

## **Program Outcomes (POs)**

After completion of B.Sc. programme, the students will be able to –

1. Understand the core fundamentals of basic sciences.
2. Understand the diverse day to day applications of various fields.
3. Demonstrate, solve and an understanding of major concepts in all disciplines of science.
4. Analyse any data in a scientific manner, interpret the data and come to a logical conclusion.
5. Apply the acquired knowledge and the applications of basic sciences to community.
6. Apply ethical principles and commit to professional ethics and responsibilities and norms of the scientific practice.
7. Have sustainable development.
8. Develop skills in handling scientific instruments, planning and performing in laboratory experiments.
9. Go for higher studies i.e. M. Sc and then do some research for the welfare of mankind.
10. Look for professional job-oriented courses, Indian Army, Indian Navy, Indian Air Force as officers, Indian Civil Services.

After completion of M.Sc. programme, the students will be able to –

1. Understand the core fundamentals and theories of basic sciences with more focus and maturity.
2. Analyse problems, formulate a hypothesis, evaluate the results and draw reasonable conclusions
3. Develop written and oral communication skills by as these students give frequent presentations and seminars on various scientific theories and activities.
4. To inculcate the scientific temperament in the students and outside the scientific community.
5. Handle the sophisticated instruments/equipment.
6. Enable students acquire jobs in R & D in scientific laboratories, industries, teaching at both school or college level (with NET), management, marketing and sales, in public sector organizations and to pursue research.
7. Go to serve in industries or may opt for establishing their own industrial unit.

After completion of Ph.D. programme, the students will be able to –

1. Apply a thorough knowledge of methods and techniques applicable to their own research to discover, interpret and communicate new knowledge through original research.
2. Work cohesively with M.Sc. students, research supervisor and other fellow workers, to create, develop and exchange research knowledge
3. Critically and creatively evaluate critical research issues
4. Influence and benefit the society by offering employability
5. Identify open problems and areas needing development in their fields.

## **Program Specific Outcomes (PSOs) and Course Outcomes (COs) of Zoology (Part of B.Sc. Program, offered in combination with other subjects)**

After completion of this programme, the students would be able to:

PSO1: Learn scientific way of classification and identification of animals. Also, understand anatomical, morphological and physiological similarities and differences among non-chordates and chordates

PSO2: Understand the importance and role of every animal in maintaining harmony with the environment for coexistence

PSO3: Understand not only the basic concepts of cell biology, molecular biology, genetics, animal physiology, developmental biology and immunology, but also learn how to apply this knowledge in real life

PSO4: Understand how to apply basic knowledge of zoology in its applied branches like aquaculture, entomology

PSO5: Understand the principles behind every technique used in various biotechniques like filtration, sterilization, separation along with others like microtechnique and biotechnology so as to evolve into skilled and employable workforce

PSO6: Understand and implement basic concepts of biology and blend the knowledge with concepts from other branches of science to have proficiency in interdisciplinary branches like bioinformatics and biostatistics for better analysis of the experimental data

## **Course Outcomes (COs) of Zoology**

After completion of these courses, the students would be able to:

### **Life and Diversity of Animals-Non chordates (Protozoa to Annelida)**

CO1: Understand the general characters of Phylum Protozoa and various taxa under Protozoa up to classes and able to identify animals based on these characters

CO2: Describe anatomical and morphological features of *Paramecium* and *Plasmodium* with the knowledge of their life cycles

CO3: Understand the modes of infection of parasitic protozoans of humans like *Entamoeba*, *Trypanosoma*, *Giardia* and *Leishmania* and learn the methods to control these protozoans

CO4: Describe general characteristics of *Phylum Porifera* and understand classification up to classes

CO5: Understand structure, reproduction and development of *Sycon* as an example of poriferans and understand various types of canal systems in observed in sponges

CO6: Learn general characteristics of Phylum Coelenterata with classification of animals under various taxa up to classes

CO7: Describe structure, life cycle of *Obelia* as representative coelenterate and study dynamics of coelenterate corals communities

CO8: Understand the general characters of Phylum Platyhelminthes and characteristics of different taxa up to classes under the phylum

CO9: Understand life cycle, morphology and reproductive systems of *Ascaris*

CO10: Learn anatomy, morphology and life cycle of *Taenia solium* and parasitic adaptations observed in helminths

CO11: Describe characteristics of Phylum Annelida and various taxa up to classes

CO12: Describe morphology and various systems including digestive and urinogenital systems of Leech

CO13: Understand various life forms during indirect development and study Trochophore larva in details

CO14: Understand importance of worms and practice vermiculture and understand its importance

CO15: Able to handle laboratory equipments, prepare temporary and permanent mountings and understand basic principles of staining

### **Environmental Biology**

CO1: Understand different zones of atmosphere, their importance and components of air

CO2: Learn the global distribution and physico-chemical properties of water

CO3: Describe various types of rocks and understand the process of formation of soil

CO4: Understand the renewable and non- renewable energy sources, the differences between them and their importance

CO5: Understand ecosystem, its types and their importance with example of pond ecosystem

CO6: Understand the meaning and importance of food chains and webs for maintaining balance in the ecosystems and the concept of ecological pyramids

CO7: Describe various models of energy flow in an ecosystem, namely, Single Channel, Y – Shape and Universal model

CO8: Understand the concept and importance of biodiversity, its conservation and causes of depletion of biodiversity

CO9: Study the Wildlife Conservation Acts (1972 and 1984),

CO10: Understand the concept of National parks and sanctuaries with examples of Tadoba, Kanha, Bharatpur and Nagzira

CO11: Describe the concept of hot spots of biodiversity and enlist such hot spots in India

CO12: Describe the causes, effects of water-, noise-, and air-pollution and study various control measures

CO13: Understand the concepts and causes of acid rain, greenhouse effect, ozone depletion leading to global warming; also to study measures to control global warming

CO14: Understand the concepts of bioaccumulation and biomagnifications; describe the effects of heavy metals (lead, cadmium and mercury) on organisms

CO15: Able to understand how to measure pH using pH paper and pH meter; estimate dissolved oxygen and carbon dioxide in water samples by understanding basic principles of titration; study various physical and chemical properties of water

CO16: Prepare temporary and permanent mountings and master principles of staining

### **Life and Diversity of Animals-Nonchordates (Arthropoda to Hemichordata)**

CO1: Understand the general characters of Phylum Arthropoda and categorization of animals into various taxa up to classes

CO2: Learn mouth parts, digestive system and reproductive system of cockroach as representative of arthropods

CO3: Identify various insect vectors, namely, mosquitoes, houseflies, sandflies, Tse-Tse flies and study their importance in completion of life cycles of various pathogens wherever applicable

CO4: Understand indirect development in arthropods and study crustacean larvae, namely, Nauplius, Zoea, and Megalopa

CO5: Understand the concept of social behavior in insects with the example of honeybees; learn the intricacies of behavior of honeybees contributing to their colony

CO6: Learn general characters of Phylum Mollusca and its taxa up to classes

CO7: Understand morphology and digestive, respiratory and reproductive systems of *Pila* that represents Phylum Mollusca

CO8: Understand economic importance of molluscs with reference to pearl formation

CO9: Understand indirect development in molluscs with study of molluscan larvae, namely, Glochidium and Veliger

CO10: Describe general characteristics of Phylum Echinodermata and classify animals into various taxa up to classes

CO11: Describe external features of starfish and study digestive and water vascular systems with a reference to locomotion

CO12: Understand indirect development in echinoderms through Bipinnaria and Auricularia larvae

CO13: Learn about general characters of Phylum Hemichordata and its phylogeny

CO14: Understand reproduction, development through Tornaria larva in *Balanoglossus* and study affinities of *Balanoglossus* with other minor and major phyla

CO15: Achieve fluency in handling laboratory instruments; prepare temporary and permanent mountings

### **Cell Biology**

CO1: Understand the concept of a cell and study ultrastructure of prokaryotic and eukaryotic cell

CO2: Describe various models of structure of plasma membrane with emphasis on Fluid Mosaic Model and understand various functions of plasma membrane

CO3: Understand the ultrastructure and functions of smooth and rough endoplasmic reticulum.

CO4: Understand the ultrastructure and functions of Golgi complex

CO5: Describe structural details of mitochondria and understand the process of oxidative phosphorylation through Glycolysis, Krebs's Cycle, Electron Transport Chain and Terminal Oxidation

CO6: Learn the structural details, concept of polymorphism in lysosomes and their functions

CO7: Describe the ultrastructure of nuclear membrane and understand the importance of it

CO8: Understand the structure, types of chromosomes including Lamp-brush and polytene chromosomes and the concept of nucleosome

CO9: Learn the structure and functions of nucleolus

CO10: Explain structure, types of ribosome with emphasis on Lake's model

CO11: Understand the cell cycle and its phases; also study the importance of synaptonemal complex, crossover and recombination.

CO12: Describe the process and types of cell division, namely, mitosis and meiosis; understand the special uncontrolled cell division leading to cancer and factors responsible for it

CO13: Describe the process of cellular aging and events leading to the apoptosis

CO14: Perform cell biology experiments with available material from plant source to have better understanding of cell biology; able to use information technology resources to have understanding of animal systems

### **Life and Diversity of Animals-Chordates (Protochordata to Amphibia)**

CO1: Describe animals belonging to protochordata up to order scientifically

CO2: Understand the structure and digestive system in *Herdmania*; study the process of development through ascidian tadpole and also to understand retrogressive metamorphosis

CO3: understand morphology and anatomy through various systems, namely, digestive, circulatory, excretory systems and sense organs in *Amphioxus*

CO4: Learn general characters of Cyclostomata with reference to *Petromyzon* and *Myxine*

CO5: Describe characteristics of Chondrichthyes and Osteichthyes

CO6: Understand the evolution of fishes in terms of occurrence of paired fins; learn about occurrence and importance of accessory respiratory organs in fishes

CO7: Study the phenomenon of migration in fishes

CO8: Describe Amphibia and classify the amphibians up to order by studying the identifying characters

CO9: Understand occurrence and importance of parental care and its various types; describe neoteny in Amphibia

CO10: Describe the process of gametogenesis in vertebrates and describe type of eggs and the process of fertilization of eggs based on their types

CO11: With emphasis on fish development, understand post fertilization changes

CO12: Describe types of scales in fishes and study development of placoid scales

CO13: Understand the development of frogs through cleavages, blastulation and gastrulation; learn about various morphogenetic movements with reference to frog gastrula

CO14: Understand the concept and importance of fate map

CO15: Understand the development of respiratory organs and aortic arches in frog

CO16: Prepare permanent preparations of fish scales and other biological samples; understand the histology of various organs of lower vertebrates and fish and frogs

## **Genetics**

CO1: Understand the principles of inheritance with the help of Mendel's experiments and also understand allelic interactions that do not follow Mendelian laws

CO2: Understand the phenomenon of gene interactions with emphasis on epistasis and altered Mendelian ratios

CO3: Understand Quantitative genetics with the help of polygenic traits; understand impact of inbreeding, outbreeding and hybrid vigor on gene pool, gene and allelic frequencies and overall recombination process

CO4: Describe the concept and importance of extracellular genome with reference to mitochondrial DNA and plasmids

CO5: Learn about the phenomenon of inheritance through cytoplasm with reference to *Kappa* particles in *Paramecium*, CO<sub>2</sub> sensitivity in *Drosophila* and milk factor in mice

CO6: Understand theories of linkage, its types and effects of linkage on crossing over

CO7: Understand different concepts of genes, namely, cistron, muton and recon

CO8: Understand the altered physiology and inheritance of genetic disorders in humans with reference to hemoglobin disorders, namely, thalassemia and sickle cell anemia and the metabolic disorder phenylketonuria

CO9: Understand various patterns of sex determination, namely, ZZ, XY, XO and ZW patterns; also describe genic balance mechanism of sex determination in *Drosophila* and role of environment in sex determination of *Bonellia*

CO10: Describe various structural chromosomal aberrations, namely, addition, deletion, duplication and inversion and understand their effects

CO11: Describe numerical chromosomal aberrations with reference to Turner, Klinefelter and Down syndromes

CO12: Understand the concept of mutations and describe spontaneous and induced mutations; also describe various types of mutagenic agents and their effects on DNA sequences and expressions

CO13: Understand the concept of lethal genes and the consequences

CO14: Learn the basic concepts of population genetics with emphasis on Hardy Weinberg equilibrium

CO15: Understand the importance of genetic counseling to deal with various hereditary diseases and disorders

CO16: Describe the use and importance of DNA fingerprinting, amniocentesis and karyotyping techniques and the usefulness of sperm banks to understand the applicability of genetics

CO17: Demonstrate the genetic crosses using coloured beads to understand Mendelian principles; perform population surveys for various traits and testing the hypothesis with appropriate statistical tools

CO18: Understand the Hardy-Weinberg principle with suitable example and perform calculations to find out gene and allele frequencies in a population

### **Life and Diversity of Animals-Chordates (Reptilia, Aves and Mammals)**

CO1: Understand the classification of reptiles considering the temporal vacuities

CO2: Study snakes with reference to the poison apparatus, biting mechanism and also understand the importance of snake venom

CO3: Compare Ratitae with Caranitae; understand flight adaptations

CO4: Understand Migration in birds

CO5: Describe the general characters of subclasses Prototheria, Metatheria and Eutheria of class Mammalia

CO6: Understand and discuss Darwinism and Neo-Darwinism

CO7: Understand the cursorial, aquatic, terrestrial, fossorial and volant adaptations with suitable examples

CO8: Describe the genetic basis of evolution with reference to species and demes and the variations responsible for the process

CO8: Understand the Caucasoid, Negroid, Mongoloid and Australoid races in man to know more about racial differences among the members of the same species

CO10: Compare aortic arches and hearts in reptiles, birds and mammals

CO11: Understand the structure of egg of a hen and study the development of chick embryo up to primitive streak stage

CO12: Understand the development and functions of extra embryonic membranes in chick

CO13: Describe structure and the importance of blastocyst in mammals



CO14: Describe implantation of embryo in mammals; study types of placenta on the basis of morphological and histological structures and the functions

CO15: Understand the concept of stem cells; study the sources, types and importance of stem cells in human welfare

CO16: Understand the behavior in birds with respect to the diurnal and rhythmic behavior and pheromones and reproductive behavior in mammals

CO17: Discuss the skeletal systems in birds and mammals with examples of fowl and rabbit respectively

CO18: Prepare permanent mountings of chick embryos representing various developmental milestones

### **Molecular Biology and Immunology**

CO1: Understand the landmark experiments that proved DNA and RNA as genetic materials

CO2: Understand the intricacies of the proposed and accepted models for structures of DNA

CO3: Learn about various forms of DNA, their properties and understand the physico-chemical parameters in which those forms exist

CO4: Understand various forms of RNA and describe their structures, their properties and roles in cellular physiology

CO5: Understand structural details of the prokaryotic and eukaryotic genes and describe various other structural elements regulating these genes

CO6: Describe Griffith's experiment to understand bacterial transformation; also learn about other modes of recombination, namely, conjugation and transduction in bacteria

CO7: Understand various experiments including Meselson-Stahl experiment which helped understand the replication process

CO8: Describe the semiconservative model of replication with the help of concepts like origin of replication and directionality of replication

CO9: Learn about the concept and characteristics of genetic code including Wobble hypothesis

CO10: Understand the mechanism of processes transcription and translation with various regulating factors to describe the process of protein synthesis

CO11: Understand regulation of gene expression with emphasis on Lac operon and Trp operon

CO12: Describe the concept of immunity and understand the importance of having an immune system; study innate and acquired immunity in addition to different organs of the immune system

CO13: Understand the basics of structure, diversity, functions and types of antigens and antibodies

CO14: Understand the mechanism of antigen-antibody interactions based on structural details to explain humoral immunity

CO15: Understand the intricacies of the B cell response and the T cell response to understand the humoral as well as cell mediated immunity

CO16: Understand the concept and pathways of the complement system and its importance

CO17: Describe one of the most important the molecular players of the immune response which are cytokines and learn about cytokines related disorders

CO18: Describe impaired immune system causing autoimmune diseases and learn about the ways in which those can be treated

CO19: Understand the immunodeficiencies including AIDS and others and understand the ways to manage those diseases

CO19: Understand the principles and working of laboratory instruments used in molecular biology experiments; learn to stain nucleic acids and also to isolate DNA from a suitable source

CO20: Demonstrate the antigen-antibody interaction and learn about organs of the immune system

### **General Mammalian Physiology-I: Enzymology; digestive, respiratory and circulatory systems**

CO1: Understand the concept, chemical nature and distribution of enzymes

CO2: Describe the general properties and classification of enzymes

CO3; Understand various physico-chemical factors and conditions affecting the enzyme action

CO4: Describe the histology and physiology of digestive glands, namely, salivary, gastric, intestinal glands, liver and pancreas

CO5: Understand the endocrinology of gastrointestinal hormones

CO6: Understand the physiology of digestion and absorption of proteins, carbohydrates and lipids

CO7: Describe various fat soluble and water soluble vitamins with reference to their sources, the deficiencies and related diseases

CO8: Learn about the types, distribution and the physico-chemical properties including binding dynamics with the respiratory gases of various respiratory pigments

CO9: Understand the detailed mechanism of respiration including transport of O<sub>2</sub> and CO<sub>2</sub> along with various respiratory pigments and working of respiratory organs

CO10: Understand the disorders of respiratory systems with special reference to effect of smoking

CO11: Learn about normal and abnormal constituents and functions of blood

CO12: Describe the importance of intrinsic and extrinsic blood clotting factors and understand the principles behind ABO blood grouping system and Rh factor

CO13: Learn about different phases of cardiac cycle; understand the principle behind ECG and describe various factors regulating blood pressure

CO14: Demonstrate enzyme action on substrate by using salivary amylase

CO15: Perform detection tests for carbohydrates, proteins and fats

CO16: Detect presence of vitamins A and C

CO17: Measure total WBC and RBC counts; demonstrate presence of haemin crystals

CO18: Measure lung capacity by using suitable method

CO19: Understand the histology of various mammalian organs with the help of available permanent slides

### **Applied Zoology-I (Aquaculture and Economic Entomology)**

CO1: Understand and discuss the parameters used for construction of various ponds used for rearing various stages of fish

CO2: Explain breeding of fishes by bund and Chinese hatcheries and understand the practice and importance of induced breeding using hypophysation and the new generation drugs

CO3: Explain different culture methods, namely, polyculture, cage culture, sewage fed fish culture and integrated fish farming

CO4: Learn about commercial aspects of aquaculture by studying fish products and byproducts and study different methods of fish preservation

CO5: Explore commercial aspects aquaculture with respect to prawn culture and pearl culture

CO6: Understand commercial setup required for culturing aquarium fish species and study the process of fabrication and setting up of aquaria, their maintenance and breeding of aquarium fishes

CO7: Learn about different diseases caused by different causative agents, namely, fungi, bacteria, protozoa and helminths

CO8: Describe the use, mode of action, merits and demerits of using different classes of chemicals as insecticides

CO9: Explain use, merits and demerits of using predators and parasites as biological control agents for insect pests

CO10: Describe the life cycle of, damage caused by and control measures for plant pests, *Earias vitella*, *Sitophilus oryzae* and animal pests *Musca nebulosa* and *Stomoxys calcitrans*

CO11: Explain life cycles, rearing methods of different species of silkworms, namely, *Bombyx mori* and *Antheraea mylitta*

CO12: Understand cocoon processing steps for synthesis of silk fabric, namely, cocoon boiling, reeling, re-reeling, winding, doubling, twisting and weaving

CO13: Explain types, life cycles of honey bees and explain methods of apiculture along with commercial importance of bee products

CO14: Understand the life cycle of the lac insect, *Laccifer lacca* and the processing of raw lac to prepare various products and understand their economic importance

CO15: Describe the economically important food and aquarium fishes; study various systems through virtual dissection or through other available media; prepare permanent mountings of scales and zooplanktons following ethical guidelines

CO16: Describe various economically important insect species; study various mountings related to insects

CO17: Understand different breeding/ rearing setups by visiting different facilities/ educational centres

### **General Mammalian Physiology-II: Nervous, muscular, excretory, endocrine and reproductive systems**

CO1: Describe neuronal cell types and understand the structure of neurons including electron micrographs of different regions of neurons

CO2: Understand the conduction of impulse across the nerve

CO3: Understand the ultrastructure of a striated muscle and the physiology of muscle contraction with the help of sliding filament theory

CO4: Describe various properties of muscles, namely, twitch, tetanus, tonus, summation, *All or None Principle* and muscle fatigue with better understanding of muscle physiology

CO5: Learn about the structural details of a uriniferous tubule

CO6: Understand the mechanism of urine formation with emphasis on counter – current mechanism and describe the idea of dialysis

CO7; Describe normal and abnormal constituents of urine

CO8: Understand the position, morphology, histology and physiology of the pituitary, thyroid, parathyroid, adrenal and pineal glands

CO9: Understand the oestrous and menstrual cycles to describe reproductive physiology of females

CO10: Describe the chemical nature and functions of male and female sex hormones

CO11: Describe the causes of infertility in males and females

CO12: Understand the concept and importance of contraception and describe different mechanical and hormonal contraceptives

CO13: Understand the concept and importance of *in vitro* fertilization

CO14: Perform experiments for detection of various normal and abnormal constituents of urine

CO15: Perform qualitative analysis of the semen sample

CO16: Study different endocrine gland of fish with suitable diagrams/ digital tools

CO17: Observe various histological slides to understand the ultrastructure of various organs of muscular, nervous, endocrine, reproductive and excretory systems

### **Applied Zoology-II: Biotechniques, Microtechnique, Biotechnology, Bioinformatics and Biostatistics**

CO1: Explain various techniques of sterilization from crude to the most sophisticated techniques, namely, filtration, autoclaving, dry heat sterilization, wet sterilization and radiation

CO2: Understand various separation techniques, namely, centrifugation, chromatography, agarose gel electrophoresis, SDS-PAGE

CO3: Describe the working principles of colorimeter and spectrophotometers

CO4: Understand basics of microtomy and the steps involved from tissue fixation to section cutting and also understand the ways of troubleshooting the process of microtomy/ section cutting and the spreading of tissue sections

CO5: Understanding the basic concepts of staining with various kinds of stains and describe double staining using haematoxylin and eosin

CO6: Describe basics and practical applications of histochemical staining techniques for carbohydrates, proteins and lipids

CO7: Understand basic concepts of recombinant DNA technology and describe the types and uses of DNA manipulation enzymes

CO8: Learn the theoretical aspects of shotgun cloning

CO9: Understand the concept of cloning vectors, their types and the merits and limitations

CO10: Understand the principles behind insertion of DNA fragment and ligation using blunt and cohesive ends

CO11: Describe the application of biotechnology for recombinant insulin and vaccine production

CO12: Understand the basic concepts, importance and role of bioinformatics in life sciences and describe the concept and types of databases used in bioinformatics including nucleotide and protein databases

CO13: Understand the concept and importance of biostatistics and learn about tabulation and presentation of data

CO14: Understand the meaning and importance concepts used in biostatistics, namely, sampling errors, mean, mode, median, probability, standard error and standard deviation

CO15: Perform experiments related to use of various biotechniques studied in theory including sterilization and separation techniques

CO16: Get acquainted with microtechnique and staining procedures

CO17: Use computer software to analyze biological data using statistical tools

CO18: Practice using various basic computer programmes

CO19: Perform specific searches related to biological information using bioinformatic tools and databases

CO20: Understand working principles of various sophisticated instruments by visiting biotechnology institutions and research centres

## **PROGRAM OUTCOMES, PROGRAM SPECIFIC OUTCOMES, AND COURSE OUTCOMES OF MSC ZOOLOGY**

### **PROGRAM OUTCOMES OF MSC ZOOLOGY**

PO1: Develop the ability to think logically

PO2: Increase the power of observation

PO3: Develop scientific temper

PO4: Improve verbal and written communication skills

PO5: Systematic management and analysis of data

PO6: Preparation for successful career

### **PROGRAM SPECIFIC OUTCOMES OF M.SC. ZOOLOGY**

PSO1: Developing a good understanding of animal science

PSO2: Learning to use scientific instruments

PSO3: Ability to conduct animal science experiments and projects

PSO4: Skill to derive logical inferences from animal science experiments

PSO5: Systematic management and analysis of scientific data

PSO6: Developing entrepreneurial skills in the field of animal science

### **COURSE OUTCOMES OF SUBJECT ZOOLOGY (AS PART OF M.SC. COURSE)**

#### **Structure and Function of Invertebrates**

CO1: Understanding of invertebrate taxonomy

CO2: Knowledge of origin of metazoans

CO3: Understanding of protozoa

CO4: Awareness of primitive invertebrate groups

CO5: Knowledge of the evolution of coelom and organ systems

#### **General Physiology**

CO1: Knowledge of enzymes

CO2: Awareness of respiratory pigments

CO3: Understanding of bioluminescence mechanism

CO4: Mechanism of working of heart

CO5: Understanding physiology of environmental stress

#### **Cell Biology and Genetics**

CO1: Understanding of membrane structure and function

CO2: Knowledge of cell signalling mechanism

CO3: Understanding of genetics of cancer

CO4: Knowledge of inheritance

CO5: Awareness of human genetics

#### **Advanced Reproductive Biology**

CO1: Understanding of sexual and asexual reproduction

CO2: Awareness of Spermatogenesis

CO3: Knowledge of accessory glands and semen

CO4: Knowledge of cryopreservation

CO5: Understanding of in-vitro fertilization

#### **Structure and Function of Vertebrates**

CO1: Understanding of origin of chordata

CO2: Knowledge of respiration in fish and amphibians

CO3: Understanding of appendicular skeleton

CO4: Awareness of origin of birds

CO5: Knowledge of nervous system in vertebrates

### **Comparative Endocrinology**

- CO1: Knowledge of neuroendocrine system in invertebrates
- CO2: Knowledge of neuroendocrine system in insects
- CO3: Understanding of major endocrine glands
- CO4: Awareness of gastro-entro endocrine system
- CO5: Understanding of gonadal hormones

### **Molecular Biology and Biotechnology**

- CO1: Knowledge of DNA replication
- CO2: Understanding of transcription
- CO3: Understanding of translation mechanism
- CO4: Awareness of biotechnology techniques
- CO5: Knowledge of medical biotechnology

### **Advanced Developmental Biology**

- CO1: Understanding of placenta
- CO2: Knowledge of amphibian metamorphosis
- CO3: Awareness of regeneration, ageing
- CO4: Understanding of animal cloning
- CO5: Knowledge of contraception

### **Parasitology and Immunology**

- CO1: Knowledge of disease causing bacteria
- CO2: Knowledge of disease causing protozoa
- CO3: Understanding of immune system
- CO4: Awareness of immune response
- CO5: Understanding of tumour immunology

### **Entomology-I**

- CO1: Knowledge of insect anatomy
- CO2: Understanding of wing structure
- CO3: Awareness of various systems
- CO4: Understanding of exocrine glands
- CO5: Knowledge of insect reproductive system

### **Entomology-II**

- CO1: Understanding of insect classification
- CO2: Knowledge of major insect orders
- CO3: Understanding of mulberry silkworm
- CO4: Awareness of lac insect biology
- CO5: Knowledge of wild silkworm culture

### **Wild Life and Avian Biology**

- CO1: Knowledge of conservation
- CO2: Understanding of predator-prey relationship



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CO3: Awareness of wildlife management  
CO4: Knowledge of morphology of birds  
CO5: Understanding of bird diversity and breeding

### **Biotechnique, Biostatistics, Ethology, Toxicology and Bioinformatics**

CO1: Knowledge of animal tissue culture  
CO2: Awareness of basic biostatistics  
CO3: Knowledge of basic toxicology  
CO4: Understanding of various toxicity tests  
CO5: Knowledge of bioinformatics

### **Entomology-III**

CO1: Understanding of insect sense organs  
CO2: Knowledge of sensory receptors  
CO3: Awareness of insect immunity  
CO4: Knowledge of social life in insects  
CO5: Understanding of major pests

### **Entomology-IV**

CO1: Knowledge of insecticides  
CO2: Understanding of biological control  
CO3: Awareness of pest control methods  
CO4: Knowledge of animal pests  
CO5: Understanding of pests affecting human

### **Radiation and Chronobiology**

CO1: Understanding of radiation biology  
CO2: Knowledge of health effects of radiation  
CO3: Awareness of biological clock  
CO4: Understanding of circadian rhythms  
CO5: Knowledge of chronotherapy

## **Program Specific Outcomes and Course Outcomes**

### **Department of Chemistry**

### **B. Sc. Chemistry**

<b>Department of Chemistry</b>	After successful completion of three year degree (Semester-I to VI) program in Chemistry a student should be able to;
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<b>Program Specific Outcomes</b>	<p>PSO-1. Gain the knowledge of Chemistry through theory and practical's.</p> <p>PSO-2. To explain nomenclature, stereochemistry, structures, reactivity, and mechanism of the chemical reactions.</p> <p>PSO-3. Identify chemical formulae and solve numerical problems.</p> <p>PSO-4. Use modern chemical tools, Models, Chem draw, Charts and Equipments.</p> <p>PSO-5. Know structure-activity relationship.</p> <p>PSO-6. Understand good laboratory practices and safety.</p> <p>PSO-7. Develop research oriented skills.</p> <p>PSO-8. Make aware and handle the sophisticated instruments/ equipments.</p> <p>PSO-9. Demonstrate, solve and an understanding of major concepts in all disciplines of chemistry.</p> <p>PSO-10. Solve the problem and also think methodically, independently and draw a logical conclusion.</p> <p>PSO-11. Create an awareness of the impact of chemistry on the environment, society and development outside the scientific community.</p> <p>PSO-12. Find out the green root for chemical reaction for sustainable development.</p> <p>PSO-13. To inculcate the scientific temperament in the students and outside the scientific community.</p>
<b>COURSE OUTCOME B. Sc. CHEMISTRY SEMESTER I</b>	
<b>Course</b>	<b>Outcomes</b> After completion of these courses students should be able to;
<b>Paper-I (CH-101) INORGANIC CHEMISTRY</b>	<p>CO-1. To study the periodic properties of elements.</p> <p>CO-2. To explain the formation of different types of bonds.</p> <p>CO-3. To predict the geometry of simple molecules.</p> <p>CO -4. To explain the different types of Hybridization and draw shape of simple covalent bonds.</p> <p>CO – 5. To understand the molecular orbital theory of diatomic theory.</p>
<b>Paper-II (CH-102) PHYSICAL CHEMISTRY</b>	<p>CO-1. To understand the concept of thermodynamics and thermo chemistry and how to know the spontaneity of chemical reaction.</p> <p>CO-2. To know the different gases law and their derivation. Relation of pressure, temperature and volume of gases.</p> <p>CO-3. To discuss the liquid state and understand the properties of liquid state. To know the different structure of liquid.</p>
	<p>CO-4. To study distinguish between adsorption and absorption. Role of catalyst in chemical reaction. Different factor affect the rate of catalyst.</p>

<b>CH-103: Laboratory Course</b>	After completion of these courses students should be able to; Students will be able to investigate different metal salts by using inorganic qualitative analysis. Students are able to understand various properties of liquids i.e. surface tension, refractive index, viscosity
<b>COURSE OUTCOME B. Sc. CHEMISTRY SEMESTER II</b>	
<b>PAPER-I (CH-201) ORGANIC CHEMISTRY</b>	CO-1. To study the structure of organic molecules using hybridization, bond length, bond angle and bond energies. To study the electronic effects of organic reaction. To learn about definition, types and consequences of hydrogen bonding in organic molecule. To learn basics terminology in organic reaction mechanism (type of reaction and reaction intermediates) CO-2. To learn stereochemistry of a molecule and D and L and R & S system of nomenclature. To learn geometrical isomerism of organic molecule and E & Z system of nomenclature. To learn Newman's projection and Sawhorse formulae CO-3. To study what are alkanes and cycloalkane, nomenclature, physical and chemical properties of alkanes. To study what are alkenes, nomenclature, physical and chemical properties of alkenes. To learn mechanism of free radical and addition reaction. CO-4. To learn nomenclature, classification of dienes and preparation and chemical properties of dienes. To study what are alkynes classification, nomenclature, physical and chemical properties of alkyne. To learn Huckel rule for aromatic, anti aromatic compound, and MO structure of aromatic structure.
<b>PAPER-II (CH-202) PHYSICAL CHEMISTRY</b>	CO-1. To study the second law of thermodynamics; Carnot cycle and advance application. CO-2. To know the different terms use in phase and phase equilibrium. Detail description on phase diagram. CO-3. To study the nuclear chemistry different molecular structure. CO-4. To study the rate of reaction, rate constant and factor affecting on rate of reaction.
<b>CH-203: Laboratory Course</b>	After completion of these courses students should be able to; Students will able to analyze organic compounds by organic qualitative analysis method. Students will able to synthesize simple molecule like benzamide and benzaldehyde. Students will able to use various techniques useful for analysis such as calorimetry, conductometry.
<b>COURSE OUTCOMES B. Sc. CHEMISTRY SEMESTER- III</b>	
<b>PAPER-I (CH-301) INORGANIC</b>	CO-1. To understand the general characteristics of the d & f block elements. CO – 2. To study the physical and chemical properties of d & f blocks.

<b>CHEMISTRY</b>	CO – 3. To study the Werner's Theory of coordination compounds. CO - 4. To study the isomerism in metal complexes. CO – 5. To study the application of d block elements.
<b>PAPER-II (CH-302) ORGANIC CHEMISTRY</b>	CO-1 To learn Activating and deactivating substituents, method of formation and chemical reaction of alkyl benzene. To learn definition, classification, method of preparation of mono, tri.a alkyl halide and their derivatives. To study SN1 and SN2 reaction mechanism. CO- 2. To learn nomenclature, classification, method of preparation of alcohols. To learn chemical reaction of glycol and Pinacol. Pinacolone reaction. To learn nomenclature, structure and bonding and chemical reaction of phenol. To study the mechanism of name reaction involve in preparation and chemical reaction of phenol. CO- 3. To study the mechanism of benzoic, benzoin, aldol, Perkin and Knoevenagel condensation, Wittig reaction, Mannich reaction. To study oxidation of aldehydes (by KMnO <sub>4</sub> , Tollens reagent and Fehling's solution), Baeyer-Villiger. To learn mechanism of Cannizzaro reaction, MPV, Clemmensen, Wolf-Kishner, LiAlH <sub>4</sub> and NaBH <sub>4</sub> reductions. CO-4. To study classification, nomenclature, method of preparation and chemical reaction of carboxylic acid and their derivatives.
<b>CH- 303: Laboratory Course</b>	After completion of these courses students should be able to; Perform volumetric analysis for the estimation of Zn, Fe and alkali content in given sample. Identify given organic compound by organic qualitative analysis.
<b>COURSE OUTCOME B. Sc. CHEMISTRY SEMESTER IV</b>	

<p><b>PAPER-I (CH-401) INORGANIC CHEMISTRY</b></p>	<p>CO -1. To understand the nomenclature, classification and properties of coordination compounds. To be able to name coordination compounds and to be able to draw the structure based on its name. Categorize coordination compounds, Relate VBT and hybridization. Discuss VBT and predict the geometry of coordination compounds and type of hybridization. Consider Effective atomic number theory and Werner complexes and correlate lewis structure.</p> <p>CO -2. To be able to differentiate between structural and Geometrical isomers in a coordination complexes or complex ions. To be able to define ionization, linkage, hydrate, coordination and polymerization isomers (structural isomer classes). To be able to define Cis /Trans and Mer /fac isomerisation (Geometric isomer class). To be able to recognise the types of isomerism in given coordination compounds. Construct and be proficient with Latimer diagrams, using them to determine unknown reduction potential values and to quickly identify stable and unstable species. Construct and be proficient with Frost diagrams, using them to identify stable and unstable species as well as those that are strong oxidizers. Construct and be proficient with Pourbaix diagrams, using them to identify redox and non-redox reactions, that are pH dependent and ultimately to predict and rationalize stability, reactivity, corrosion and passivation.</p> <p>CO -3. To be able to understand the need for separation of substances, apply different methods to separate the components of a mixture. Determine appropriate chromatographic technique and approach for</p>
	<p>analysis. Comprehend the optimization of chromatographic methods. Critically evaluate the quality of acquired data. To be able to understand theory of ion-exchange chromatography, cation and anion exchange media, Column packing and procedure of ion-exchange chromatography and its application..</p> <p>CO -4. Define inorganic polymer, list their properties and classify inorganic polymers. Recognise phosphorus, Phosphorus-nitrogen compounds and polymers, interpret synthetic methods and their application areas. Define synthesis methods of polyphosphate and polyphosphazenes. Explain polyphosphazenes and their characteristics. Relate applications of Inorganic Polymers in Technology.</p>
<p><b>PAPER-II (CH-402) PHYSICAL CHEMISTRY</b></p>	<p>CO-1. To know the state of matter especially about solid state and different method to know the structure of solid.</p> <p>CO-2. To study the relation between chemicals and electric current and different application.</p> <p>CO-3. To introduction about spectrochemistry and discussion about rotational and vibrational spectroscopy.</p> <p>CO-4. To understand quantum chemistry and Schrödinger wave equation and other terms.</p>

<b>CH- 403: Laboratory Course</b>	After completion of these courses students should be able to; Perform gravimetric analysis of Ni, Ba. To estimate amount of constituents present in given solution by conductometer, potentiometer.
<b>COURSE OUTCOME B. Sc. CHEMISTRY SEMESTER V</b>	
<b>PAPER-I (CH-501) ORGANIC CHEMISTRY</b>	CO-1. To learn chemical, physical and stereochemistry aspects of nitrogen containing compounds. CO-2. To study the definition of heterocyclic compound and classification; five member and six membered heterocyclic compound. CO-3. To learn Calculation of Empirical and molecular formula with Numerical. To learn preparation and chemical properties and uses of 1) Organo Magnesium 2) organo Lithium and 3) organo Zinc compound CO- 4. To study principle and basics of electronic spectra. To learn principle and application of infrared absorption.
<b>PAPER-II (CH-502) PHYSICAL CHEMISTRY</b>	CO-1. To study advance application of electrochemistry and different cell. Discussion on different electrodes. CO-2. To study quantum numbers, quantum chemistry and molecular orbital theory. CO-3. To gain the knowledge of photochemistry, laws of photochemistry and detail introduction on Raman spectroscopy. CO-4. To study solution, colligative property, osmosis, osmotic pressure and macromolecules.
<b>CH- 503: Laboratory Course</b>	After completion of these courses students should be able to; Perform estimation of different functional groups present in organic compound. Perform analysis based on viscosity, colorimetry, refractometry.
<b>COURSE OUTCOMES B. Sc. CHEMISTRY SEMESTER- VI</b>	

<p><b>PAPER-I (CH-601) INORGANIC CHEMISTRY</b></p>	<p>CO-1. Describe and explain the bonding in d- metal complexes using CFT. To be able to use CFT to understand the magnetic properties and in simple terms the colour of coordination compounds. Get a clear idea about orbital and spin magnetic moments and also of d-d transition along with spectro chemical series of ligands. To predict relative stability of metal complexes with different ligands.</p> <p>CO-2. Students will demonstrate knowledge of organometallic Chemistry, learn historical background of metal carbonyl complexes. Learn Co ligand and its binding ability to metal. Understand Synergism between the ligand to metal forward sigma donation and the metal to ligand backward pi donation observed in a metal- CO interaction. Metal carbonyls, hydrocarbon and carbocyclic ligands, 18-electron rule, synthesis and properties, pattern of reactivity.</p> <p>CO-3. To understand bioinorganic chemistry of haemoglobin, myoglobin etc. Students are able to describe role of different metal ions in biological system. Students are able to recognize role of porphyrin ring in haemoglobin. To be able to understand about the acid-base equilibria in aqueous solution and pH, acid-base neutralization curves. Acquire thorough knowledge about the toxic effects of different metal ions and diseases caused. Understand and classify Acid and base on the basis of SHAB concept.</p>
<p><b>PAPER-II (CH-602) ORGANIC CHEMISTRY</b></p>	<p>CO -1. To study the basic principle and terminology in NMR spectroscopy. To study Chemical shift, Spin-spin splitting and Coupling constant. Areas of signals. Interpretation of NMR spectra of organic molecules. To elucidate the structure of organic molecule by NMR technique.</p> <p>CO -2. To learn the synthesis of organic compound via enolate. To study definition, classification and structural information of carboxylic acid.</p> <p>CO-3. To learn definition, classification and stereochemistry of amino acid and peptides. To learn nomenclature, classification and structure determination of protein. To learn preparation and mechanism of action of soap. To know classification of oils and fats and their reactions</p> <p>CO-4. To learn colour and constitute and method of preparation of dyes. To learn Definition, Classification, Preparation, properties and uses of synthetic drugs (:Aspirin, Paracetamol, Dettol, Chloroquine, Phenobarbitone, Chloramphenicol, Chloramine T). To learn definition and method of polymerization.</p>
<p><b>CH- 603: Laboratory Course</b></p>	<p>After completion of these courses students should be able to;</p> <p>Perform estimation of <math>Ni^{2+}</math> &amp; <math>Ba^{2+}</math>.</p> <p>Perform colorimetric estimation <math>Cu^{2+}</math>; Fe-SSA analysis by Mole-ratio &amp; Job method.</p> <p>Separation of two components organic mixture using NaOH /NaHCO<sub>3</sub> and identify the separated components with suitable derivatives.</p>

Post Graduate Teaching Department of Chemistry **M. Sc. Chemistry**

PROGRAM SPECIFIC OUTCOME	
PSO- 1	Chemistry Knowledge: Possess knowledge and comprehension of the core and basic knowledge associates with the profession of chemistry, including specialized area of inorganic chemistry, organic chemistry, physical chemistry, analytical chemistry, and elective subjects of medicinal chemistry, nuclear chemistry, polymer chemistry and environmental chemistry.
PSO- 2	Problem analysis & Modern tool usage: Utilize the principle of scientific enquiry, thinking analytically, clearly and critically, while solving problems and making decision. Find analyze, evaluate and apply information systematically and to make defensible decisions, learn select and apply appropriate methods and procedures recourses and modern chemistry- related to computing tools with an understanding of the limitations.
PSO- 3	Environment and sustainability: Understand the impact of the professional chemistry solution in social and environmental contexts, and demonstrate the knowledge of, and need for sustainable knowledge.
PSO- 4	Life - long learning: Recognize the need for, and have the preparation and ability to engage in independent and life long learning in the broadest context of technological change. Self access and use feedback effectively from others to identify learning needs and to satisfy these needs on an ongoing basis.
PSO- 5	Leadership skills: Understand and considered the human reaction to change, motivation issues, leadership and team building when planning changes requires for fulfillment of practice, professional and social responsibilities. Assume participatory role as a responsible citizen or leadership roles when appropriate to facilitate improvement in health and well being.
PSO- 6	Professional identity; Understand, analyze and communicate the value of their professional role in the society (e.g., environmental professionals, analytical professionals, educators, researchers, employers and employees).
PSO- 7	Communication: Communicate effectively with the society at large, such as being able to comprehend and write effective reports and make effective representation and documentation, and give and receive clear instructions.



<b>M. Sc. Chemistry</b>	
<b>COURSE OUTCOME; M. SC. SEMESTER-I</b>	
<b>Course name: Inorganic Chemistry (CH-1T1)</b>	
CO 1	Be able to predict the geometry of individual molecules or complexes.
CO 2	Be able to understand the complex formation in equilibria in solution and to know unusual methods to study of reaction rates.
CO 3	With informed with boron hydrides, or poly boranes which are the original cluster compound as well as the first known family of electron-deficient compounds.
CO 4	Be able to study of clustering of metal atoms.
<b>Course name: Organic Chemistry (CH-1T2)</b>	
CO 1	Be able to understand the applicability of concepts like delocalized bonding, conjugation, cross-conjugation, resonance, in various carbon containing compounds and develop the understanding of the reactive intermediates.
CO 2	Be able to study the optical activity in compounds without chirality and analyze stereo chemical aspects involved in various compounds and the corresponding chemical reactions.
CO 3	Be able to understand mechanism of various substitution nucleophilic reactions and get basic knowledge about archimeric assistance and isotope effect.
CO 4	Be able to understand the mechanism of various aromatic nucleophilic and electrophilic substitution reactions and get acquainted with assorted outcomes like resonance, field, steric effects and its quantitative treatment.
<b>Course name: Physical Chemistry (CH-1T3)</b>	
CO 1	Get acquainted with various law of thermodynamics ad its application
CO 2	Be able to understand partial molar quantities, its determination and reduced phase rule in various component system.
CO 3	Be able to recapulation of terms of surface tension and different adsorption isotherms and to be able to validate the newly developed analytical methods as well as reported methods.

CO 4	Able to propose some new methods or modify existing methods of qualitative and quantitative analysis.
<b>Course name: Analytical Chemistry (CH-1T4)</b>	
CO 1	Get acquainted with various terminology and fundamentals of analytical chemistry including classical and instrumental methods.
CO 2	Recapitulate the separation technique like chromatography.
CO 3	Be able to explain analytical techniques in terms of the working principles of volumetric and gravimetric.
CO 4	Able to propose some new methods or modify existing methods of quantitative and qualitative analysis.

<b>Course name: Practical Inorganic Chemistry (CH-1T1)</b>	
CO	Be able to understand the basic principles coloration in metal complexes and, preparation of metal complexes.
<b>Course name: Practical Physical Chemistry (CH-1T1)</b>	
CO	Be able to understand the principle of physical chemistry and interpret them through small experimental performance.
<b>Course name: Seminar (CH-1S1)</b>	
CO	On completion of seminar, the student will be in a position to present the topic in front of subject audience that will enhance confidence level and lead to personality development.
<b>COURSE OUTCOME; M. SC. SEMESTER-II</b>	
<b>Course name: Inorganic Chemistry (CH-2T1)</b>	
CO 1	Will be able to understand the origin of colors in the complexes and their magnetic behavior.
CO 2	Develop ability to understand various reactions of transition metal complexes.
CO 3	Will know the concept of bonding in various metal carbonyls.
CO 4	Will be able know chemistry behind the metal nitrosyl.
<b>Course name: Organic Chemistry (CH-2T2)</b>	

CO 1	Be able to acquire the knowledge and understand applicability of carbon carbon multiple bond and carbon hetero atom multiple bond, addition reaction and develop understanding of reaction mechanism in metal hydride reaction.
CO 2	Be able to analyze various mechanism of molecular rearrangement and concept of elimination reaction.
CO 3	Be able to understand free radical reaction.
CO 4	Be able to comprehend various aspects of green chemistry.
<b>Course name: Physical Chemistry (CH-2T3)</b>	
CO 1	Be able to understand the Eigen value and Eigen function and application of Schrodinger wave function to various systems.
CO 2	Be able to determine the activity coefficients and ionic strength.
CO 3	Able to identify symmetry in crystals.
CO 4	Get the knowledge about various statistics and understand and working of different counters.

<b>Course name: Analytical Chemistry (CH-2T4)</b>	
CO 1	Be able to understand the working, principle and techniques involved in methods of analysis
CO 2	Be able to explain the advantages of modern methods over the classical ones.
CO 3	Apply the principles of spectroscopic techniques in the quantitative and qualitative analysis of various samples.
CO 4	Be able to develop their own methods of quantitative analysis of metal ions using instrumental methods.
<b>Course name: Practical Organic Chemistry (CH-2P1)</b>	
CO	Be able to perform the quantitative analysis of organic binary mixture and able to get hands on training for the synthesis of commercially important organic compounds (single and two stage organic reaction).
<b>Course name: Practical Analytical Chemistry (CH-2P2)</b>	
CO	Get expertise in titrimetric analysis based on neutralization, precipitation, redox, and complexometric analysis, gravimetric estimation of barium and calcium, separation technique of paper

	chromatography and electro analytical techniques as potentiometry, conductometry and optical method like colorimetry.
<b>Course name: Seminar (CH-2S1)</b>	
CO	On completion of seminar, the student will have an improved knowledge about the subject and will be in a position to present the topic more confidently.
<b>COURSE OUTCOME; M. SC. SEMESTER-III</b>	
<b>Course name: Organic Chemistry Special Paper I (CH-3T1)</b>	
CO 1	Be able to explain what happen when organic molecule are excited by irradiation and be capable to discuss the photochemistry in nature and in various photochemical reaction.
CO 2	Pericyclic reaction is used in very vast way in nature and also by organic chemist. This course gives the students the theoretical basis of this kind of reaction and also helps them to find a way to carry out these types of reaction
CO 3	Get well versed with the various oxidation and reducing agents and the stereo chemical aspects involved in various chemical reactions.
CO 4	Acquire knowledge about the chemistry of compounds of phosphorus and sulfur and their application of organo boranes and organo silicon compounds in organic synthesis.
<b>Course name: Organic Chemistry Special Paper II (CH-3T2)</b>	

CO 1	Be able to acquire knowledge about terpenoids and porphyrines, the stereochemistry involved along with the structure determination and synthesis of some representative molecules.
CO 2	Be able to build learning about alkanoids, the stereochemistry involved along with structure determination and acquire brief idea about prostaglands.
CO 3	Be able to develop understanding of steroid chemistry and plant pigments.
CO 4	Be able to quantify the contribution of carbohydrates in nature and get as well versed with properties of amino acids, and structural features of polypeptides.
<b>Course name: Medicinal Chemistry Elective Paper (CH-3T3)</b>	

CO 1	Became acquainted with various terminology and fundamentals of drug designing including classical method for QSAR
CO 2	Be able to study pharmacokinetics and pharmacodynamic aspects of drug metabolism and would be able to acquire knowledge and applicability of diuretic and the analgesic and antipyretic drugs.
CO 3	Be able to get well versed either cardiovascular and antineoplastic agents and their applicability.
CO 4	Able to develop comprehensive knowledge about various psycho active drugs and anticoagulants.

**Course name: Spectroscopy-I (core subject centric) Paper (CH-3T4)**

CO 1	Be able to understand symmetry elements and operations to organic and inorganic molecules
CO 2	Learn the mass spectroscopy technique and will be able to identify the molecule on the basis of the fragmentation pattern in the mass spectrum and learn application of radio active molecules in Mossbauer Spectroscopy
CO 3	Be able to understand energy changes at very lower level and capable of predicting the satellite pattern of geographical areas. ESR techniques used to determine the presence of unpaired electron especially in complexes
CO 4	Elucidate the structure determination of organic molecules b IR spectroscopy, problem based on IR spectra

**Course name: Practical Organic Chemistry Special I (CH-3P1)**

CO	Be able to isolate natural product using fractional distillation, column chromatography and extraction method, get hands on the technique involved for the qualitative analysis of a mixture of three organic compounds and able to understand application of volumetry analysis in the estimation of organic analyze from given solutions
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**Course name: Practical Medicinal Chemistry Elective(CH-3P2)**

CO	Be able to estimate the active ingredients of various pharmaceutical; compounds and get acquainted with the strategies involved the preparation of many organic and drug moieties.
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**Course name: Seminar (CH-3S1)**

CO	On completion of seminar, the student will be able to consolidate idea about the subject and thereby develop knowledge about the subject which will boost their confidence.
<b>COURSE OUTCOME; M. SC. SEMESTER-IV</b>	
<b>Course name: Organic Chemistry Special Paper I (CH-4T1)</b>	
CO 1	Be able to quantify the applicability of carbanion intermediate in organic synthesis.
CO 2	Be able to understand organic synthesis using transition metals and organo metallic reagents.
CO 3	Be able to be well familiar with the advance terminologies rules and concepts involved in stereochemistry and will have a deeper knowledge about the applicability of stereo chemical and the protection deprotection concepts.
CO 4	The student will able to apply logic behind organic synthesis using retro synthesis approach
<b>Course name: Organic Chemistry Special Paper II (CH-4T2)</b>	
CO 1	Get acquainted with basic terminology involved in enzyme chemistry which is important to understand several life processes
CO 2	Come to know importance of heterocyclic compounds as a part of many natural product as well as pharmaceutical drugs
CO 3	Be able to analyze structure of nucleic acid, lipids, peptides and vitamins which are important building blocks in living system
CO 4	Be able to have brief idea about the terminologies and concepts involved in drugs, dyes and polymer chemistry
<b>Course name: Medicinal Chemistry Elective Paper (CH-4T3)</b>	
CO 1	Get acquainted with various terminology and fundamentals of drug rules and drug acts
CO 2	Be able to study and analyze assorted chromatographic separation technique for drugs: TLC
CO 3	Be able to know the concept of analytical and statistical sampling
CO 4	Able to the chemistry of anti viral, anti-malarial, histamines and anti-histamic, antibiotics, anti-helmenthis, anti-amoebic and anti-inflammatory drugs
<b>Course name: Spectroscopy II (core subject centric) Paper (CH-4T4)</b>	

CO 1	Be able to understand the theoretical aspects of UV, NMR and electron spectroscopy
CO 2	Be able to identify various molecular excitations and calculation of wavelengths of absorption
CO 3	Be able to elucidate the structure of molecule based on NMR spectra and be in a position to carry out the spectral analysis for structure determination.
CO 4	Comprehend the XRD data for crystal structure determination
<b>Course name: Practical Organic Chemistry Special (CH-4P1)</b>	
CO	Be able to carry out elemental analysis of organic compounds, get experience in the estimation of biomolecules and some organic drug molecules. The students will get hands on training of multi-step preparation of small organic molecules and will develop ability to identify various known organic molecules using NMR, IR, Mass and U. V. spectra.
<b>Course name: Project (CH-4P2)</b>	
CO	Learn how to carry out literature survey in a specific area of research, work on a small idea to develop their own observations, analyze the results obtained from the experiments carried out, validate the methods developed by him/her and develop an overall research attitude so that he can become a good researcher in future
<b>Course name: Seminar (CH-4S1)</b>	
CO	After successful completion these four seminars assigned to them, they will be in a position to explain the concepts they learned from the dais in front of any number of audiences. This will lead to overall personality development of the student for entering into teaching profession.

## **S.M.Mohota College of Science, Nagpur**

### **Department of Botany B. Sc.**

**(2020-2021)**

#### **Programme specific outcomes (PSOs)**

After completion of this course, students would be able to

1. Understand the fundamental concepts of microorganisms, plant pathogen and life cycle of algae, fungi, lichens, bryophytes, pteridophytes and higher plants.
2. Understand the palaeobotany and life cycle of higher group plants.
3. Understand taxonomy and anatomical details of higher plants.
4. Understand the plant tissue structure.
5. Understand application of genetics, molecular biology for plant improvement.
6. Understand Plant Physiology, concepts of ecology.
7. Perform the procedure of laboratory technique in biochemistry, biotechnology and utilization of plants.
8. To Build life skills in Edible mushroom cultivation, through short term course.
9. To create platform for higher studies in Botany.
10. To peruse higher education in Botany, research and also be
11. Get ready for employable fields related to plant sciences and Life sciences with both basic and applied knowledge.
12. Under Skill Development study: Introduction of various fields of applied Botany and Agriculture, Gardening, landscaping, Soil Science, Biofertilizer, Floriculture, Horticulture, Mushroom cultivation, Seed technology, Hydroponics, Organic farming, Herbal technology have been covered.

#### **Course outcomes (Cos)**

##### **SEMESTER -I**

##### **Paper -1 VIRUSES, PROKARYOTES AND ALGAE BIOFERTILIZERS**

Course Outcomes: By the end of this course, the students would be able to:

1. Understand General characteristics and nature of different types of Viruses and their Economic importance.
2. Understand the basic concept of mycoplasma.
3. Understand difference between Archaeobacteria and Eubacteria.
4. Understand Cell structure, Reproduction and Economic importance of bacteria, Cyanobacteria and algae
5. Differentiate between bacteria and Algae.
6. Describe life-cycle of microorganism and Algae.
7. Introduction of Biofertilizer and different types of Biofertilizer

##### **SEMESTER – I**

##### **PAPER – II FUNGI, LICHEN, PLANT PATHOLOGY, BRYOPHYTA, MUSHROOM CULTIVATION**



Course Outcomes: By completion of this course, the students will be able to:

1. Compare lower group of plants with higher.
2. Identify the different plant diseases, symptoms, causal organisms, and control measures.
3. Understand Cell structure, Reproduction and Economic importance of fungi, lichens and bryophytes.
4. Classify fungi and Bryophytes.
5. Introduction and Technique of different types of Mushroom cultivation, infrastructure requirement.

#### B.Sc.Course:SEM-I Practical

Course Outcomes: By completion of this course, the students will be able to:

1. Understand working of microscope.
2. Understand the basic technique in lab e.g. Slide preparation and Section cutting.
3. Identify bacteria, cyanobacteria, algae, fungi, lichens and bryophytes
4. Do Comparative study of lower groups and lower higher groups.
5. Study of plant diseases causal organisms, and control measures.
6. Understand and identify the algal, bryophyte, fungal, plant pathology and lichens under natural habitat during their study tour or excursion.
7. Technique of different types of Mushroom cultivation

#### SEMESTER – II

PAPER – I, (PALEOBOTANY, PTERIDOPHYTA & GYMNOSPERMS, SOIL ANALYSIS)

Course Outcomes: By completion of this course, the students will be able to:

1. Classify pteridophyta & gymnosperms.
2. Understand General characters, Economic importance, alternation of generation of pteridophyta & gymnosperms.
3. Understand apogamy, apospory, Stellar system in pteridophytes, Concept of heterospory and seed habit.
4. Study alternation of generation of pteridophyta & gymnosperms.
5. Study life history of some common members of pteridophyta & gymnosperms.
6. Understand Fossil pteridophyte & gymnosperms.
7. Information regarding types of soil, chemical and physical properties of soils.

#### SEMESTER – II

PAPER – II, PALAEOBOTANY & MORPHOLOGY OF ANGIOSPERMS,  
FLORICULTURE

Course Outcomes: By completion of this course, the students will be able to:

1. Understand concept of Palaeobotany, Geological time scale, Fossilization and Types of fossils and some Fossil plants.
2. Understand Root Morphology, types, Modifications for storage, Respiration & reproduction.
3. Understand Stem and Leaf Morphology, their types and modifications
4. Understand Inflorescence types.
5. Understand details structure of Flower and its parts, types.
6. Classify fruits.
7. Commercial cultivation of common flowering plant and its maintenance.

**B.Sc.Course: SEM-II Practical**

Course Outcomes: By completion of this course, the students will be able to

1. Identify the anatomy of plants material by making temporary mount.
2. Identify various Plant specimen.
3. Understand and identify the morphological characters of plants in natural environment.
4. Students will understand the structure of fossil.
5. Students will identify types of roots, stem, leaves, inflorescence, flower and fruits in the field visit.
6. Commercial aspects of floriculture.

**(2018-2019)**

**SEMESTER – III**

**PAPER – I , ANGIOSPERM TAXONOMY**

Course Outcomes: By completion of this course, the students will be able to:

1. Understand Origin of Angiosperms and Phylogeny of Angiosperm.
2. Fossil Angiospermic Flower
3. Understand basic concepts of Angiosperm Taxonomy
4. Understand the Principles of Botanical Nomenclature.
5. Describe Systems of classification of angiosperms along with merits and demerits.
6. Describe Modern trends in Taxonomy
7. Study of Families of dicots and monocots

**SEMESTER – III**

**PAPER – II , CELL BIOLOGY, PLANT BREEDING & GENETICS**

Course Outcomes: By completion of this course, the students will be able to:

1. Study detailed Structure of typical plant cell and ultrastructure of various cell organelles.
1. Study Structure of sex chromosome in plants.
2. Study Cell division in plants: Mitosis, Meiosis and their significance
3. Understand fundamental concepts of Plant Breeding and theory Evolution of angiosperms.
4. Understand basic concepts of Biostatistics.

**Practical**

Course Outcomes: By completion of this course, the students will be able to:

1. Study of Families of angiosperms.
2. Study of fossil Angiosperms.
3. Gain the knowledge of different plant taxon in and around our city through botanical field visit/ Botanical Excursions.

**SEMESTER- IV**

**PAPER – I**

**ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS**

Course Outcomes: By completion of this course, the students will be able to:

1. Understand basic concepts of plant anatomy.
2. Understand various types of meristems and tissues.
3. Gain knowledge about vascular bundles in monocots and dicots.
4. Understand primary and secondary structure of stem, root and internal structure of both monocot and dicot plants.
5. Understand normal and abnormal secondary growth.
6. Senescence and abscission of leaves.
7. Gain detail knowledge of pollination, male and female reproductive structure .
8. Study Double fertilization and triple fusion, endosperms and its types, Structure of dicot (Onagad) and monocot embryo.

#### SEMESTER -IV

##### Paper-II

##### Genetics & Molecular Biology

Course Outcomes: By completion of this course, the students will be able to:

1. Understand the great concept of Mendelism
2. Interaction of genes and Linkage Theory, types and significance .
3. Understand concept of Crossing over, Variation in chromosome number
4. Understand Structural changes in chromosome.
5. Understand Structure of DNA and t-RNA.
6. Understand Semi conservative method of DNA replication in eukaryotes
7. Understand the Concept of gene.
8. Understand concept and types of Mutations, mutagens, application of induced mutations in crop improvement
9. Understand DNA damage and repair, Satellite and repetitive DNA
10. Understand Genetic code: Definition and characteristics
11. Understand Gene expression in prokaryotes and its regulation.

##### Practical

Course Outcomes: By completion of this course, the students will be able to:

1. Study types of tissues and vascular bundles
2. Study the internal structure of dicot and monocot root, stem and leaf.
3. Take hand section and prepare temporary and permanent slides.
4. Study of internal structure of normal secondary growth and anomalous secondary growth and growth rings.
5. Study of types of ovules, anther structure, pollen grains, adaptations for pollination
6. Calculate the percent pollen germination in the given specimen
7. To prove Mendel's Law of Inheritance through coloured beads
8. To work out the type of gene interaction in the given cross.

#### SEMESTER – V

##### PAPER – I BIOCHEMISTRY & PLANT PHYSIOLOGY-I

1. Course Outcomes: By completion of this course, the students will be able to:
2. Understand properties, structure, classification and role of carbohydrate, lipids, amino acids and enzymes.
3. Understand Plant-water relations, Water conduction through xylem and Phloem transport
4. Understand concept of Mineral nutrition.

5. Understand in detail the process of plant Respiration, Photosynthesis, Nitrogen metabolism in plants.

#### SEMESTER – V

##### PAPER – II PLANT ECOLOGY - I

**Course Outcomes: By completion of this course, the students will be able to:**

1. Understand basic concepts in Ecology.
2. Know Climatic Factors, Edaphic, Physiographic factor and Biotic Factor.
3. Understand Biogeochemical Cycles: Nitrogen, phosphorous.
4. Understand Biotic and Abiotic components, Food chain, Food web, Ecological pyramids
5. Know about branches of ecology.
6. Study of community characters.
7. Understand Principles of Phytogeography of India and Phytogeographic regions of India.

#### Practical

Course Outcomes: By completion of this course, the students will be able to:

1. Perform major and minor Physiology Experiments.
2. Perform the Biochemical and Ecological Experiment
3. Perform microchemical tests.
4. Study concepts in ecology, various instrumentations and techniques through ecological/ botanical tour or research laboratory visit.

#### SEMESTER – VI

##### PAPER – I PLANT PHYSIOLOGY-II & BIOTECHNOLOGY

Course Outcomes: By completion of this course, the students will be able to:

1. Understand phenomenon of plant Growth in detail.
2. Understand Plant growth regulators and Plant movements.
3. Understand Physiology of flowering.
4. Understand Senescence, abscission, Seed dormancy and Plant defence.
5. Understand Genetic engineering and DNA library.

#### SEMESTER – VI

##### PAPER – II PLANT ECOLOGY, TECHNIQUES & UTILIZATION OF PLANTS

Course Outcomes: By completion of this course, the students will be able to:

1. Understand the concept and types of plants succession and plant adaptation
2. Understand regarding sources and solution of environmental pollution,
3. Gain knowledge of natural resources & its conservation
4. Understand principal, types and application of various techniques used in life science studies
5. Gain knowledge about morphology, utilization and importance of chemical constituents of some food, oil, fibers, spices, beverages, medicinal properties of important plants.
6. Gain knowledge about branches and importance ethnobotany

#### Practical

Course Outcomes: By completion of this course, the students will be able to:

1. Study the morphological and anatomical characteristics plant groups.
2. Understand Principle and working of various instruments in plant science studies.

3. Determine the DO, transparency, pH , salinity and temperature of different water bodies .
4. Determine the percent leaf-area injury of different leaf samples collected around polluted sites.
5. Study the plants of ethnobotanical importance.
6. Perform Microchemical Tests
7. Separate of biomolecules.

## **PROGRAM OUTCOMES, PROGRAM SPECIFIC OUTCOMES, AND COURSE OUTCOMES OF MSC BOTANY**

### **Program Outcomes (PO): M.Sc. Botany**

#### **(PO)**

- PO1.** Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking, actions, Increase the power of observation, develop scientific temper and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
- PO2.** Effective Communication and Social Interaction: Speak, read, write and listen clearly in person and through electronic media in English, and make meaning of the world by connecting people, ideas, books, media and technology.
- PO3:** Environment, Sustainability and Ethics: Understand the issues of environmental contexts and sustainable development. understand the moral dimensions of your decisions, and accept responsibility for them.
- PO4.** Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio- technological changes, Preparation for successful career.

### **Program Specific Outcomes**

#### **(PSO)**

- PSO1.** Understand the nature and basic concepts of cell biology, Biochemistry, Taxonomy and ecology.
- PSO2.** Analyze the relationships among animals, plants and microbes, Knowledge and understanding about plant diversity
- PSO3.** Perform procedures as per laboratory standards in the areas of Biochemistry, Molecular biology, Bioinformatics, Taxonomy, Economic Botany and Ecology. Practical skills in the field and laboratory experiments. . Hands on expertise inplant sciences.
- PSO4.** This program is a Research oriented learning, The students will be qualified to face IFS, CSIR-NET, SET, GATE, ICMR.NET, ICAR.
- PSO5.** It enhances skills in handling scientific instruments, planning and executing biological research. They become focused to take up Research and Teaching opportunities.
- PSO6.** It also promotes creative and novel ideas in biological concepts. They become Hands on expertise.
- PSO7.** Expertise student in the field of Mycology and Plant pathology both in basic and in applied knowledge.

<b>COURSE OUTCOMES OF SUBJECT BOTANY</b>			
<b>S. No.</b>	<b>Course Code / Paper</b>	<b>Title of the Course</b>	<b>Course Outcomes</b> After completion of the course, the student will be able to
<b>M. Sc. M.Sc. Botany Semester -I</b>			
1	1T1	Microbiology, Algae and Fungi	<ul style="list-style-type: none"> <li>Identify the structure, life cycles, economic importance, etc. of bacteria, virus, arhaebacteria, algae, fungi and apply this knowledge</li> <li>Based on symptoms, identify plant diseases and apply knowledge for control of diseases</li> <li>Perform various microbial culture techniques and apply for development of various cultures.</li> </ul>
2	1T2	Bryophytes & Pteridophytes	<p>After successful completion of the course the students will be able to</p> <p>Learn various types of bryophytes, Pteridophytes characters for identification in lab and nature.</p> <p>Understand various types of fossils in bryophytes and Pteridophytes</p> <ul style="list-style-type: none"> <li>Understand evolutionary trends in bryophytes and pteridophytes</li> </ul>
3	1T3	Paleobotany and Gymnosperms	<p>Identification, nomenclature, reconstruction of fossils and their significance in time scale</p> <p>Identification of various gymnosperms, evolution of gymnosperms and their relationships</p>
4	1T4	Cytology and Genetics	<ul style="list-style-type: none"> <li>Know various types of inheritances in biological organisms and analyse inheritance patterns</li> <li>Understanding population genetics and equilibrium affecting various factors</li> <li>Understand the molecular mechanism of mutations and its role in crops improvement</li> </ul>
5	1P1	Algae, fungi, Bryophytes	Hands on expertise in Algae, fungi, Bryophytes
6	1P2	Pteridophytes, Gymnosperms, Paleobotany, Cytology & Genetics	Hands on expertise in Pteridophytes, Gymnosperms, Paleobotany, Cytology & Genetics experiments

7	1S1	Seminar	To understand recent advances of the topics
<b>M. Sc. Botany Semester –II</b>			
8	2T1	Plant Physiology and Biochemistry	<ul style="list-style-type: none"> <li>• After successful completion of the course the students will be able to</li> <li>• Understand the aspects of plant respiration and photosynthesis.</li> <li>• Understand the aspects of metabolism of different components</li> <li>• Perform and check the enzymatic activities of different components.</li> </ul>
9	2T2	Plant Development and Reproduction	<p>Know the basic growth kinetics and role of phytohormones in plant development</p> <p>Know the molecular mechanism of growth and differentiation of root, leaf flowers and seeds</p> <p>Learn to use biomolecules for flower formation, seed setting, senescence effects.</p>
10	2T3	Cell and Molecular Biology-I	<p>Know the cell wall &amp; cellular organization of the eukaryotic and prokaryotic cells</p> <p>Learn the cell cytoskeleton and its role</p> <p>Learn and apply techniques of stress related problems in plants</p>
11	2T4	Angiosperms-I and Ethnobotany	<ul style="list-style-type: none"> <li>• Understanding the morphology of flowers of dicot and monocots for proper identification of angiosperm plants</li> <li>• Understanding plant taxonomy and modern trends in taxonomy and conservation methods of ethnobotanical plants</li> </ul> <p>Outcomes: After successful completion of the course the students will be able to</p> <ul style="list-style-type: none"> <li>• Learn basic structure of flowers for identification and distinguish them</li> </ul> <p>Apply taxonomic tools in taxonomic classification, modern and numerical</p>
12	2P1	Plant Physiology, Plant Biochem., Plant Development & Reproduction	Hands on expertise in Plant Physiology, Plant Biochem., Plant Development & Reproduction
13	2P2	Cell and Molecular Biology I, Angiosperms I	Hands on expertise in Cell and Molecular Biology I, Angiosperms I
14	2S1	Seminar	To understand recent advances of the topics



<b>M. Sc. M.Sc. Botany Semester –III</b>			
15	3T1	Plant Ecology and Conservation Biology	Learn structure and function of ecosystems and their succession and climax formation Learn and apply the knowledge of conservation methods. Learn and apply techniques of Botanical gardens etc.
16	3T2	Angiosperms-II	Learn and apply knowledge basic structure of flowers for identification and distinguish them family-wise.  Training in usage of floras for identification of species, field trips for preparation of field notes and compilation of plant data.
17	3T3	Elective -I :Mycology and Plant Pathology - I	Learning the structure, life cycles, economic importances etc of bacteria, virus, fungi and apply this knowledge in identification of organisms. Analysis of diseases based on symptoms, and apply knowledge for identification of disease Understanding and application of knowledge of fungal metabolites, their uses for human welfare
18	3T4	Foundation I Core : Aesthetic Botany	Learn phytogeographical regions of India, world, scope of gardening, landscaping. Learn designing of lawns and cactus, ornamental gardens.
19	3P1	Plant Ecology and Conservation Biology and Angiosperms II	Hands on expertise in Plant Ecology and Conservation Biology and Angiosperms
20	3P2	Elective Mycology and Plant pathology	Hands on expertise in Mycology and Plant pathology both in basic and in applied knowledge.
21	3S1	Seminar	To understand recent advances of the topics
<b>M. Sc. M.Sc. Botany Semester –IV</b>			
22	4T1	Cell and Molecular Biology-II	<ul style="list-style-type: none"> <li>• Learn structure and functions of ribosomes, mechanism of transcription and translation.</li> <li>• Learn gene structure and regulation of gene expression</li> </ul> Learn mechanism of cell cycle, apoptosis, application of cell biology techniques.

23	4T2	Plant Biotechnology and Plant Breeding	<ul style="list-style-type: none"> <li>○ Learn gene cloning, recombinant DNA technology etc.</li> <li>○ Learn tissue culture methods.</li> </ul> Learn and apply bioinformatic tools for analysis of bioinformation data.
24	4T3	Elective II Mycology and Plant Pathology -II	Knowledge on the history, milestones in phytopathology of India, Learn host-parasite relationships, various diseases and control methods.
25	4T4	Foundation II Applied Botany	Learn the production of plant bio-products Applying knowledge with reference to green herbal techniques, culture technique and cultivation of garden, silviculture, post-harvesting techniques etc.
26	4P1	Cell and Molecular Biology-II, Plant Biotechnology and Plant Breeding	Hands on expertise in Cell and Molecular Biology-II, Plant Biotechnology and Plant Breeding
27	4P2	Project	It is for Research oriented learning, It enhances skills in handling scientific instruments, planning and executing biological research
28	4S4	Seminar	To understand recent advances of the topics

## SHRI MATHURADAS MOHOTA COLLEGE OF SCIENCE, NAGPUR

### Department of Geology

#### Program Specific Outcomes and Course Outcomes of Geology at UG level

Semester	UG Paper	Course Outcomes	Program Specific Outcomes
B.Sc Sem-I	Paper-I Introduction to Geology	<ol style="list-style-type: none"> <li>1. Describe the branches of geology, solar system and its relation to other planets, origin of the earth and their hypothesis.</li> <li>2. Describe earth's internal structure: core, mantle and crust.</li> <li>3. Discuss volcanoes, their classification, products and distribution.</li> <li>4. Describe earthquakes, effects and causes of earthquakes, intensity and distribution of earthquakes.</li> <li>5. Describe radiometric age determination methods.</li> <li>6. Give a detail of Isostasy and hypothesis proposed by Pratt and Airy.</li> <li>7. Explain the Wegner's theory of Continental drift</li> </ol>	<p>Students will be able to:</p> <ol style="list-style-type: none"> <li>1. Know about branches of geology, earth origin, processes and various hypothesis of origin of the Earth (Solar System).</li> <li>2. Understand the broad perspective of crust, mantle and core of the Earth and reorganization of the Earth's layers.</li> <li>3. Explain volcanoes, their classification, products and distribution.</li> <li>4. Compare and contrast properties and mechanics of different types of waves, understand the causes and effects of earthquakes and recognize our limited ability to predict seismic activity, compare magnitude versus intensity.</li> <li>5. Acquire an introductory understanding of geologic time and the importance of both relative and radiometric dating techniques.</li> <li>6. Develop the concept of Isostasy, Isostatic anomalies, Isostatic models, and Evidence.</li> <li>7. Understand continental drift as plate motion and develop the concept and theories of continental drift.</li> </ol>
	Paper-II Mineralogy	<ol style="list-style-type: none"> <li>1. Describe Mineral composition of the earth's crust and Chemical bonding.</li> </ol>	<p>The student will be able to:</p> <ol style="list-style-type: none"> <li>1. Understand how atoms interact to form minerals and how the structure and chemical composition of minerals.</li> </ol>

		<ol style="list-style-type: none"> <li>2. Give an account of Isomorphism, Pseudomorphism and Polymorphism</li> <li>3. Describe in detail the various Silicate structures</li> <li>4. Give an account of various rock-forming minerals with reference to chemical composition, physical properties and geological occurrence.</li> </ol>	<ol style="list-style-type: none"> <li>2. Describe chemistry of minerals (Polymorphism, Isomorphism and Pseudomorphism).</li> <li>3. Demonstrate the silicate structures with examples.</li> <li>4. Identify the common minerals in hand specimen using their physical properties.</li> </ol>
B.Sc Sem-II	Paper-I Physical Geology and General Geology	<ol style="list-style-type: none"> <li>1. Give an account of Geological work done by wind, river, underground water, glaciers and oceans.</li> <li>2. Describe various theories regarding origin of oceans and continents.</li> <li>3. Give an account of orogeny and epeirogeny.</li> <li>4. Give an account of various types of geosyncline.</li> <li>5. Tectonic and Volcanic mountains.</li> <li>6. Give an account of various diastrophic movements and relate with plate tectonics.</li> </ol>	<p>Students will be able to:</p> <ol style="list-style-type: none"> <li>1. Understand geological works of wind, river, underground water, glaciers, oceans and their landforms of erosion and deposition processes.</li> <li>2. Explicate the evolution of continents and oceans.</li> <li>3. Understand the endogenic processes originating within the earth like diastrophism and how they interact to create landforms.</li> <li>4. Explain geosynclines, classification and evolution of Geosynclines, causes of subsidence and uplift.</li> <li>5. Understand the mountain building process and types of mountains</li> <li>6. Recognize the role of plate tectonics in the development of all Earth's surface features including mountain ranges, ocean basins, etc. Recognize the ongoing development of, evidence for and large-scale planetary effects of the Theory of Plate Tectonics, Critique and interpret major types of evidence supporting the Theory of Plate Tectonics.</li> </ol>
	Paper-II Optical Mineral ogy and	<ol style="list-style-type: none"> <li>1. Discuss petrological microscope and its accessories.</li> <li>2. Define refractive index and its determination by i) Becke line</li> </ol>	<p>Students will be able to:</p> <ol style="list-style-type: none"> <li>1. Identify general characteristics of light - polarisation, refraction, and describe the parts of polarized microscope.</li> </ol>

	Crystallography	<p>method and ii) Abbe refractometer</p> <ol style="list-style-type: none"> <li>Define the microscopic/optical characteristics of minerals: Twinkling, birefringence, pleochroism, interference colours, extinction and extinction angle, twinning, isotropism and anisotropism.</li> <li>Describe optical properties of the given mineral.</li> <li>Describe crystal's structural system, symmetry class and morphological forms present in the given symmetry class.</li> <li>Describe laws of crystallography.</li> </ol>	<ol style="list-style-type: none"> <li>Determine the refractive index by Becke line method and Abbe refractometer.</li> <li>Explain the properties of uniaxial and biaxial minerals under parallel and crossed nicols.</li> <li>Identify the diagnostic characteristics of minerals using petrological microscope.</li> <li>Study the symmetry in crystals and classify crystals based on symmetry elements and describe its forms.</li> <li>Acquaint about various laws of crystallography governing the consistency of crystal structures with respect to specific chemical composition.</li> </ol>
B.Sc Sem-III	Paper-I Igneous Petrology	<ol style="list-style-type: none"> <li>Discuss rock cycle.</li> <li>Describe intrusive forms and extrusive of igneous rocks and comment on their creation.</li> <li>Give detail account of textures, structures and classification of igneous rocks.</li> <li>Explain evolution of magma by different processes takes place from origin to emplacement.</li> <li>Explain crystallizing phase equilibrium of multi component magma system.</li> </ol>	<p>Students will be able to:</p> <ol style="list-style-type: none"> <li>Identify rock type and the steps of the rock cycle related to their formation.</li> <li>Recognize different forms of igneous rocks</li> <li>Assign a name to an igneous rock on the basis of its mineralogical and textural characteristics, and appreciate the environment(s) of formation.</li> <li>Understand the origin of magma and its evolution.</li> <li>Understand phase equilibrium of magma crystallizing systems.</li> </ol>
	Paper-II Sedimentary and Metamorphic Petrology)	<ol style="list-style-type: none"> <li>Explain various sedimentary processes involving origin of sediment.</li> <li>Give an account of sedimentary rocks with their diagnostic features.</li> <li>Describe clastic and non-clastic textures of sedimentary rocks.</li> <li>Give an account of sedimentary structures.</li> <li>Give an account of textures, structures and classification of metamorphic rocks.</li> </ol>	<p>Students will be able to:</p> <ol style="list-style-type: none"> <li>Understand the processes of sedimentation; Origin of sediments.</li> <li>Identify sedimentary rocks and describe the mineralogy of sedimentary rocks.</li> <li>Recognize the textures of clastic and non-clastic sedimentary rocks and their significance.</li> <li>Identify key sedimentary structures and appreciate the significance of such features with regard to</li> </ol>

		6. Discuss metamorphic facies, grades and zones.	geological processes that have operated. 5. Interpret structures and textures of metamorphic rocks and their importance in understanding metamorphic reaction principle. 6. Understand the concept of facies, grade and zone of metamorphism
B.Sc Sem-IV	Paper-I Palaeontology	<ol style="list-style-type: none"> <li>1. Define fossil, ichnofossil and index fossils.</li> <li>2. Describe processes of fossilization.</li> <li>3. Give the application of fossils in economic geology, palaeoecology, evolution, stratigraphy, palaeogeographic and palaeoclimatic reconstructions.</li> <li>4. Give an account of morphology, classification, evolution, and geological history of Brachiopoda, Mollusca (Bivalvia, gastropoda and cephalopoda), Echinoidea and Trilobita.</li> <li>5. Give morphology, uses and geological history of Foraminifera, Graptoloidea, and Anthozoa.</li> <li>6. Give distribution of flora during Gondwana time.</li> </ol>	<ol style="list-style-type: none"> <li>1. Demonstrate understanding of the nature of fossils and types of fossilization that turn organic remains into fossils</li> <li>2. Students will understand methods of fossil preservation and preparation.</li> <li>3. Demonstrate understanding of the uses of fossils in solving geological problems: paleoenvironments, relative age, paleo-ecology, economic geology, evolution, stratigraphy, palaeogeographic and palaeoclimatic reconstructions.</li> <li>4. Recognize the major groups of invertebrate fossils on the basis of their morphology, classification, evolution, and geological history of major invertebrate classes like Brachiopoda, Mollusca, Echinoidea and Trilobita and identify key index fossils to the species level.</li> <li>5. Understand the classification, morphology, uses and geological history of Foraminifera, Graptoloidea and Anthozoa.</li> <li>6. Recognize characteristic features and assemblage of the Gondwana flora.</li> </ol>
	Paper-II Structural Geology	<ol style="list-style-type: none"> <li>1. Describe various stage of rock deformation.</li> <li>2. Describe stress and strain.</li> <li>3. Discuss Stereographic projections and its use in structural analysis</li> </ol>	<p>Students will be able to:</p> <ol style="list-style-type: none"> <li>1. Understand the concept of rock deformation in time and space.</li> <li>2. Demonstrate a basic understanding of stress, strain and rheology of Earth's lithosphere.</li> </ol>

		<ol style="list-style-type: none"> <li>4. Give classification and describe various types of folds and their recognition criteria. Describe faults on the basis of geometrical pattern. Give classification of joints and describe joints of tectonic origin.</li> <li>5. Describe erosional structures: Inlier and Outlier, Klippe and Fenster, Synclinal hill and Anticlinal valley.</li> <li>6. Explain effects of structures on outcrop pattern.</li> <li>7. Give an account of linear and planar structures.</li> <li>8. Give an account of lineation and foliations.</li> <li>9. What are Shear zones?</li> </ol>	<ol style="list-style-type: none"> <li>3. Use stereographic projections in structural analysis.</li> <li>4. Comprehend how to describe and classify brittle and ductile structures, including faults, folds, joints, unconformity etc.</li> <li>5. Identify and explain different erosional structures such as Inlier and Outlier, Klippe and Fenster, Synclinal hill and Anticlinal valley.</li> <li>6. Interpret the outcrops and their relationship with topography.</li> <li>7. Identify linear and planar structures.</li> <li>8. Understand lineation and foliations and their relation to major structures.</li> <li>9. Demonstrate brittle and ductile shear zones.</li> </ol>
B.Sc Sem-V	Paper-I Economic Geology	<ol style="list-style-type: none"> <li>1. Distinguish how a particular mineral deposit formed by magmatic, hydrothermal, sedimentary, oxidation-reduction, metamorphic or by another processes.</li> <li>2. Describe processes of hydrothermal deposits, both cavity filling and replacement.</li> <li>3. Describe a given process of formation of mineral deposit.</li> <li>4. Describe origin, mode of occurrence, association, uses and Indian occurrences of the ores of important metallic minerals.</li> <li>5. Give origin, mode of occurrences, association and grades for mineral used in fertilizer, refractory and cement industry.</li> <li>6. Discuss mineralogy, uses, geological occurrences, origin and geographical distribution in India.</li> </ol>	<p>Students will be able to:</p> <ol style="list-style-type: none"> <li>1. Understand the processes of formation of mineral deposit and various theories of ore genesis explaining how the various types of mineral originate and deposited within the Earth's crust.</li> <li>2. Demonstrate knowledge of variety of ore forming processes.</li> <li>3. Describe the variety of minerals deposits and how they are found and formed.</li> <li>4. Explain origin, mode of occurrence, association, uses and Indian occurrences of the ores of important metallic minerals.</li> <li>5. Explain origin, mode of occurrence, association, specification and grades for uses in industries and Indian occurrences of important non-metallic minerals.</li> <li>6. Understand origin, composition, occurrences, prospecting and preparation of coal.</li> </ol>

		<p>7. Discuss mineralogy, uses, geological occurrences, origin and geographical distribution of the mineral deposits of natural hydrocarbons</p> <p>8. Discuss geological setting and mineralization of important ore deposits in India.</p>	<p>7. Understand origin, migration and accumulation of petroleum and natural gas.</p> <p>8. Understand and compare the geological setting and mineralization of Kolar gold field, Singhbhum copper belt, Malanjkhand copper deposit, Lead zinc deposit of Zawar, Manganese belt of Maharashtra, Iron ore deposits of Bastar, Bauxite deposits of Maharashtra, Mica deposits of Bihar, and Andhra Pradesh. Gondwana coal deposits, Neyveli lignite deposit, Gypsum deposit of Rajasthan and beach placers of Kerala.</p>
	Paper-II Indian Stratigraphy	<p>1. What are major boundaries in geological time scale?</p> <p>2. Discuss Principles of Stratigraphy.</p> <p>3. Give stratigraphic classification and explain how the rocks have been classified in geological sequences in lithostratigraphic units in terms of chronostratigraphic divisions.</p> <p>4. Describe Physiographic subdivision of the Indian subcontinent and their characteristics.</p> <p>5. Give detail account of Archaean Supergroup of Peninsular India, Dharwar Supergroup and associated granitic rocks, Sausar Group, Sakoli Group, Dongargarh Supergroup, Aravalli Supergroup and associated gneissic rocks.</p> <p>6. Give detail account of Cuddapah Supergroup of Cuddapah basin, Kaladgis, Pakhals, Penganga Formation, Delhi Supergroup, Shimla</p>	<p>Students will be able to:</p> <p>1. Understand time concept in stratigraphic and major stratigraphic boundaries and their causative factors</p> <p>2. Explain fundamentals of stratigraphic principles and various methods of stratigraphic analysis.</p> <p>3. Understand geological time, classification of sequences in terms of Litho-, Bio- and Chronostratigraphy.</p> <p>4. Know about physiographic subdivision of the Indian subcontinent and their characteristics.</p> <p>5. Understand Archaean Supergroup of Peninsular India, Dharwar Supergroup and associated granitic rocks, Sausar Group, Sakoli Group, Dongargarh Supergroup, Aravalli Supergroup and associated gneissic rocks with reference to its classification, geographic distribution, lithological characteristics, fossil content and economic importance.</p>



		<p>Formation, Vindhyan Supergroup of Vindhyan basin, Kurnool Supergroup, Chattisgarh Supergroup.</p> <p>7. Give an account of Palaeozoic succession of Spiti valley, Gondwana Supergroup, Triassic of Spiti, Jurassic of Kutch, Rajasthan and Spiti.</p> <p>8. Discuss Cretaceous deposits of Narmada Valley.</p> <p>9. Discuss Deccan volcanic Province and intertrappeans.</p> <p>10. Discuss Siwalik System in detail.</p>	<p>6. Acquaint with the important stratigraphic Supergroup and formations such as Cuddapah Supergroup of Cuddapah basin, Kaladgis, Pakhals, Penganga Formation, Delhi Supergroup, Shimla Formation, Vindhyan Supergroup of Vindhyan basin, Kurnool Supergroup, Chattisgarh Supergroup.</p> <p>7. Know about the classification, geographic distribution, lithological characteristics, fossil content and economic importance of Palaeozoic succession of Spiti valley, Gondwana Supergroup, Triassic of Spiti, Jurassic of Kutch, Rajasthan and Spiti.</p> <p>8. Describe Cretaceous deposits of Narmada Valley namely, Bagh Beds and Lameta Beds.</p> <p>9. Render understanding of Deccan volcanic Province, type of eruptions and Intertrappeans.</p> <p>10. Know about Siwalik System and its vertebrate life.</p>
B.Sc Sem-VI	Paper-I Elements of Remote Sensing and Environmental Geology	<p>1. Define Remote Sensing and give detail account of its scope.</p> <p>2. Differentiate Aerial photography and satellite imagery.</p> <p>3. Describe types of aerial photographs.</p> <p>4. Explain the elements of photo-interpretation of aerial photographs.</p> <p>5. What are mosaics and stereopairs?</p> <p>6. Discuss application of photo-geology and remote sensing in the study of geologic features.</p> <p>7. Give the detail account of guidelines for lithologic, structural and geomorphic interpretation.</p>	<p>Students will be able to:</p> <p>1. Give basic idea, scope and aim of remote sensing.</p> <p>2. Distinguish remote sensing from aerial heights and space heights.</p> <p>3. Introduce aerial photographs and their types.</p> <p>4. Apply the underlying principles of interpreting image data.</p> <p>5. Study aerial photos in the form of mosaics and stereopairs.</p> <p>6. Application of photo-geology and remote sensing in geological studies.</p> <p>7. Interpret lithologic, structural and geomorphic features on aerial photos</p> <p>8. Understand the concept of environmental geology and render understanding of</p>

		<ol style="list-style-type: none"> <li>8. Define and explain the concepts of Environmental Geology.</li> <li>9. Discuss natural hazards such as earthquakes, floods, volcanic activity, coastal erosion, desertification and their impact on environment.</li> <li>10. Give an account of soil types, soil degradation and mitigation and soil pollution.</li> <li>11. Discuss environmental changes caused due to human dominated environment over nature dominated system.</li> <li>12. What are environmental considerations in the constructions of large dams, reservoirs, and tunnels.</li> <li>13. Explain pollution, its effect on natural ecosystem and anti-pollutional measures.</li> </ol>	<p>interdependent nature and processes operative over earth surface.</p> <ol style="list-style-type: none"> <li>9. Evaluate the concerned impact of human development on environment systems.</li> <li>10. Understand natural hazards and their impact on environmental system.</li> <li>11. Comprehend soil types, soil degradation and mitigation and soil pollution.</li> <li>12. Analyse environmental considerations in the constructions of large dams, reservoirs, and tunnels.</li> <li>13. Comprehend effects of pollution on natural ecosystem and anti-pollutional measures.</li> </ol>
	<p>Paper-II Elementary Hydrogeology and Geomorphology</p>	<ol style="list-style-type: none"> <li>1. Discuss hydrological cycle and its importance.</li> <li>2. Give an account of occurrence and distribution of groundwater.</li> <li>3. Describe zones of aeration and saturation</li> <li>4. Give an account of aquifers and their various types.</li> <li>5. Discuss porosity and permeability.</li> <li>6. Describe Darcy's Law.</li> <li>7. Describe hydrologic characteristics of different types of rocks.</li> <li>8. Give in detail of Groundwater provinces of India.</li> <li>9. Discuss influent and effluent seepages and springs.</li> <li>10. Discuss various concepts of geomorphology.</li> <li>11. Discuss weathering, mass-wasting and related landforms.</li> </ol>	<p>Students will be able:</p> <ol style="list-style-type: none"> <li>1. To demonstrate understanding of the hydrologic cycle as it pertains to ground water systems.</li> <li>2. To explain geological factors governing the occurrence and distribution of groundwater.</li> <li>3. To understand zones of aeration and saturation.</li> <li>4. To explain aquifers and their classification.</li> <li>5. To explain the porosity and permeability.</li> <li>6. To state Darcy's law.</li> <li>7. To elucidate the hydrological properties of rocks.</li> <li>8. To describe the characteristics of Groundwater provinces of India.</li> <li>9. To understand influent and effluent seepages and springs.</li> <li>10. To explain the concepts of geomorphology and give examples of its application.</li> </ol>

		<ol style="list-style-type: none"><li>12. Give an account of drainage patterns and their significance.</li><li>13. Describe features of karst areas in view of erosion activities.</li><li>14. Describe topography developed over folded and faulted structures.</li></ol>	<ol style="list-style-type: none"><li>11. To explain weathering, mass-wasting, their types and related landforms.</li><li>12. To give knowledge of drainage patterns and their importance in deducing structural and lithology of the area.</li><li>13. To attribute knowledge of karst geomorphic cycle, characteristics of karst region, origin of limestone caverns.</li><li>14. To give knowledge of the topography developed over folded and faulted area.</li></ol>
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## Program Outcomes Physics (UG)

### Program Outcomes (POs) of B.Sc.

**The science  
graduate will  
be able to – :**

1. Develop the knowledge with facts and figures related to various subjects in sciences.
2. Understand the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevancies in the day-to-day life.
3. Develop the skills of observations and drawing logical inferences from the scientific experiments.
4. Acquire the skills in handling scientific instruments, planning and performing in laboratory experiments.
5. Develop scientific outlook not only with respect to science subjects but also in all aspects related to life.
6. Analyze the given scientific data critically and systematically and the ability to draw the objective conclusions.
7. Develop various communication skills such as reading, listening, speaking, etc., which will help in expressing ideas and views clearly and effectively.
8. Imbibe ethical, moral and social values in personal and social life leading to

**COURSE OUTCOMES COURSE OUTCOMES (COS) OF  
PHYSICS (UG)**

**S-I P-1 Properties of Matter and Mechanics**

- 1: Use the basic knowledge of mechanics and properties of matter.
- 2: Understand an equation of motion and Bernoulli's theorem and its applications.
- 3: to understand the surface tension.
- 4: to use the conservation of rotational motion and apply to understand rocket science.

**S-I P-II Electrostatics, Time varying fields & Electric Currents**

- 1: Use the basic laws of electrostatics.
- 2: Understand the Polarization of charges in a dielectric, Clausius - Mossotti equation.
- 3: to understand the time varying fields.
- 4: to use the complex number in solving an a. c. circuit.

**S-II P-I Oscillations, Kinetic theory of gases and Thermodynamics**

- 1: To understand basic laws of linear and angular momentum.
- 2: Understand the forced oscillations and kinetic theory of gases.
- 3: to understand Transport phenomenon in gases.
- 4: to use the Maxwell general relationship and its applications to Joules coefficient with Porous plug experiment.

**S-II P-II Gravitation, Astrophysics, Magnetism and Magneto statics**

- 1: Use of basic laws of planetary motion to understand universe.
- 2: to understand the Stellar spectra and shape, size, clusters of the Milky way Galaxy.
- 3: to understand theories of para magnetism, Ferromagnetism.
4. To understand basic laws Magneto statics

**S-III, P-I Sound waves, applied acoustics, ultrasonic and power supply**

- 1: Use the basic ideas acoustics.
- 2: Understand the specific principles applied acoustic.
- 3: Understand the different methods for generation and applications of the ultrasonics.
- 4: Use a knowledge and apply it regulated power supply.

**S-III, P-II Physical optics and Electromagnetic waves**

- 1: Understand the basic concepts of Interference of light in optics.
- 2: Apply the Rayleigh criteria for resolution in Diffraction of light.

- 3: Understand the principle of Brewster's law in polarisation.
- 4: Use the knowledge of characteristics of EM waves.

**S-IV,P-I Solid state Physics, X-Ray and laser**

- 1: To learn the basic knowledge of crystal structure.
- 2: understand the basic principle of Bragg's law and its applications in X-rays.
- 3: Understand the different x-ray spectra and the concept of Auger effect.
- 4: To understand the fundamentals of laser, their unique properties and applications

**S-IV,P-II Solid state electronics and molecular physics**

- 1: To understand the basic principle of electronics.
- 2: Understand the construction, working and characteristics of EFT's
- 3: Understand the concept of the molecular physics.
- 4: Use the knowledge of elementary ideas of NMR and ESR.

**S-V,P-I Atomic physics, free electron theory and Statistical Physics**

- 1: To study Vector atom model, Stern-Gerlach experiment.
- 2: Understand the concept of free electron theory and band theory.
- 3: Use the basic knowledge of Statistical physics.
- 4: Understand the various models in statistical physics.

**S-V,P-II Quantum Mechanics, Nanomaterials and Nanotechnology:**

- 1: To understand the Compton Effect and Schrödinger equation.
- 2: Understand and apply the principle of wave mechanics to free particle in a one and three dimension.
- 3: Understand the basics of Nanomaterials.
- 4: Acquire fundamental understanding of integrated multidisciplinary nature of nanotechnology.

**S-VI,P-I Relativity, Nuclear physics and Bio-physics:**

- 1: To acquire basic knowledge of relativity and apply it to various physical problems.
- 2: Understand the various model of nucleus.
- 3: Understand the various decays in Nuclear physics.
- 4: Acquire the basic knowledge of Biophysics and Bioinstrumentation

**S-VI,P-II Electronics, Fiber optics, communication and Digital electronics:**

- 1: Understand the classification of amplifiers and OP-AMP.
- 2: To understand the importance of optical fiber.
- 3: Understand the concept and basic principals of Communication.
- 4: To Acquire basic knowledge of digital electronics.

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Department of Physics, RTMNU

Name of Programme: M.Sc. Physics

Programme specific outcome

After completion of course, the student will be to:

PSO1: Understanding basic principles of Physics which are underlying a wide selection of physical phenomenon.

PSO2: Explore with current state-of-art in the selected area of Physics.

PSO3: Inculcate the habit to plan, design and execute new experiment. Analyze, interpret experimental result and write report on it.

PSO4: Assess the errors involved in an experiment work; searching out and adopting new methodology to reduce errors. Presents the experimental outcome in effective manner.

PSO5: After completing PG degree from this programme, they will be eligible to continue research at the higher degree (Ph.D) level. They will be trained by experimental, computer programming and data interpretation programming skill and exposed to improve their employability in research and development, in scientific and engineering industries.

PSO6: Additionally, they will have necessary numerical and transferable skills to select general career choice such as accounting or computing

Programme matrix

Name of Programme: M.Sc. Physics

CO	Program Outcomes	Program Specific Outcomes (PSOs)					
	Course Name: IT1 Mathematical Physics	Domain Specific					
		POSI	POS2	POS3	POS4	POS5	POS6
COI	Curvilinear co-ordinate Systems, Physical ideas about gradient, Applications to the solution of differential equations.		M	H	M		
C02	Elementary ideas about tensors, Cartesian tensors, differential of Cartesian tensors, gradient, divergence and curl, Laplacian of Cartesian tensors, Laplace transform of elementary functions.						
C03	Linear vector spaces - linear independent bases, Dimensionality, inner product, matrices, linear transformation, Orthogonal and Unitary matrices, Cayley Hamilton theorem.						
C04	Linear differential equations, Special Function- Laguerre, Hermite, Legendre polynomials, Special Bessel's function.		M	H		M	M
	Course Name: IT2: Complex Analysis and Numerical Methods	Domain Specific					
COI	Solve simple problems involving complex algebra such as rationalization.		M	L	L	M	L
C02	Given a function, determine if it is analytic. Integrate various functions using calculus of residues.	1			L	L	
C03	Compute pole expansion and product expansion of certain functions.		L	H	M	L	M
coa	Find the roots of a given nonlinear function.		L	L		M	M
cos	For a given data, fit a function, interpolate or extrapolate as necessary.		L	M	M		
C06	Solve ordinary differential equations. Compute integrals numerically.	M	M	M	L	L	



Course Name: IT3: Electronic		Domain Specific					
COI	Clear the conceptual knowledge of Semiconductor discrete devices, Bipolar junction transistor (JFET, MOSFET, SCR, UJT), Opto-electronic devices like Photodiode, solar cell, LED, LCD and photo transistor.		L	L	L	H	L
C02	Gains the knowledge of applications of semiconductor devices in linear and digital circuits, transistor as amplifier, coupling of amplifier, feedback in amplifiers and types of oscillators clipping and clamping circuits also gets the knowledge of transistor as a switch OR, AND and NOT and Gates.			L	L	M	L
C03	Explores the field of Digital integrated circuits- NAND and NOR gates building block, simple combinational Circuits, Multivibrators, sweep generator, shift registers, counters, converters, semiconductor memories (ROM, RAM, and EPROM) along with architecture of 8-bit microprocessor (INTEL 8085).						
C04	Gain understanding of Linear integrated circuits- Operational Amplifier and its applications-inverting and noninverting amplifier, adder, integrator, differentiator, waveform generator, comparator and Schmitttrigger, Butterwoth active filter, phase shifter.						
cos	Understand the Communication Electronics in terms of Basic principle of amplitude frequency and phase modulation also Simple circuits for amplitude modulation and demodulation, digital (PCM) modulation and demodulation.						
Course Name: IT4: Electrodynamics-1		Domain Specific					

COI	Familiar with the static properties of electric and magnetic fields.						
C02	Understand the concept of electric field and they should be able to solve problems.						
C03	Familiar with the definition of electric current and electric current density. They should understand the important information contained in the equation of continuity and they should be able to solve simple problems involving this equation.		H	M	H		
C04	Understanding the concept of the magnetic field and be able to calculate this from given current distributions.				H	M	H
cos	Understand how the Maxwell equations arise as a synthesis of the various individual electromagnetic phenomena and know how Maxwell's equations lead to electromagnetic waves.						
	Course Name: 1= 2TI: Quantum Mechanics I	Domain Specific					
COI	construct operators in coordinate and momentum representation.			M	M	L	
C02	familiar with Dirac notation, notions of inner and outer product and basic mathematical structure.			L	M	M	
C03	write matrix representation for a given operator, understand various transformations and diagonalization.				L	L	
C04	Understand tunnelling, parity of eigenfunctions,		L	L		M	
C05	frame a radial equation for a given central force problem and solve it.		L	M	H	H	
C06	Find Clebsch - Gordon coefficients for addition of angular momenta.		L	M	M	L	
	Course Name: Statistical Physics	Domain Specific					
COI	Understand basics of theory of probability and statistical approach for thermodynamical					M	

	properties.						
C02	Gain the knowledge of theory of indistinguishable particles for fifth state of matter i.e Bose Einstein condensate.						
C03	Demonstrate Fermi Dirac condensation on the basis of BCS theory and its application for free electron gas in metal.				L	M	
coa	Describe phase transition phenomenon using Ising model and Landau theory.			H	L	L	
	Course Name: 2T3: Classical Mechanics	Domain Specific					
COI	Solve simple systems by writing Lagrangian.		L	H	L	L	
C02	Understand cyclic coordinates, canonical transformations.		H	H	L	L	
C03	Compute Poisson brackets, interpret them.		L	L	H	H	
coa	Understand central force motion and interpret scattering cross-section		L	L	M	H	
cos	Understand Euler angles, Inertia tensor. Compute equations of motion for simple coupled systems.		L	L	H	H	
C06	Learn Hamilton-Jacobi theory and its importance.		L	L	M	M	
	Course Name: 2T4: Electrodynamics-II	Domain Specific					
COI	Use of Maxwell equations in analysing the electromagnetic field due to time varying charge and current distribution			M	M		
C02	Describe the nature of electromagnetic wave and its propagation through different media and interfaces.						
C03	Explain charged particle dynamics and radiation from localized time varying electromagnetic sources					M	
C04	Formulate and solve electrodynamic problems in relativistically covariant form in four-dimensional space-time						
cos	be familiar with some elementary phenomena and concepts in quantum electrodynamics,		H	H	M	H	M
	Course Name: 1=2T1 Quantum Mechanics	Domain Specific					

COI	Solve simple problems using perturbation theory.		H	M	M	L	L
C02	Solve simple problems of perturbation theory, understand symmetries of wavefunction.			H	M	L	L
C03	Solve simple problems involving time dependent perturbation.		H	H	M	M	L
C04	Solve barrier problem using WKB method.					L	L
cos	Understand the physical meaning of scattering coefficients. Difference between bosons and fermions.		L	L	M	H	M
cos	know about Klein-Gordon equations, Dirac equations. Solve for Hydrogen atom using Dirac's theory.		L	L	L	M	H
	Course Name: 3T2 Solid state physics and Spectroscopy	Domain Specific					
COI	Clear basic concept of crystal classes, lattices, symmetries and to understand the relationship between real and reciprocal lattice.			M	M	L	M
C02	Understanding the correlation Of crystallography with experimental crystal study by Braggs conditions for X-ray diffraction.					L	L
C03	Explore with the knowledge of different crystal defect and its influence on basic physical behaviour of crystals.			H	M	M	M
C04	Gain basic knowledge of dielectric properties of materials and learn the basic of the dielectric behaviour of various materials.		M	M	M		
cos	Describe the spectra of single and multiple electrons atoms including fine and hyperfine structure of alkaline, Helium like atoms, spin and relativity correction, different type of coupling such as L-S and J-J couplings.		M	M	M	L	
COG	Analyse the spectra of diatomic molecules such as electronic, rotational, vibrational spectra and a basic introductory idea about the		H	H	M	M	

	Raman Spectroscopy.						
C07	Explain effect of electric and magnetic field on the atomic spectrum.				H	L	
	Course Name: El.2:X-rays-I	Domain Specific					
COI	Basic concepts of production of X-rays, Designing concepts conventional of X-ray generators, Basics of Advanced radiation source Synchrotron and its advantages over conventional sources.		H	M	L		
C02	Understanding of interaction of X-rays with the matter, Applications of X-rays based on different physical processes involved after interaction of x-rays with matter.			H	M	H	
C03	Understanding the method of X-ray radiography and its applications in medical and industrial fields. Details of material characterization techniques based on X-ray photoelectron/Auger electron spectroscopies and X-ray fluorescence spectroscopy.						
C04	Designing concepts of different x-ray spectrographs, Understanding the concepts and methods of x-ray detection. Gaining the knowledge to select proper spectrograph and detectors for particular application.						
C05	Different theoretical concepts regarding x-ray spectra and their interpretation. Knowledge about calculating relative intensities of spectral lines.		M	M	L	M	M
C06	Interpretation of X-ray absorption spectra. Experimental techniques for obtaining X-ray absorption spectra and its important applications.		H	H	H	H	M
C07	Understanding the concept of dispersion Of X-rays and its significance.		L	L	L	H	L
	Course Name: El.3: Nanoscience and Nanotechnology	Domain Specific					

COI	Clear basic concept of quantum approach for density of states for quantum well, wires and dots.				H	H	
C02	Understanding the different methods of synthesis of nanomaterials.						
C03	Explore with the knowledge of different instrumentation useful to analyse materials at nanoscale.						
C04	Understanding the properties nanomaterials for technology application						
	Course Name: 4T1: Nuclear and Particle Physics	Domain Specific					
COI	Clear basic concept of nuclear properties; its size, radii, shape charge distribution, spin, parity, mass, nuclear stability and also to understand binding energy, semi empirical mass formula, liquid drop model, laws of radioactive decay.		M	M	L	M	
C02	Understands elements of deuteron problem, n-n scattering, charge independence, and symmetry of nuclear forces along with electric and magnetic moments of nuclei.		M	H	M	L	
C03	Gains the knowledge of elementary particles, decay of nuclei, their classification, characteristics, selection rule and their theories.		H	H	L	M	
C04	Explores the field of nuclear reactions, conservation laws, mechanism, cross section, compound nucleus along with fission and fusion reactions, nuclear energy and elements of nuclear power.		M	L	L	L	
cos	Explains the interaction of charged particles and electromagnetic radiation with matter along with principles of radiation detectors including G-M Counter, proportional counter, Na(Tl) Scintillation detectors, semiconductor detectors.		H	M	M	L	
COG	Describe classification of elementary particles, strong, weak		M	L	L	M	

	and electromagnetic interactions also will be able to understand Gellamann — Nishijima formula along with properties of elementary particles and their symmetry and conservation laws.						
COI	Clear basic concept of nuclear properties; its size, radii, shape charge distribution, spin, parity, mass, nuclear stability and also to understand binding energy, semi empirical mass formula, liquid drop model, laws of radioactive decay.		M	L	L	L	L
	Course Name: 4T2 Solid State Physics	Domain Specific					
COI	Band theory, Bloch theorem, the KronigPenney model, construction of Brillouin zones, extended and reduced zone schemes, Quantum theory of paramagnetism, exchange interactions. Pauli paramagnetic susceptibility.				M	H	
C02	Lattice dynamics, energy of atomic motions, adiabatic principle, harmonic approximation, Theories of lattice specific heat, Dulong and Petit's law, Einstein and Debye models.		M	M	H		
C03	Free electron theory, electrons moving in one and three dimensional potential wells, quantum state and degeneracy, density of states, electrical and thermal conductivity of metals, semiconductors, free carrier concentration in semiconductors, Fermi level and carrier concentration in semiconductors.				M	H	H
C04	Superconductivity, Type I and II superconductors, Meissner effect, isotope effect, London equation, coherence length, Josephson junction, high temperature superconductor.		H	H		M	H
	Course Name: E2.2:4T3: X-ray-II	Domain Specific					

COI	Concepts of crystal classes, lattices, symmetries, methods of Crystallographic Projections, Point groups, space groups and to understand the relationship between real and reciprocal lattice.		L	L	L	H	L
C02	Conceptual understanding of different Xray Scattering processes involved in X-ray diffraction.		M	L	L	M	L
C03	Physical Basis of X-ray Crystallography, Different theoretical concepts to interpret and analyse x-ray diffraction pattern.		M	M	H		
C04	Demonstration of different X-ray diffraction based experimental techniques used for materials characterization.					H	M
cos	Interpretation of different phase formation phenomenon in materials using x-ray diffraction technique.			M	L	H	L
CO G	Comparison of different diffraction techniques with that of x-diffraction. Advantages, disadvantages and applicability		H	M	M	H	L
	Course Name: E2.3: 4T3: Nanoscience and Nanotechnology II	Domain Specific					
COI	Understanding the behaviour of materials at nanoscale and their use in different industrial application accordance with properties.		H	M		H	L
C02	Familiar with concept of Nanophotonics and tuning the optical properties nanomaterials and their use in different applications.						
C03	Understand the concept of Nanomagnetism and magnetic properties of nanomaterials.		L	M			
coa	Understanding the electronic properties of nanomaterials and how		M	H			



	to use these properties in making the electronic devices of current trends.						
cos	be familiar with different nanocomposite materials and their synthesis techniques and the need of nanocomposite for current and future applications.				M	H	
	Course Name: S2.2-4T4: Experimental Techniques in Physics	Domain Specific					
COI	Explain different types of radiation, their sources and detectors which are commonly used in experimental techniques.		H	M	H		
C02	Clear the conceptual understanding of functionality of different types of sensors.		H	M	L	M	L
C03	Demonstrate different X-ray and thermal analysis based experimental techniques used for materials characterization in Physics			M	L	M	M

## **Program Specific Outcomes (PSOs) of Electronic (Part of B.Sc. Program) Electronics**

The B.Sc. Course with Electronics as a subject encompasses the domains of knowledge comprising:

1. Components and network theorems
2. Semiconductors
3. Analogue Electronics
4. Digital Electronics
5. Microprocessors and Microcontrollers
6. Instrumentation
7. Communication Electronics
8. "C" computer language

Course Outcomes:-

### **C1: Components and Network Theorems**

CO1: Identification of passive and active electronic components its coding schemes and deployment as circuit elements.

CO2: Make effective use of electronic instruments and systems for measurements and analyses.

CO3: Application of network theorems for circuit analysis.

CO 4: Use of semiconductor elements diodes and transistors circuits and their applications

### **C2: Semiconductor Electronics:**

CO1: Understanding of constructional details, working and applications of FETs and Thyristors

CO2: Use of hybrid parameter models for circuit analysis.

CO3: Understanding working and applications of power amplifiers.

### **C3: Analogue Electronics:**

CO1: Understand electronic systems with a continuously variable signal. The proportional relationship between input –output signals.

CO2: Understand basic circuits using active components, construction and characteristics of components and circuits.

CO4: Design of amplifiers, oscillators and feedback circuits, understanding of working principles

CO5: Basic design of differential amplifier, operational amplifier and its applications

### **C4: Digital Electronics**

CO1: Understanding basic digital signals and logic elements their truth tables and applications.

CO2: Boolean algebra and its applications in design of digital circuits. Use of Karnaugh maps

for digital systems design

CO3: Design of digital circuits and systems using digital integrated circuit.

CO4: Working and design aspects of memory modules.

C5: Microprocessors and microcontrollers:

CO1: Understand basic architecture of 8 bit microprocessor 8085.

CO2: Acquire programming skills in assembly language for 8085 microprocessor.

CO3: Understand architecture of microcontroller its features and applicability.

CO4: Design of interface circuits using microcontrollers.

C6: Instrumentation:

CO1: understand basic analogue and digital meters for its effective use in systems measurements.

CO2: Use of test elements such as power supplies, function generators, CRO, DFM

CO3: Transducer principles, construction, working and applications in instrumentation systems.

CO4: Understanding, design and development of conventional, PC based and Virtual instrumentation modules and systems.

CO5: Use of software platform for study and analysis of electronic circuits and systems.

C7: Communication Electronics:

CO1: Understanding various aspects of communication process, its components and types of communication.

CO2: Understand modulation and demodulation processes in communication systems. Understanding of analogue and digital communication systems and its processes.

CO3: understanding of Optical communication system elements and principles

CO4: Basic knowledge of mobile communication system.

C8: "C" Programming

CO1: Acquisition of basic programming skills in C language.

CO2: Application of C programming techniques to control electronic hardware systems and modules.

## **Programme Outcomes, programme specific outcomes & course outcomes of the subject English**

PSO1 : In pursuance with an emphasis on Language, English gains a deeper understanding of the resources of the written word.

PSO2 : It helps students to explore the entire range of human experience in the arena of language, specifically in Fiction, Poetry, and Drama.

PSO3 : It helps students to build skills of analytical and interpretive arguments; becomes careful and critical reader, practice writing in a variety of genres as a process of intellectual inquiry, creative expression and ultimately to become more effective thinkers and communicators who remains well equipped for a variety of careers in our information intensive society.

PSO4 : It offers students the opportunity to study influential writings from the British, American and global Anglophone traditions.

PSO5 : It provides imagination and critical insights into all areas of human experience - war and peace, nature and culture, love and sexuality, selfhood and social identity, justice and atrocity, the burdens of history and the dreams of the future.

PSO6 : Reads complex texts, actively recognizes key passages, raises questions, appreciates complexity and ambiguity, and comprehends the literal and figurative uses of language.

PSO7 : Increases confidence in speaking publicly, articulates clear questions and ideas in class discussion; listens thoughtfully and respectfully to other ideas and prepares, organizes and delivers engaging oral presentations.

### Programme Outcomes (POs)

#### B. Sc. I Compulsory & Supplementary English

PO1: Increases confidence in their ability to read, comprehend, organize and retain written information.

PO2: Increases Vocabulary through the study of word parts, use of context clues and practice with a dictionary.

PO3: Uses standard grammar, syntax, punctuation and spelling. Achieves clarity and conciseness in formal technical writing.

PO4: Learns to analyze unfamiliar words by understanding the structure of the English language.

PO5: Improves comprehension and retention.

PO6: Improves ability to read and spell words through an analysis of structure of the English language.

PO7: Develops ideas with coherence and cohesion.

PO8: Builds confidence in speaking & writing English language.

#### Course Outcomes (B. Sc.I) Compulsory English

CO1 : Comprehend the nature of literary forms like prose, poetry drama, short stories.

CO2 : Learn to draft an application, letter, and report.

CO3 : Comprehend and compare passages.

CO4 : Develop and improve vocabulary skills through one word substitute.

CO5 : Learn antonyms and synonyms and use them in sentences.

CO6 : Learn appropriate use of parts of speech.

CO7 : Learn to draft curriculum vitae.

CO8 : Learn to identify common errors in English.

CO9 : Learn to prepare sentences from given words.

#### Course Outcomes (B. Sc. I ) Supplementary English

CO1 : Illustrate the nature of literary forms like prose, poetry drama, short stories.

CO2 : Comprehend the passage and make a précis of it.

CO3 : Improve vocabulary by learning one word for a group of words.

CO4 : Learn word formation.

CO5 : Improve essay writing skill.

CO6 : Learn usage of foreign words in English.

CO7 : Learn to prepare news reports.

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CO8 : Learn to prepare advertisements.

CO9 : Learn to improve writing skill through expansion of idea.