunities. To understand sequence alignment, biological database and phylogenetic analysis this helps to understand evolutionary relationship.

<b>Title of paper</b>	Animal Physiology – I (Physiology of Brain, Nerve and Muscle)
<b>Course Code</b>	PG- ZOO (07)- S4-T2-SP2

**CO1:** understand and learn the morphological differentiation of mammalian brain, and brain stem. To understand and learn the concept of cerebellum and physiology of learning, memory and sleep.

**CO2:** acquire the knowledge of types and functional properties of neurons and also the ultrastructure of neuron. To understand the mechanism of synaptic transmission and ultrastructure of synapse.

**CO3:** study and understand about the biosynthesis, storage and release of neurotransmitter and neuropeptides. Student will be able to understand about the Mechanoreception, Photoreception, Phonoreception, Chemoreception and disorder of nervous system like Alzheimer's disease, parkinson's disease.

**CO4:** acquire the knowledge about ultrastructure of skeletal muscle and molecular mechanism of muscle contraction. To gain knowledge of properties of muscle, muscular disorders and ultrastructure of neuromuscular junction.

<b>Title of paper</b>	Animal Physiology-II (Physiology of Respiration and Reproduction)
<b>Course Code</b>	PG- ZOO (07)- S4-T3-EL2

**CO1:** Gain the knowledge and understand physiological anatomy of respiratory system and mechanism of respiration this helps to understand mechanism of breathing and the exchange of respiratory gases at pulmonary surface. To understand transport of respiratory gases by blood and lung volume capacities, partial pressure of gases.

**CO2:** evaluate oxygen dissociation curve, carbon dioxide dissociation curve and carbonic anhydrate, chloride shift. To understand neural and chemical regulation of respiration and knowledge about Hypoxia and cyanosis.

**CO3:** understand endocrine control of spermatogenesis and oogenesis, also the leydig cells, sertoli cells and their hormones. To acquire the knowledge about follicular cells, luteal cells their hormones and formation, structure, hormones and function of corpus luteum.

**CO4:** gain knowledge about structure, hormones and function of placenta also the physiology of lactation. To understand role of hormones and pheromones in reproduction and causes of infertility in male and female; In vitro fertilization and Test Tube Baby.

<b>Title of the Paper</b>	Biotechniques-II
<b>Course Code</b>	PG-ZOO (07)-S4-T4-FC2

After successfully completing this course, students will have the knowledge of

**CO1:** Molecular biology techniques dealing with Phage display and yeast two hybrid assay; Transcript analysis and Foot printing assay and site directed mutagenesis; Principle type and uses of Biosensors.

**CO2:** Design and functioning of Drosophila culture laboratory; Types of Drosophila culture media; Cell proliferation and Cell viability assay

**CO3:** Histochemical and Immunochemical techniques in relation to Principles, Types of fixatives; Instruments in sectioning, principle and types of tissue staining methods; Insitu hybridization of nucleic acids.

**CO4:** Radioisotope and mass isotope techniques in biology with reference to metabolic

labelling, sample preparation for radioactive counting; Safety guidelines for Autoradiography.

<b>Title of paper</b>	<b>Zoology Practical VII-Special Group- Animal Physiology</b>
<b>Course Code</b>	PG- ZOO (07)- S4-P1

After successfully completing this course, students will have the knowledge of

**CO1:** electrocardiograph and measuring heart beat under different physiological conditions.

**CO2:** know about body size and oxygen consumption in aquatic animals, gain the knowledge about effect of pH and temperature on oxygen and carbon dioxide concentration in pond water.

**CO3:** study about biochemical estimation of tissue cholesterol, SGOT/SGPT, lactose dehydrogenase, RNA and DNA from blood sample, separation of protein by SDS-PAGE.

**CO4:** study about nerve cell and neurosecretory cells of cockroach, muscle, liver glycogen, lactose in milk in vertebrates.

**CO5:** understand about determination of fructose in semen and semen constituent and gain knowledge about histochemical localization of a dehydrogenase, carbohydrate, glycogen, lipid and protein and histology of brain, testis, ovary, thyroid, adrenal, corpus luteum in ovary, Leydig cell in testis, T.S. of muscle fibre and spinal cord, cerebellum, cerebrum, nerve fiber and lung.

<b>Title of paper</b>	<b>Zoology Project work</b>
<b>Course Code</b>	PG- ZOO (07)- S4-PJ

After successfully completing this course

**CO1:** Students will be exposed to basic principle and working of research methodology.

**CO2:** will be able to find out local problems and their scientific solution.

**CO3:** will get problem solving ability and analytical approach to local problems; learn integrated approach in designing experiments or study, get hands on scientific instruments and its working.

**CO4:** Students get expertise in particular techniques, scientific preparation, statistical data analysis and scientific writing.

**CO5:** This project work will help students to develop interest in research studies.

### **Programme Specific outcomes (PSOs) in M.Sc. (Mathematics)**

After completing M.Sc. (Mathematics), students will:

**PSO1:** Get advanced knowledge of various branches of Mathematics.

**PSO2:** Be able to apply their skills, mathematical ideas and tools to solve mathematical problems.

**PSO3:** Develop abilities for logical reasoning, critical thinking, analysing, and problem solving.

**PSO4:** Develop research culture.

## Master of Science (M.Sc.) in Mathematics

### Course outcomes

<b>Title of paper</b>	Algebra I
<b>Course Code</b>	PG- MATH (03)- S1-T1

After successful completion of this course, students will:

**CO1:** Understand basic group theory and advanced group theory.

**CO2:** Be prepared for basic Algebra.

**CO3:** Get basics of ring theory and field theory, Galois theory etc.

<b>Title of paper</b>	Real Analysis I
<b>Course Code</b>	PG- MATH (03)- S1-T2

After successful completion of this course, students will:

**CO1:** Develop mathematical understanding of Real analysis.

**CO2:** Gain confidence in proving theorems and solving problems on Uniform Convergence.

**CO3:** Understand the generalized concept of Sequence and Series of Functions.

**CO4:** Appreciate the concept of Manifolds and Lie Groups.

<b>Title of paper</b>	Topology I
<b>Course Code</b>	PG- MATH (03)- S1-T3

After successful completion of this course, students will:

**CO1:** Understand the concepts of topological spaces, and their role in mathematics.

**CO2:** Have ability to prove results about completeness, compactness, connectedness.

**CO3:** Have knowledge of convergence of sequences in topological spaces.

**CO4:** Will form a basis for advanced topology.

### Course outcomes

<b>Title of paper</b>	Ordinary Differential Equations
<b>Course Code</b>	PG- MATH (03)- S1-T4

After successful completion of this course, students will:

**CO1:** Get basic notions in Differential Equations and use the results in developing advanced mathematics.

**CO2:** Have ability to solve application problems modelled by linear differential equations

**CO3:** Use power series methods to solve differential equations about ordinary points and regular singular points.

**CO4:** Understand the concepts of existence and uniqueness of solutions.

<b>Title of paper</b>	Integral Equations
<b>Course Code</b>	PG- MATH (03)- S1-T5

After successful completion of this course, students will:

**CO1:** Have knowledge of preliminary concepts of integral equations.

**CO2:** Have ability to use the results in other branches of mathematics.

**CO3:** Have capability to solve Volterra and Fredholm equation.

<b>Title of paper</b>	Algebra-II
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<b>Course Code</b>	PG- MATH (03)- S2-T1
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After successful completion of this course, students will:

**CO1:** Understand advanced group theory and abstract algebra.

**CO2:** get idea about s rings, ideals, homeomorphism rings and modules.

**CO3:** have enhanced thinking power in algebra and motivation for research.

<b>Title of paper</b>	Real Analysis II
<b>Course Code</b>	PG- MATH (03)- S2-T2

After successful completion of this course, students will:

**CO1:** Understand the generalized concept of measure and integration.

**CO2:** The student will gain confidence in proving theorems and solving problems.

**CO3:** develop mathematical maturity.

**CO4:** Student will understand the need to generalize the concept of integration.

<b>Title of paper</b>	Topology II
<b>Course Code</b>	PG- MATH (03)- S2-T3

After successful completion of this course, students will:

**CO1:** Get the advanced concepts of topological spaces.

**CO2:** Have ability to prove results about completeness, compactness, connectedness.

**CO3:** Have knowledge of convergence of countability and separation axioms.

**CO4:** Have motivation for research.

<b>Title of paper</b>	Differential geometry
<b>Course Code</b>	PG- MATH (03)- S2-T4

After successful completion of this course, students will:

**CO1:** Get fundamentals of Differential geometry.

**CO2:** Have clarity on theory of curves and surfaces in 3-spaces.

**CO3:** Derive fundamental quadratic forms of the surfaces and Gauss-Bonnet theorem.

<b>Title of paper</b>	Classical Mechanics
<b>Course Code</b>	PG- MATH (03)- S2-T5

After successful completion of this course, students will:

**CO1:** Have ability to derive Lagrange Equation and Conservation Theorems.

**CO2:** Have knowledge of Legendre Transformations and Canonical Transformations.

**CO3:** Understand Hamilton Principle and Variational Principle.

<b>Title of paper</b>	Complex Analysis
<b>Course Code</b>	PG- MATH (03)- S3-T1

After successful completion of this course, students will:

**CO1:** Become familiar with the concepts of Complex numbers and their properties and operations with Complex number.

**CO2:** Evaluate limits and checking the continuity of complex function.

**CO3:** Checking differentiability and Analyticity of functions.

- CO4:** Evaluate Complex integrals and applying Cauchy integral.
- CO5:** Understand how complex numbers provide a satisfying extension of the real numbers.
- CO6:** To understand certain theorems like Casorti-wierstrass theorems, Hadamards three circle theorem.

<b>Title of paper</b>	Functional Analysis
<b>Course Code</b>	PG- MATH (03)- S3-T2

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

- CO1:** Appreciate how functional analysis uses and unifies ideas from vector spaces, the theory of metrics, and complex analysis.
- CO2:** Understand and apply fundamental theorems from the theory of normed and Banach spaces, including the Hahn-Banach theorem, the open mapping theorem and the closed graph theorem.
- CO3:** Appreciate the role of Inner product space
- CO4:** Understand and apply ideas from the theory of Hilbert spaces to other areas.
- CO5:** Understand the fundamentals of spectral theory, and appreciate some of its power.

<b>Title of paper</b>	Mathematical Methods
<b>Course Code</b>	PG- MATH (03)- S3-T3

After successful completion of this course, students will:

- CO1:** Have ability to solve Differential Equations with initial conditions using Laplace Transforms.
- CO2:** Develop skills to evaluate Fourier Transform of continuous function and be familiar with its basic properties.
- CO3:** Appreciate Finite Hankel Transform, Finite Legendre Transform and Finite Mellin Transform.

<b>Title of paper</b>	Fluid Dynamics-I
<b>Course Code</b>	PG- MATH (03)- S3-T4- EL1

At the end of this course students will be able to:

- CO1:** Develop appreciation properties of fluid.
- CO2:** Derive Euler's equation, Bernoulli's equation and discuss the case of steady motions under conservative body forces.
- CO3:** Apply concepts of mass, momentum and energy conservation to flows.
- CO4:** Prove Milne-Thomson circle theorem and derive some application.
- CO5:** Understand the concept of elements of thermodynamics and explain Entropy-Maxwell's Thermodynamics relations.

<b>Title of paper</b>	Operation Research-I
<b>Course Code</b>	PG- MATH (03)- S3-T5

At the end of this course students will be able to:

- CO1:** Solve many financial decision-making problems by using linear programming technique.
- CO2:** Explain the graphical solution of linear programming problem by different method.
- CO3:** Develop all skill and technique of problem solving.
- CO4:** Acquire the knowledge and understanding of Queuing system.

<b>Title of paper</b>	Dynamical Systems
<b>Course Code</b>	PG- MATH (03)- S4-T1

At the end of this course students will be able to:

**CO1:** understand fundamental concepts related to modelling time dependent phenomena.

**CO2:** extend their knowledge of calculus to solve problems in difference (and maybe differential) equations.

**CO3:** improve problem solving skills.

**CO4:** Develop Research Attitude.

<b>Title of paper</b>	Partial Differential Equations
<b>Course Code</b>	PG- MATH (03)- S4-T2

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

**CO1:** Find solutions of partial differential equations and determine the existence, uniqueness of solution of partial differential equation.

**CO2:** Find out the complete integral by Charpits method and also find the particular integral, singular integral

**CO3:** Solve simple eigenvalue problems of Sturm-Liouville type.

**CO4:** Classify partial differential equations into Linear equation, Semi-linear, Quasi-linear and nonlinear equations.

**CO5:** Understand the Dirichlet problem, Neumann problem and apply to solve problem for half plane.

<b>Title of paper</b>	Advanced Numerical Methods
<b>Course Code</b>	PG- MATH (03)- S4-T3

After the completion of the course, Students will be able to:

**CO1:** Enhances their theoretical view towards numerical methods.

**CO2:** Clear core linear algebra as well as numerical methods.

**CO3:** Understand different types of methods to calculate LU factorization, floating point numbers.

**CO4:** Appreciate different types of methods to calculate LU factorization, floating point numbers.

<b>Title of paper</b>	Fluid Dynamics II
<b>Course Code</b>	PG- MATH (03)- S4-T4- EL2

After the completion of the course, Students will be able to:

**CO1:** Apply scientific method strategies to fluid mechanics to analyse qualitatively and quantitatively the problem situation, propose hypotheses and solutions.

**CO2:** Define and illustrate Viscous Flow, apply to solve problems.

**CO3:** Understand concept of Magneto hydrodynamics and derived Maxwell's electromagnetic field equation.

**CO4:** Acquire the knowledge of boundary layer and apply to solve problems.

<b>Title of paper</b>	Operation Research-II
<b>Course Code</b>	PG- MATH (03)- S4-T5

At the end of this course a student will be able to:

**CO1:** Solve Linear Programming Problem by Revised Simplex Method.

**CO2:** Understand Integer Programming and Post Optimality Analysis.



**CO3:** Develop all skill and technique of problem solving.

**CO4:** Acquire the knowledge and understanding of Queueing Theory and Inventory Control.

**CO5:** Appreciate Bounded Variable Technique for solve Linear Programming Problem.

