POST GRADUATE LEVEL

PROGRAMME OUTCOMES

FACULTY–SCIENCE

After completing the post-graduation studies in any subject belonging to science, the student should have

Critical thinking

- Understanding how the scientific theories are proposed and how they are accepted or rejected by experimental evidences.
- Recognized the in-depth progress of subject matter from ancient times to recent ones with path-breaking discoveries, key inventions, theories and the scientists who contributed to this.
- Assimilated a deep knowledge on possibilities in the concerned subject by extensive reading of reference books, research journals & periodicals, internet, etc.
- Partaken in seminars and workshops, summer/short-term trainings and developed the thinking skills and practical skills.

Effective Communication

- Developed the capability of creative thinking (Convergent & divergent) to be able to provide solutions to the unsolved problems or designing new experimental substantiation trials.
- Acquired extraordinary skills in laboratory experimentation and conjecturing the coherent inferences.

Social Communication

- Recognized the role of scientific knowledge in disabling social evils, blind faith, poverty, health issues, and eventually improving the quality of human beings.

Effective Citizenship

- Perceived where and how the principle of processes can be used in future for a advancement of mankind.
- Elucidated the contribution of subject knowledge has influenced the progress in expanses of science and technology valuable in the progressing the peoples life.

Ethics

- Developed a resilient conviction that ethical, moral and social values are of prime importance for chasing a scientific profession.

Environment and Sustainability

- Grasped the necessary measures for sustainable development of Earth and regulating environmental pollution menaces.
- Developed awareness about activities of routine life leading to depletion of natural resources and contribute to its management.

Self-directed and Life-long Learning

- Adjudicated the currently accepted theories with their strength and weaknesses and provide improved descriptions for the modification of the existing theory.
- Recognized the research areas lacking advanced research work done or are yet to be explored.
- Pursuing independent research project in R & D organizations of industries or government authorized national laboratories.
- Participated in Project, worked on independent designing & implementation of the research work.

UNDER GRADUATE LEVEL

PROGRAMME OUTCOMES

FACULTY–SCIENCE

After graduating from science faculty, a student should have:

Critical thinking

- Understood the basic concepts, fundamental principles, and scientific theories based on various scientific phenomena and their applications in life activities.
- Acquired expert skills in handling and operating the laboratory instruments, analysing scientific data and performing laboratory oriented experiments, highlight significant observations and deduce the logical inferences/conclusions based on facts and findings.

Effective Communication

- Developed numerous communication skills such as writing, reading, listening, speaking, etc., which shall eventually help in expressing thoughts, ideas and cognitive views evidently and effectively.

Social Communication

- Developed an aptitude for participating in various socio-cultural activities with enthusiasm, to disperse the seeds of knowledge and contribute in creating awareness about the social myths, disbeliefs.
- Realized that importance of knowledge of other faculties such as humanities, performing arts, social sciences and sports can greatly and effectively influence & inspire in evolving new scientific theories and inventions.

Effective Citizenship

- Developed a patriotic and disciplined citizen following the rules and regulations for furtherance of society.

Ethics

- Imbibed science oriented ethical, moral and social values in personal and social life leading to highly cultured and civilized personality.

Environment and Sustainability

- Understood the need of rational use of natural resources and be aware of waste treatment reduction in carbon footprint for sustainable environment

Self-directed and Life-long Learning

- Realized that pursuit of knowledge is a lifelong activity and in combination with untiring efforts and positive attitude to rejoice a successful life.
- Developed creative thoughts and propose novel ideas to solve the immediate societal problems and invade in advancing the current technologies.

DEPARTMENT OF CHEMISTRY
PROGRAMME: B.SC.

Statements of Programme Specific Outcomes (PSOs)

By the end of the course, the students will be able to:

1. Join school or junior college as Chemistry teacher.
2. Prepare for competitive exams like MPSC,SET,UPSC,NET,GATE,CAT.
3. Analyze and grasp abstract ideas to apply them to important practical problems.
4. Develop strong analytical skills and a broad-based background in the Chemistry sciences to join research and pharmaceutical industry.

Statement of Course Outcomes (COs)

M.SC. Course: SEM-1 CH-101: Paper I (Inorganic Chemistry)

By the end of this course,the students will be able to:

1. Understand Stereochemistry and bonding in main group compound and metal ligand bonding.
2. Understand Metal-ligand equilibria in solution.
3. Understand the reaction mechanism of Transition metal complexes.
4. Understand the Borohydride compounds and metal-metal bonds.

M.SC. Course:SEM-1 CH-102: Paper II (Organic Chemistry)

By the end of this course,the students will be able to:

1. Understand the nature and bonding and reactive intermediate in organic chemistry.
2. Study stereochemistry of organic compound.
3. Study the reaction mechanism and reactivity of organic compounds i.e. Aliphatic nucleophilic substitution reaction,aromatic nucleophilic and electrophilic substitution reaction.

M.SC. Course: SEM-1 CH-103: Paper III (Physical Chemistry)

By the end of this course, the students will be able to:

1. Understand the concept of classical thermodynamics.
2. Understand the concept of Gibbs function and phase equilibria.
3. Understand the surface phenomenon of macromolecules and chemical kinetics of reactions.

M.SC. SEM-1 CH-104: Paper IV (Analytical Chemistry)

By the end of this course, the students will be able to:

1. 1.To study statistical analysis of chemical reactions.
2. To understand separation techniques involved in purification process.
3. Students will be able to perform volumetric and gravimetric analysis.
4. To study the conceptual understanding of electrochemical analysis.

M.SC. SEM-1 CH-105: Practical-I (Inorganic Chemistry)

By the end of this course, the students will be able to:

1. Prepare inorganic complexes and their analysis.
2. Perform quantitative analysis of different metal salts.
3. Able to perform qualitative analysis of rare earth metals.
4. To understand gravimetric and spectrometric analysis of complexes.

M.SC. SEM-1 CH-106: Practical-II (Physical Chemistry)

By the end of this course, the students will be able to:

1. To determine molecular wt. of polymer by viscosity method.
2. To study the kinetics of chemical reactions.
3. To determination of heat of reaction, entropy change and equilibrium constant of the reaction between metallic zinc and Cu+2 ions in solution.
4. To determine equivalent conductance of weak electrolyte at infinite dilution by kaulrausch's Method.

M.SC. SEM-1 CH-107: Seminar-I

By the end of this course, the students will be able to:

1. Seminar of 30 minutes duration will be a part of internal assessment and helpful for students to improve their communication and presentation skills.
2. Students will gain knowledge of literature survey.

M.SC. SEM-1I CH-201: Paper V (Inorganic Chemistry)

By the end of this course, the students will be able to:

1. Understand electronic spectra of transition metal complexes.
2. Gain knowledge about magnetic properties of transition metal complexes
3. Understand reaction mechanism of transition metal complexres.
4. To study metal carbonyls and nitrosyls.

M.SC. SEM-1I CH-202: Paper VI (Organic Chemistry)

By the end of this course, the students will be able to:

1. Study reaction mechanisms for addition to carbon-carbon multiple bond and addition to carbon-hetero atom multiple bond.
2. Understand mechanism for molecular rearrangement and elimination reactions.
3. To gain knowledge of free radical reactions.
4. To study and understand importance of green chemistry

M.SC. SEM-1I CH-203: Paper VII (Physical Chemistry)

By the end of this course, the students will be able to:

1. Understand formulation of quantum mechanics.
2. Gain knowledge about chemical thermodynamics
3. Understand solid state chemistry.
4. Study the statistical thermodynamics and nuclear chemistry

M.SC. SEM-1I CH-204: Paper VIII (Analytical Chemistry)

By the end of this course, the students will be able to:

1. Understand Sampling and quantification.
2. Study modern separation techniques such as gas Chromatography, liquid chromatography, supercritical fluid chromatography.
3. To understand Optical methods of analysis.

M.SC. SEM-1I CH-205: Practical-III (Organic Chemistry)

By the end of this course, the students will be able to:

1. Perform organic qualitative analysis for structure determination.
2. Students will be able to perform single stage preparations.
3. Carry out purification of the compounds by crystallization, TLC and chromatographic techniques.

M.SC. SEM-1I CH-206: Practical-IV (Analytical Chemistry)

By the end of this course, the students will be able to:

1. To understand classical methods and separation techniques: calibration, validation and computers
2. To study instrumental techniques: electro analytical techniques.
3. To perform volumetric and gravimetric analysis.
4. To understand and perform Optical methods of analysis.

M.SC. SEM-1I CH-207: Seminar-II

1. Seminar of 30 minutes duration will be a part of internal assessment and helpful for students to improve their communication and presentation skills.
2. Students will gain knowledge of literature survey.

M.Sc. Semester III CH-301: Paper IX (Special I-Inorganic Chemistry)

By the end of this course, the students will be able to:

1. To understand importance of essential and trace metals in biological systems.
2. Gain knowledge about bio-energetics and atp cycle and electron transfer in biology.
3. To study the role of metallo enzymes.

M.Sc. Semester III CH-302: Paper X (Special II-Inorganic Chemistry)

By the end of this course, the students will be able to:

1. To understand crystal structure of some simple compounds
2. Understand chemistry of glasses, ceramics and composite.
3. Gain the knowledge about liquid crystals.

M.Sc. Semester III CH-305: Practical-V (Inorganic Chemistry Special)

By the end of this course, the students will be able to:

1. Perform experiments related to colorimetry and spectrophotometry.
2. Study Kinetics and mechanism of chemical reactions.
3. Perform experiment of extraction and absorption spectral study of chlorophyll from green leaves.
4. Separate chlorophyll and study their electronic spectra.

M.Sc. Semester III CH-301: Paper IX (Special I-Organic Chemistry)

By the end of this course, the students will be able to:

1. To study Photochemistry and pericylic reactios of organic compounds.
2. Understand oxidation and reduction methods in chemical methods.
3. Gain the knowledge about chemistry of P, S, Si,and Boron compounds.
4. Use of Organo silicon compounds in organic synthesis.

M.Sc. Semester III CH-302: Paper X (Special II-Organic Chemistry)

By the end of this course, the students will be able to:

1. Understand chemistry of natural products.
2. Importance of alkaloids and prostaglandins in biological systems.
3. To gain the knowledge about carbohydrate, amino acids, protein and peptides**.**

M.Sc. Semester III CH-305: Practical-V (Organic Chemistry Special)

By the end of this course, the students will be able to:

1. Perform quantitative analysis of vitamin "c" iodometry, glucose by benedict's solution, aldehyde by oxidation method.
2. To isolate organic compounds from natural source.
3. Perform separation of the components of a mixture of three organic compounds.

M.Sc. Semester III CH-301: Paper IX (Special I-Physical Chemistry)

By the end of this course, the students will be able to:

1. Understand the use of statistical thermodynamics.
2. To gain the knowledge about electrochemistry of interfaces.
3. To study the photo physical phenomenon and photochemical reactions.
4. To understand chemical dynamics of reactions.

M.Sc. Semester III CH-302: Paper X (Special II-Physical Chemistry)

By the end of this course, the students will be able to:

1. Understand applications of quantum mechanics.
2. To gain the knowledge about solid state reactions and nanoparticles.
3. To study and understand electrochemistry of solutions.
4. Know the applications of irreversible thermodynamics.

M.Sc. Semester III CH-305: Practical-V (Physical Chemistry Special)

By the end of this course, the students will be able to:

1. Determine partial molar volume of solute and solvents.
2. To study the effect of addition of an electrolyte such as NaCl, KCl,Na2SO4,K2SO4 etc. on the solubility of an organic acid.
3. To determine the activation energy of hydrolysis of an ester by acid.
4. Determine the eq. conductance of strong electrolyte (KCl, NaCl, HCl, KNO3) at several concentration and hence verify Onsager's equation.

M.Sc. Semester III CH-301: Paper IX (Special I-Analytical Chemistry)

By the end of this course, the students will be able to:

1. Understand use of radioanalytical chemistry.
2. Know about the Optical methods of analysis.

3. Gain knowledge about electrochemical methods of analysis such as stripping voltammetry, adsorptive stripping voltammetry, cyclic voltammetry.
4. To understand Fluorometry, phosphorimetry, Nephelometry and turbidimetry, Photoacoustic spectroscopy.

M.Sc. Semester III CH-302: Paper X (Special II-Analytical Chemistry)

By the end of this course, the students will be able to:

1. Know the use of organoanalytical chemistry.
2. Understand the procedure for analysis of ores and cement.
3. To gain the knowledge about water pollution and analysis.
4. To understand the air pollution and analysis.

M.Sc. Semester III CH-305: Practical-V (Analytical Chemistry Special)

By the end of this course, the students will be able to:

1. Determine percent Na2CO3 in soda ash by pH-metric titration.
2. Estimate Cl-, Br- and I- in a mixture.
3. Determine percent purity of phenol by potentiometric titration with NaOH.
4. Estimate nickel and cobalt by coulometric analysis at controlled potential.
5. Determine percentage of two optically active substances (d-glucose and d-tartaric acid) in mixture.

M.Sc. Semester III CH-303: Paper XI (Elective- Environmental Chemistry)

By the end of this course, the students will be able to:

1. To understand concept and scope of environmental chemistry.
2. Gain the knowledge about water and air pollution.
3. Understand the causes of soil pollution.
4. Study and understand causes and effect of radioactive pollution.

M.Sc. Semester III CH-303: Paper XI (Elective- Polymer Chemistry)

By the end of this course, the students will be able to:

1. Know about the basics of polymer chemistry.
2. Determine molar mass of polymers by various methods.
3. Understand the physical characteristics of polymers.
4. To gain the knowledge about Organic polymers: Commercial polymers, synthesis and and application of polyethylene, Cellulose Acetate, PMMA, polyaimdes, polyesters, Urea resins and eposy resins.

M.Sc. Semester III CH-303: Paper XI (Elective- Medicinal Chemistry)

By the end of this course, the students will be able to:

1. Understand the basics about drug design.
2. Gain the knowledge about pharmacokinetics and pharmacodynamics of drugs.
3. Study about the cardiovascular drugs, antineoplastic agent, psychoactive drugs, coagulant and anticoagulants.
4. Get knowledge about drugs absorption, distribution and disposition of drugs,

excretion and elimination, pharmacokinetics of elimination and pharmacokinetics in drug development process.

M.SC.: SEM-IV CH-401: Paper XIII (Special I-Inorganic Chemistry)

By the end of this course, the students will be able to:

1. 1.Understand nanoparticle and nanostructural material.
2. Learn coordination polymer and their characterization.
3. Understand organotransition metal inorganic chemistry and their reactions.
4. Understand catalysis and optical sensor for metal ions.

M.SC.: SEM-IV CH-402: Paper XIV (Special II-Inorganic Chemistry)

By the end of this course, the students will be able to:

1. 1.Understand basics of photochemistry.
2. Learn redox reactions by excited metal complexes.
3. Understand organotransition metal inorganic chemistry and their reactions.

M.SC.: SEM-IV CH-405: Practical-VII (Inorganic Chemistry Special)

By the end of this course, the students will be able to:

1. Preparation and characterization of complexes/organometallic compound including their structural elucidation by the available physical methods.
2. Separation and quantitative estimation of binary and ternary inorganic mixture.

M.SC.: SEM-IV CH-401: Paper XIII (Special I-Organic Chemistry)

By the end of this course, the students will be able to:

1. Study carbanion , organometallic in organic chemistry.
2. Understand use of organometallic reagents in organic chemistry.
3. Study stereochemistry and retrosynthetic analysis of organic compound.

M.SC.: SEM-IV CH-402: Paper XIV (Special II-Organic Chemistry)

By the end of this course, the students will be able to:

1. Understand enzyme chemistry, mechanism of enzyme action.
2. Study different heterocyclic compounds, their preparation and reactions.
3. Understand nuclic acids and lipids.
4. Study organic polymer.

M.SC.: SEM-IV CH-405: Practical-VII (Organic Chemistry Special)

By the end of this course, the students will be able to:

1. Do quantative analysis of Nitrogen,halogen and Sulpher based on classical and instrumental technique.
2. Estimation of streptomycin sulphate, vitamin B-12, amino acids etc by spectrophotometric technique.
3. Do Organic multi-step preparations (Two/Three steps).
4. Structure Elucidation of organic compounds on the basis of spectral data (UV, IR, 1H and 13CNMR and Mass)

M.SC.: SEM-IV CH-401: Paper XIII (Special I-Physical Chemistry)

By the end of this course, the students will be able to:

1. Understand chemical thermodynamics.
2. Understand corrosion and corrosion analysis.
3. Understand and uses of Radiation chemistry.
4. Learn electrical and thermal properties of solids.

M.SC.: SEM-IV CH-402: Paper XIV (Special II-Physical Chemistry)

By the end of this course, the students will be able to:

1. Study solid state of compound and their magnetic properties.
2. Do electrical properties of compound.
3. Study liquid states and interfaces.
4. Understand ionic liquid and battery technology.

M.SC.: SEM-IV CH-405: Practical-VII (Physical Chemistry Special)

By the end of this course, the students will be able to:

1. To verify Gibbs adsorption isotherm and to find surface excess concentration of solute.
2. Determination of pKa value of a weak acid by chemical kinetic method (formate-iodine reaction)
3. Transport number by potentiometry.
4. To determine the stability constant of reaction between Ferric ion solution and SCN- ion solution by Job's method.

M.SC.: SEM-IV CH-401: Paper XIII (Special I-Analytical Chemistry)

By the end of this course, the students will be able to:

1. Prepare radioisotopes and application of radioisotopes.
2. Learn optical method of analysis.
3. Do electrochemical and thermal method of analysis of all types of compounds.

M.SC.: SEM-IV CH-402: Paper XIV (Special II-Analytical Chemistry)

By the end of this course, the students will be able to:

1. 1.Study clinical and pharmaceutical analysis.
2. Do soil analysis and coal analysis.
3. 3.Study corrosion and corrosion analysis.
4. Learn automation in analytical chemistry.

M.SC.: SEM-IV CH-405: Practical-VII (Analytical Chemistry Special)

By the end of this course, the students will be able to:

1. Estimate different types of elements like P,S,C,N, halogen present in given organic compound.
2. Estimation of phenol and aniline.
3. Study different types of separation technique like solvent extraction, ion exchange, paper chromatography, thin layer chromatography.
4. Check different types of water parameters.
5. Understand uses and applicationsof HPLC and GC.

M.SC.: SEM-IV CH-403: Paper XV (Elective- Environmental Chemistry)

By the end of this course, the students will be able to:

1. 1.Study causes of water pollution and how to minimize it.
2. Study air pollution – causes and remedies.
3. Study Soil pollution – causes and remedies.

M.SC.: SEM-IV CH-403: Paper XV (Elective- Polymer Chemistry)

By the end of this course, the students will be able to:

1. Study different types of polymers.
2. Prepare different types of polymers.
3. Study different characterization method of analysis of polymer.

M.SC.: SEM-IV CH-403: Paper XV (Elective- Medicinal Chemistry)

By the end of this course, the students will be able to:

1. Study different types of drugs with their action.
2. Reactivity of drug with active sites.
3. Prepare different types of drugs.

M.SC.: CH-404: SEM-IV Paper XVI (Foundation-II)
Instrumental Methods of Analysis – II

By the end of this course, the students will be able to:

1. Study spectroscopical techniques for structure determination.
2. Study Nuclear magnetic Resonance Spectroscopy which is useful for structure determination.
3. Study diffraction technique which is useful for structure determination.

M.SC.: SEM-IV CH-406: Practical VIII- Project

By the end of this course, the students will be able to:

1. Learn different techniques of research used in anlaysis.
2. Perpare ppt presentation.
3. Improve presentation skill and teaching communication skill.

DEPARTMENT OF ENVIROMENT SCIENCE
PROGRAMME: M. SC.

Semester I

Paper I Environmental Chemistry (1T1)

Student shall be able to:

- Explain the Fundamentals of Chemistry: Concept of Molarity, Normality and Standard Solutions.
- Apply The Laws and Principles of Basic Chemistry and solve the problems.
- Analyze the various constituents present in environment.
- Understand the Green Chemistry and apply the knowledge for Sustainable Future.
- Interpret the process of soil formation and explain the concept of soil chemistry.
- Discern the typical characteristics of Paper and Pulp, Tannery, Textile, Dairy, Sugar, Petrochemical, Pharmaceutical, Oil Refinery and Power Plants-Thermal, Gas Based and Hydroelectric and design the suitable treatment.

Paper II: Atmospheric Science (1T2)

Student shall be able to:

- Explain the Fundamentals of Atmospheric Science: Composition and evolution of Atmosphere and concept of temperature inversion and lapse rate.
- Understand the concept of Climatology, Insolation-Factors, Solar Radiation, Condensation and Hydrologic Cycle.
- Discern the various forms of Condensation: Dew, Frost, Fog, Mist, Smog.
- Interpret the primary and secondary Meteorological Parameters and their Measurement: Temperature, Wind, Humidity and Solar Radiation.
- Collect and analyze of Wind Data and plot Wind Roses and pollution roses.
- Explain the sources and effects of Green House Gases: O2, O3, H2O, NH3, N2, NO, NO2, NO3, CH4 and CFCs and the mechanism of Ozone Depletion.

Paper III: Environmental Biology (1T3)

Student shall be able to:

- Explain the concept of Ecology and the ecological relationships and Ecological Status in India
- Understand Population Ecology and its dynamics, Biotic potential, Pray- Predator Relationship, Concept of Carrying Capacity.
- Interpret and explain Community Ecology with composition, functions and characteristics and discern the terms Stratification, Periodicity, Fluctuation, Eco-tone and Edge Effect, Ecological Niche, Eco-types.
- Utilize the knowledge of Dose – Effect and Dose-Response Relationship- Frequency and Cumulative Response, Lethal and Non-Lethal Effects, LD_{50}, in eco-toxicological studies.
- Apply the principles of Bioassay studies and explain chemical toxicology.

Paper IV: Environmental Microbiology and Biotechnology (1T4)

Student shall be able to:

- Understand the scope and importance of Environmental Microbiology and Structure of Microorganisms-Fungi, Bacteria, Virus and their role in Air, Water and Soil for Environmental Management and pollution abatement.
- Apply the Techniques used of Enrichment of Culture, Method of Pure Culture (Pour plate, Streak plate and Spread plate).
- Explain the Basic and scope of Environmental Biotechnology its approach of Environmental Pollution abatement with Bioremediation, Reclamation and Restoration.
- Apply In-situ and Ex-situ Bioremediation, Phytoremediation- Metal Phytoremediation, Organic Phytoremediation, Microbes in Pollution Mitigation.

SEMESTER – I:PRACTICAL – I

Student shall be able to:

ENVIRONMENTAL CHEMISTRY AND ATMOSPHERIC SCIENCE (1P1)

- Prepare standard solutions and discern the weighing capacity and sensitivity of weighing balances.
- Carry-out water sampling and storage techniques.
- Estimate primary productivity.
- Examine the water quality with respect to: pH, conductivity, density, viscosity, turbidity, colour, Acidity, Alkalinity, TDS & DO and iron.
- Inspect texture and particle size distribution (sand, silt and clay) porosity, water holding capacity, electrical conductivity and infiltration rate of soil.
- Determine meteorological parameters wind velocity, direction and relative humidity for air pollution studies.

PRACTICAL – II: ENVIRONMENTAL BIOLOGY, ENVIROMENATAL MICROBIOLOGY AND BIOTECHNOLOGY (1P2)

Student shall be able to:

- Estimate the primary productivity and interpret the effects of light/pollutants on photosynthetic activity.
- Analyze the lake ecosystem with special reference to its conservation and management.
- Isolate the bacteria from soil water & air and analyze by Standard plate count and Coli form count by MID & MPN technique.
- Identify and enumerate Phytoplankton and zooplankton in surface water.
- Collect affected leaves from road side plantation and compare with reference plants.

Paper V: Environmental Ecosystem and Biodiversity (2T1)

Student shall be able to:

- Explain the Concept and Structure, Functions and Types of Ecosystem-Abiotic and biotic components.
- Interpret the Importance of Conservation, Reason for extinction of wildlife and conservation measures.
- Understand Biomes and Conservation of Forest with Special Emphasis on Indian Biomes and explain Characteristics Features and Different Types of Ecological Indicator.

- Discern the Level and Types of Biodiversity, Significance, Magnitude & Distribution of Biodiversity, Trends, Biogeographic Classification of India, Values and Impact of Biodiversity.
- Conserve and restore Wilderness and Green Cover and apply Biodiversity Legislation, Diversity Act 2002, Biodiversity Rules 2004.

Paper VI: Natural Resources Management (2T2)

- Understand Natural Resources its Conservation and Management, Broad Classification, Renewable, Non-Renewable and Mineral Resources.
- Discern Importance, Methods, Barriers and Measures to Energy Conservation.
- Explain the Water resources: Surface, Ground and Frozen Water, causes for water stress and Water Conservation Strategies in India.
- Interpret the exploitation and impact of Land & Forest Resources and apply control measures and conservation practices: Afforestation and Joint Forest Management – Social Forestry, Agro-Forestry.

Paper VII: Environmental Sampling and Research Methodology (2T3)

Student shall be able to:

- Discern Air Sampling Location, Sampling Methods (Sedimentation, Filtration, Centrifugal and Impingement Method), Instrumental Techniques used in Estimation of Atmospheric Air Pollutant
- Collect, Handle and Preserve Water Samples and classify, analyze, interpret the water quality parameters with the significance of measurement.
- Explain the Soil and Solid Waste Sampling: objectives, criteria, site selection and significance of Physico-Chemical Parameters.
- Collect and represent the data for Environmental Analysis and interpret the statistical terms: Measure of Central Tendency, Measure of Variation, Correlation and Regression, Testing of Hypothesis, Standard Deviation, Bias, Precision and Accuracy.

Paper VIII: Analytical Techniques for Environmental Monitoring (2T4)

Student shall be able to:

- Understand the Theory and Classification of Chromatographic Separation and explain the chromatographic techniques-instrumentation.
- Apply principle and working of UV-Visible Spectrophotometer, Infrared (IR) Spectrophotometer, Nuclear Magnetic Resonance (NMR), Atomic Absorption Spectrophotometer (AAS), Flame Photometer.
- Explain Electro Chemical Techniques: Principle, Instrumentation and Application of Polarography, Anodic Stripping Voltametry and speciation in Environmental Analysis.
- Interpret the Modern Instrumental Techniques: Atomic mass Spectrometery, Molecular Mass Spectrometery, Mass Spectrometric Applications, Radiochemical Analysis, ICP, ATOMFS in Environmental Analysis.

- **SEMESTER II**

PRACTICAL – III (2P1)L: Environmental Ecosystem And Management

Student shall be able to:

- Explain the Biotic components of pond and lake ecosystem and different ecological indicators of an ecosystem.
- Interpret forest ecosystem as biome, vegetation type characteristics and features of forest, soil type etc.
- Collect and interpret wild life data with respective common spices, endanger species
- Determine the important value index (IVI) of vegetation.
- Implement conservation strategies with respect to project tiger, project elephant, project crocodile in India.

Natural Resources Management

- Perform proximate analysis of Coal.
- Determine calorific value of biomass.
- Estimate Chemical Oxygen Demand and Biochemical Oxygen Demand of waste water sample.
- Determine efficiency of biogas by raw materials and outlet effluents.
- Estimate soil for Organic Carbon, NPK, CEC and SAR.

Practical IV (2P2): Industrial chemistry

Student shall be able to:

- Explain and discern industrial processes of different industries.
- Able to explain and interpret the raw material used in industries and their environmental significances.
- Analyze the Characteristics of different waste from industries.
- Understand and treat the wastewater by Preliminary treatment, Chemical treatment and biological treatment of waste water.
- Discern amongst preliminary treatment of waste water Study of chemical treatment of waste water biological treatment of waste water.

Analytical techniques

- Explain the principle components and working of U.V. visible spectrophotometer
- Analyze the concentration of sulphate by spectrophotometer.
- Analyze the concentration of phosphate by spectrophotometer.
- Analyze the concentration of nitrate by spectrophotometer.
- Determine the concentration of sodium, potassium, calcium and lithium by flame photometer.
- Demonstrate AAS and analyze trace and heavy metals.
- Demonstrate HPLC and analyze GC for pesticide analysis.

Semester III

Paper IX: Physico-Chemical Treatment of Water & Waste Water (3T1)

Student shall be able to

- Discern Domestic and Industrial Wastes and its sources and the factors affecting Quantity of Sanitary Sewage.
- Explain the objectives, system, principle and design of wastewater collection and understand the Physico-chemical and Biological Characteristic of wastewater.
- Apply the design principle and construction of Screen, Grit Chamber, Oil & Grease Trap, Pre-Sedimentation, Pre-aeration, and Equalization.
- Understand the wastewater treatment methods Unit Operations, Processes and Treatment Systems Used in Wastewater Treatment, Treatment Flow sheet, Plant Layout, Hydraulic

Profile.

- Analyze the Methods of Treatment, Chemical Coagulation, Flocculation, Sedimentation, Filtration, Air Stripping, Ion Exchange Carbon Adsorption, Reverse Osmosis, Clarifiers and Efficiency of Chemical Precipitation.

Paper X:Biological Process in Wastewater Treatment (3T2)

Student shall be able to

- Understand Basic Principles of Anaerobic Treatment and explain Anaerobic Digestion and Sludge Treatment.
- Apply Basic Principles of Aerobic Treatment Technologies and explain Activated Sludge Process.
- Interpret the Operation & Maintenance measures of Wastewater Treatment Plant for various units & equipment such as Screens, Grit Chamber, Skimming Tanks, Primary clarifiers, aeration tanks, secondary clarifiers , Anaerobic digesters.
- Explain Waste water treatment & Reuse: Treatment scheme, flow diagram & hydraulic profile for Sewage reuse plant, generation & utilization of methane from treatment of industrial waste water & sewage.

Paper XI (ELECTIVE – I): Water and Water Treatment (3T3)

Student shall be able to

- Understand Water Treatment Process: Primary, Secondary and Tertiary and explain Objective, Principles, Unit Operation and Unit Processes of Water Treatment.
- Explain the Necessity, Method and Theory of Filtration and Disinfection and discern Plain Chlorination, Prechlorination, Post chlorination, Super Chlorination, Double Chlorination, Break Point Chlorination.
- Analyze Methods of Water Softening, (Lime, Soda Process, Zeolite Process, Demineralization Process, Ion Exchange Resins) and their Chemical.
- Apply Modern Water Treatment Techniques for Removal of Colour, Odour and Taste, Aeration and Treatment With Activated Carbon.

Paper XII (ELECTIVE-II): Water Supply and Resources (3T3)

- Student shall be able to
- Explain Importance and Necessity of Water Supply Scheme, Essential of Water Supply Scheme, Types of Water Sources.
- Interpret Surface & Ground Water Quality: Infiltration, Porosity, Water Bearing Stratum, Groundwater flow, Groundwater Yield, Permeability, Groundwater Velocity, Springs, Infiltration Galleries, Porous Pipe Galleries.
- Discern Quantity and Quality of Water: Types of Demand, Measurement of Water Quantity, Pure and Potable Water, Physical Tests, Chemical Test, Bacteriological Tests.
- Understand Distribution of Water: Method of Distribution System, Requirement of

Distribution of Water and their Merits and Demerits, System of Supplying Water, Types of Service Reservoir.

Paper XIII (Foundation-I): Fundamentals of Environmental Science- I (3T4)

- Student shall be able to
- Define and explain Scope of Environmental Science, Types of Environment, Environmental Organizations and Agencies, Activists in Environmental Movements and their role.
- Interpret the Structure of Atmosphere, Hydrological Cycle, Global Water Balance, Structure and Composition of Lithosphere and Biosphere.
- Understand the Branches of Ecology, Ecological Landmark, Concepts, Structure and Functions of Ecosystem and Biogeochemical Cycles.
- Discern Diversity of Wildlife, Protected Wildlife Species, Categories of Threatened Species and Developmental Projects: Project Tiger, Project Elephant.

Paper XIV: Core (Subject Centric) 1: Advanced Water & Waste Water Treatment (3T4)

Student shall be able to

- Interpret the advanced treatment in water and waste water: Zero Liquid Discharge, Concept of CETP.
- Understand Advancement in Water Treatment: Membrane technology, Modern Desalination plants, Dual Media Filtration.
- Apply advanced Waste Water Treatments: Dissolved Air Floatation Unit, High Rate Solid Contact Clarifier, Membrane Bio Reactor, Moving Bed Biofilm Reactor.
- Explain Cost Economics of Modern Technologies and Nano Filtration, Multi Effect evaporators, Biogas generation and it's reuse.

Practical –V: Physico- Chemical Treatment of water & Waste Water and Biological Process in Waste Water Treatment (3P1)

Student shall be able to

- Perform Relative density test for a sample of waste water.
- Determine of Sludge Volume Index (SVI) of sludge samples and Sludge Density Index (SDI) of sludge samples.
- Estimate Nitrogen by Kjeldahl's methods and Phosphate and Sulphate in sludge for fertilities values.
- Estimate of Chemical Oxygen Demands (COD) of waste water and Biochemical Oxygen Demands (BOD) of waste water.
- Determine percent organic matter of a sludge.
- Study the sludge for its composition (solids, suspended volatile fixed and total)
- Estimate the suspended, dissolves, total, volatiles solids in sewages.
- Study the sewage treatment plant with respect to :
- Flow measurement

- Design of screen, grit chamber, aeration tank, anaerobic digesters, settling units.

Practical (ELECTIVE I) (3P2): Water & Water Treatment

Student shall be able to

- Determine the impurities of water viz. color, temperature, odour and taste of water.
- Determine the total solids in water (suspended & dissolved).
- Determine the iron and manganese by spectrophotometer.
- Determine the hardness in raw and treated water.
- Determine the chloride in water samples by argentometric method.
- Conduct the chlorine demand test of a sample of water and to draw chlorine demand curve to determine brake point chlorination.
- Determination of optimum coagulant dose by jar test apparatus.

Practical (ELECTIVE) II (3P2): Water Supply and Resources

Student shall be able to

- Determine the turbidity of the sample by turbidity meter.
- Determine the optimum coagulant dose by jar test apparatus.
- Determine the fluoride concentration by SPADNS methods / Ions selective Electrodes.
- Determine the langelier calcium carbonate saturation Index.
- Conduct the chlorine demand test of a sample of water and draw chlorine demand curve.
- Determine break point chlorination.
- Determine the alum dosage for defluoridation of water by application of Nalgonda techniques.
- Prepare different models for rain water harvesting.

SEMESTER IV

Paper XV: Air and Noise Pollution Control Technology (4T1)

Student shall be able to

- Explain the Origin and Composition, Structure, Atmospheric Photochemical Reactions, Acid Rain, Photochemical Smog and Air Pollution Index.
- Interpret the Air Sampling & Monitoring: Criteria, Selection of Sampling Locations, Analytical and Instrumental Techniques Used in Estimation of Atmospheric Pollutants, Methodology of Measurement of SO_2, NO and Dust.
- Understand Industrial Air Emission Control: Characterizing the Air Stream, Equipment Selection, Principle & Design - Condensation, Absorption, Adsorption, Filtration, Impingement Separator.
- Discern Noise Pollution: Basic Properties of Sound, Sound Pressure and Intensity Levels Equivalent Sound Pressure Levels (leq), Noise Pollution Levels (npl), Sound Exposure Levels (sel).

Paper XVI: Solid and Hazardous Waste Management (4T2)

Student shall be able to

- Understand the Nature of Solid Waste: Classification and Origin, Characteristic and Methods of Solid Waste Treatment and Disposal Pyrolysis, Recycling and Reuse of Solid Waste and Management.
- Apply the knowledge of Solid Waste Management: Vermiculture, Composting, Biogas from MSW, Land Fill (Site Selection, Site Investigation and Site Characterization) Landfill Planning and Designing, Construction and Operational Practices.
- Interpret the Hazardous Waste: Classification, Identification, Sources and Characteristics of Hazardous Waste and Integrated Approach for Minimization of Air, Water and Solid Pollutants, Collection, Storage, Transportation, Hazardous Waste.
- Explain the Hazardous Waste Treatment & Management: Physico-Chemical, Biological and Thermal Destruction of Hazardous Wastes, Incineration, Pyrolysis, Wet Air Oxidation, Containment Technologies, Secured Landfill, Land Farming, Bioremediation.

(ELECTIVE-I):Paper XVII: Environmental Impact Assessment and Legislation (4T3)

Student shall be able to

- Explain Environmental Impact Assessment: Basic Concepts and Principles of EIA, Need, Elements, Environmental Attributes, Overview of Impacts.
- Understand EIA Procedure: Screening and Scoping in EIA, Methodologies of EIA, Checklist, Matrices, Overlays, Cost Benefit Analysis, Computer Aided EIA, Battelle Environmental Evaluation System-Impact Identification Networks
- Interpret Environmental Audit and EMS: Concept, Types, Benefits, Scope and Objectives of EA, Pre-Audit, On-Site Audit and Post Audit Activities
- Apply Environmental Legislation: Constitutional and Statutory Laws in India, Fundamental Duties and Fundamental Rights, Legal Control of Environmental Pollution.

Paper XVIII (ELECTIVE-II): Environmental Management (4T3)

Student shall be able to

- Explain the Ecosystem Management, Exploitation (Overuse and Misuse) and its Consequences Wildlife Management and Water and Soil Management.
- Apply the knowledge of Computer Programming: Generation and Classifications, Structure, Function, Capabilities and Limitations of Computers, Operating System and Remote Sensing and GIS and its application in Agriculture, Environmental Management and Land Use, Land Cover.
- Interpret Environmental Geoscience: Conservation of Matter in Various Segments Atmosphere, Hydrosphere, Lithosphere and Biosphere and Earth Process and Hazards: Catastrophic Geological Hazards.
- Analyze Current Issues and Environmental Problems: Environmental Education and Awareness, Narmada Dam, Tehri Dam, Almatti Dam, Waste lands and their Reclamation and Restoration of Indian Lakes.

Paper XIX (Foundation-II): Fundamentals of Environmental Science- II (4T4)

Student shall be able to

- Understand the Air Pollution, Classification of Air Pollutants and their Sources, Effects, Control Measures, Chemical Reaction, Climate Change and Global Warming.
- Explain the Noise Pollution, Properties of Sound, Sound Pressure and Intensity Levels, Equivalent Sound Pressure Levels (leq), Noise Pollution Levels (npl), Sound Exposure Levels z(sel)
- Interpret Water Pollution, Classification, and their Adverse Effects, Sources and Bioaccumulation, Bio-Magnification and Eutrophication, Water Sampling.
- Utilize the knowledge of Soil Pollution, Soil Pollutants, Causes and Effects of Soil Pollution, Sources and Methods of Solid Waste Treatment and Disposal.

Paper XX: Core (Subject Centric) –II: Disaster Management (4T4)

Student shall be able to

- Interpret the Disaster: Disaster management cycle, general effects and concerns.
- Understand the nuclear disasters, forest fires, desertification and transportation accidents: Causes, general effects and management.
- Discern the natural disasters: Earthquake, Volcanic eruptions, Snow avalanches, landslides, cyclone, Floods, drought, Heat and cold waves and tsunami and its characteristics, causes, impacts and mitigation.
- Analyze the disaster response, risk and vulnerability assessment, disaster preparedness, disaster mitigation and Recovery.

Practical - VII (4P1)

Student shall be able to

- **Air and Noise Pollution Control Technologies**
- Determine the Suspended Particulate Matter (SPM) and RSPM in ambient air by using High Volume Sampler.
- Carry out the Comparative analysis of air sampling from residential, commercial, and industrial zone using key parameters like SOx and NOx.
- Measure the noise pollution by noise meter in silent, residential, commercial, and industrial zone and comparison with standards.
- Determine the carbon monoxide in ambient air.
- Prepare and interpret the wind roses.
- Estimate the poly-aromatic hydrocarbons in air.
- **Solid and Hazardous Waste Management**
- Determine the volatile matter from solid waste sample.
- Estimate the non-volatile matter form solid waste sample.
- Study the calorific value of solid waste sample.
- Study the moisture content of solid waste sample.
- Study the bio-medical waste generation and disposal practices in urban area.

- **Environmental Impact Assessment and Legislation & Environmental Management**
- Study the natural environment of the area with respect to soil, air, water, noise and socio-economics.
- Study the environmental impact of the industries on water, air, soil and noise quality.
- Study and undertake the preliminary survey to identify impact on environmental parameters.
- Carry-out the Base line Study of investigation of water, air, soil and noise quality of the area.
- Study the EIA legislation for environmental protection.
- Study the environmental management practices in industries.

DEPARTMENT OF PHYSICS
OUTCOMES OF THE PG COURSE

Revised Syllabus to be implemented from 2015-16 Choice Based Credit System (CBCS) …

M.Sc.Part -I,

SEMESTER- I

Paper 1 (Core- 1) 1T1, Mathematical Physics:

Learning Outcomes:

- **Mathematical physics is** the field as the application of mathematics to problems in physics and the development of mathematical methods suitable for such applications and for the formulation of physical theories
- It includes matrices which are used in physics related application Matrices are applied in the study of electrical circuits, quantum mechanics, and optics; it is used for solving Kirchhoff's laws of current and voltage.
- Fourier series simplify the analysis of periodic, real valued functions. Specifically, it can break up a periodic function into an infinite series of sine and cosine waves. This property makes Fourier series very useful in many applications. Fourier transform of a signal tells you what frequencies are present in your signal and in what proportions.
- Bessel functions are used in Acoustics (such as drum or other membrane of phone), Signal processing, heat conduction, cylindrical waveguide. Laguerre polynomials are used to solve Laguerre equations.
- Laplace transforms are useful for solving electrical circuit problems.

Paper 2 (Core 2) 1T2, Complex Analysis and Numerical Methods:

Learning Outcomes:

- Paper includes two parts i.e Complex analysis and Numerical techniques. Complex analysis has great applications not only in mathematics but in electrical engineering, fluid dynamics, in conformal mapping to solve boundary value problems, in control theory, field theory and in wave guide study. One can solve real integrals using complex analysis without tedious calculations.
- Numerical method to solve a problem gives an easy to use method that gives a quick result as compared to the analytic methods. Numerical methods are useful to solve the problems where analytic methods fail.

Semester I Paper 3 (Core 3) 1T3 Electronics:

Learning Outcomes:

By the end of this course, the students will be able to:

- Understand the basic concepts, mainly characteristic curves and physics of p-n junction of different solid state electronics devices:
    a) Special purpose diodes- Schottky, Tunnel and MOS diodes
    b) BJT, JFET, MOSFET
    c) UJT, SCR
    d) Opto-electronic devices: Photodiodes, Solar cells, LED, LCD and Photo transistor
    e) Some processes for manufacturing ICs: diffusion of impurities in Silicon, growth of oxides

- Use the semiconductor devices in linear and digital circuits:
    a) Use of zener diode to make a regulated dc power supply
    b) Making amplifier circuits using BJT, JFET and MOSFETs
    c) Cascading of amplifier stages to increase the gain of the amplifier using RC coupling, transformer coupling and direct coupling
    d) Understand the concept of negative feedback in amplifiers: voltage [series, shunt], current [series, shunt]
    e) Use of positive feedback to understand the working of different oscillator circuits like Phase shift oscillators, Hartley, Colpitts, and Crystal control oscillator circuits
    f) Cutting the unwanted signal by using clippers and to raise or decrease the signal voltage level by clampers
    g) How to use the transistor as a switch and understand the universal TTL and Complimentary MOS gates

- Understand the digital integrated circuits:

a) Understand the basic working of different logic gates and laws of Boolean algebra, De Morgan theorem, NOR & NAND logic for simplification of circuits. Understand and design different controlling circuits used in digital electronics
b) Use of transistor as multivibrators
c) Analyze the relationship between analogue and digital circuits.
d) Understand different digital storage devices, memory, and their classification with expansion.
e) Understand and describe 8085 microprocessor
f) Analyze the different parameters of OP-AMP
g) Understand the applications of OP-AMP for positive and negative feedback concept

- Understand the basics of electronics communication and types of communication
  a) Describe different propagation modes of signals
  b) Understand the concept of digital communication
  c) Understand fiber optics communication system and concept of modern communication system
  d) Understand the working of different microwave oscillators, resonators and standing wave detector

Paper 4 (Core 4) 1T4, Electrodynamics-I:

Learning Outcomes

On completion of the course the student shall be able to:

- Apply vector calculus to static electric-magnetic fields in different situations.
- Formulate potential problems within electrostatics, magnetostatics and stationary current distributions in linear, isotropic media.
- Interpret the deeper meaning of the Maxwellian field equations and account for their symmetry and transformation properties.
- Define and derive expressions for the energy both for the electrostatic and magneto statics fields, interpret Poyntings theorem derived from Maxwell's equations.
- To make a detailed account for gauge transformations and their use.

SEMESTER- II

Paper 5 (Core 5) 2T1, Quantum Mechanics I:

Learning Outcomes:

- The students can gain the knowledge of the time-dependent and time-independent Schrödinger equation for simple potentials like, the harmonic oscillator and hydrogen like atoms.
- Students will understand the central concepts and principles in quantum mechanics, such as the Schrödinger equation, the wave function and its statistical interpretation, the uncertainty principle,
- Students will be able to solve the Schrödinger equation on their own for simple systems in one to three dimensions. Also they will be able to use these solutions to calculate their time evolution, associated probabilities, expectation values, and uncertainties.
- Students will have mastered the concepts of angular momentum and spin, as well as the rules for quantization
- Identify and relate the Eigen value problems for energy, momentum, angular momentum and central potentials and explain the idea of spin.

Paper 6 (Core 6) 2T2 Statistical Physics:

Learning Outcomes:

- The students are able explain fundamentals of statistical physics and thermodynamics as logical consequences of the postulates. The students able to elaborate the BE, FD and BE statistics.
- Able to explain Fermi function, Fermi energy, ideal Fermi gas at absolute zero and below Fermi temperature, Fermionic condensation and fermions in metals.
- The students can understand and explain the importance of Phase transition of first and second order, Landau theory of phase transition, Ising model, Brownian motion, Langevin theory, Fokker-Planck equation. Weiss theory of ferromagnetism.

Paper 7 (Core 7) 2T3 Classical Mechanics:

Learning Outcomes:

- The students will be able to understand and describe mechanics of a particle, and the motion of a mechanical system using Lagrange-Hamilton formalism.
- Able to describe conservation theorems and symmetry properties, Hamiltonian formalism, conservation laws, Poisson theorems and Hamilton-Jacobi theory.
- Able to describe and understand planar and spatial motion of a rigid body, two body collisions, Rutherford scattering in laboratory and centre-of-mass frames
- The students are able to explain Rigid body dynamics, Euler's angles, Euler's theorem, moment of inertia tensor, eigen values, Periodic motion, oscillations.

Paper 8 (Core 8), 2T4 Electrodynamics II:

Learning Outcomes:

- Examine the phenomena of wave propagation in different media and its interfaces and applications.
- Analyze the nature of electromagnetic wave propagation in guided medium which are used in microwave applications.
- Calculate the electromagnetic radiation from localised charges which move arbitrarily in time and space, taking into account retardation effects.
- Formulate and solve electrodynamic problems in relativistically covariant form in four-dimensional space time.

M.Sc.Part -II,

SEMESTER- III

Paper 9 (Core 9) 3T1 Quantum Mechanics II:

Learning Outcomes:

Quantum mechanics (QM) is important because

- It plays a fundamental role in explaining how the world works. It is almost essentials part of our Modern Life.
- QM governs the behavior of microscopic systems that is it governs the behavior of all physical systems, regardless of their size.
- QM tells us a lot about the structure of reality that is all physical systems exist in multiple versions. Information can flow in the multiverse in ways that can't happen in classical physics, such as single particle interference and entanglement.
- QM is also important for the theory of computation. According to QM it is possible to build a universal quantum computer that can simulate any physical system. This means we can test theories about physical systems by simulating them and then checking the results of the simulations against reality.
- It is successful in explaining microscopic phenomenon in all branches of Physics

Quantum mechanics (QM) has several potentials applications as bellow

- Most electronic devices use quantum effects or require QM to understand their properties in order to make rational design considerations.
- Used in Electron Microscope, MRI Scanner, STM, Atomic Clocks, Lasers and telecommunications etc.
- Have the applications in Computers and Smart-phones, GPS, X rays, etc.

Paper 10 (Core 10) 3T2 Solid State Physics and Spectroscopy:

Learning Outcomes:

- The syllabus covers crystal arrangement, parameter determination and its defects in first two units. Over all study is gate way to research in material science. And last two units' covers study of atomic and molecular spectra al so including NMR and ESR. The quantum study of microscopic bodies and interaction of light to matter covers in this syllabus.

Paper 11 (Core Elective E1.1) 3T3 Materials Science I:

Learning Outcomes:

- Materials science is a branch of Physics which with properties & characteristics of materials Developments of new materials and their applications. It is an applied branch of Physics and has got tremendous potential for job as researcher and as technician.

Paper 11 (Core Elective E1.4) 3T3 Atomic and Molecular Physics I:

Learning Outcomes:

On completion of the course, the student shall have advanced knowledge of modern atomic and molecular physics including quantum mechanical computational techniques in order to:-

- Master both experimental and theoretical working methods in atomic and molecular physics for making correct evaluation and judgments.
- Developing analytical, laboratory and computing skills through problem solving, laboratory & computer based exercises which involve the applications of atomic and molecular physics.
- Carry out experimental and theoretical studies on atomic and molecular physics with focus on structure & dynamics of atoms and molecules.
- Account for theoretical models, terminology & working methods used in atomic and molecular physics.
- To successfully apply the theoretical techniques presented in course to practical problems.

(Subject Centric Core Course S1.2) 3T4 Nanoscience and Nanotechnology:

Learning Outcomes:

- Nanoscience and Nanotechnology are now become the buzz words all over the world.
- Nanoscience is related to synthesis and characterization of nanomaterials. The use of nanomaterials is gaining impetus in the present century as they possess defined chemical, optical and mechanical properties.

SEMESTER IV

Paper 13 (Core 11) 4T1 Nuclear and Particle Physics:

Learning Outcomes:

- The core paper Nuclear & Particle Physics deals with the detailed study of the structure and energetic of atom and the nucleus viz. protons and neutrons. In order to study the properties of a material, one should be familiar with the properties of atom of that material. Nuclear physics solved the fundamental puzzle of the existence of strong nuclear force. Nuclear and particle Physics include various interesting branches such as radioactivity, fission and fusion reactions nuclear reactors, nuclear power plants, particle physics etc. that has huge applications for the benefits of society.

IV Paper 14 (Core 12) 4T2 Solid State Physics:

Learning Outcomes:

- The student will understand the band formation in solids by using different models along with electron behavior in solid. Also gain knowledge of magnetic properties of materials.
- The student will able to understand and explain interaction of lattice in solids through different theories and temperature effect on solids.
- Students Able to elaborate electron in potential wells, degeneracy state, density of states, thermal and electrical conductivity of metals, and thermoelectric power.
- The students will know Semiconductor properties and carrier concentration, effect of temperature on mobility, electrical conductivity and Hall Effect in conductors and semiconductors.
- Students able to understand and elaborate superconductors, types along with their properties and applications.

Paper 15 (Core Elective E2.1) 4T3 Materials Science II:

Learning Outcomes:

- The students will know the Mechanical response of Materials under applied load such as elastic response, stress-strain curve, viscoelasticity, Plastic deformation.
- Students able to understand and explain Corrosion and degradation of materials and corrosion inhibition. Also the Spintronics and Photonics properties of materials.
- The students will understand the synthesis and processing of materials for better applications.
- Students will able to explain the importance of microscopic study of material with different experimental techniques.

Paper 15 (Core Elective E2.4) 4T3 Atomic and Molecular Physics II:

Learning Outcomes:

After completion of course the student should be able to:

- Describe in oral and written form the observations in atomic and molecular physics which led to the modern quantum physics.
- Motivate the necessity of using quantum mechanics calculations for describing atomic and molecular processes.
- Explain how signatures of the quantum physics are seen in atomic- and molecular physics experiments.
- Understand the basic concepts of most of the commercially available lasers.
- To design experimental setups in order to characterize a laser in the time or the frequency domain.
- Know the basic principles of nonlinear optics.
- Carry out numerical calculations of simpler processer for free atoms and molecules and their interactions with electric and magnetic fields.
- Read and understand the literature on a subject not developed during the lecture but related tolaser Optogalvanic spectroscopy or applications of lasers, fluorescence spectroscopy and Microwave Spectroscopy.
- Describe, in oral and written form, and analyze example of experiments which could answer a given scientific question within the basic atomic and molecular physics.

(Subject Centric Core Course S 2.2) 4T4 Experimental Techniques in Physics:

Learning Outcomes:

- Physics is an exact science and its real home is laboratory .The test of the all knowledge is experiment. Experiment is the soul judge of scientific truth. The real understanding of physics cannot be acquired without lab experience. The purpose of this paper is to introduce the basic knowledge of instruments (recent technology) used for structural, optical, mechanical, electrical, etc. characterization of all types of materials. The purpose is to provide experimental foundation for the theoretical concepts. The content of this paper is very important to develop the research in material science and particularly in nanomaterials.

B. SC. FIRST YEAR
SEMESTER –I

Paper - I (101) Properties of Matter and Mechanics:

Learning Outcomes:

- The syllabus covers general properties of matter includes solid and liquid out of these elasticity is the property of solid which gives the idea about material strength in three forms , Viscosity of liquid and importance of Surface tension in geometrical shape of liquid.
- Mechanics covers basics Newton's laws of motion and their applications. Geometrical description of laws improves students' imagination and study of constraints generate branch of physics known as classical mechanics. Rotational motion gives relation between M.I.and motions of body.

Paper-II (102) Electrostatics, Time varying fields & Electric Currents:

Learning Outcomes:

After completing this course students will be:

- Able to state and express Coulombs law in vector form and use it to solve for E due to stationary charges, Electric potential due to point charge, due to dipole, field due to dipole at any point.
- Able to state that potential is force per unit charge, and give a conceptual description of V and its relationship to energy.
- Able to describe similarities and differences between a conductor and dielectric, effect of electric field, polarization in dielectrics, polar and non-polar molecules, solving Classius-Mossoti equation.
- Able to calculate the E field inside a dielectric when given epsilon and the free charge on the dielectrics.
- Able to learn basic ideas of parallel plate capacitor, derivation of capacity with or without dielectrics and solve the numerical problems.
- Able to state and express Faradays laws of electromagnetic induction, self and mutual induction, transformer and its working , losses and uses of transformer, Kirchhoffs laws.
- Able to learn series resonance, derivation of frequency of resonance, power in ac circuit, solve the the mathematical problems.

SEMESTER- II

Paper-I (201): Oscillations, Kinetic theory of gases and Thermodynamics:

Learning Outcomes:

- The students able to understand linear and angular S.H.M., differential equation of S.H.M. and its solution. Also able to elaborate differential equations of damped oscillations and energy dissipation by damped oscillations.
- The students will know the fundamentals and applications of forced vibrations, resonance, and its energy and quality factor. Also gas laws with their applications.
- Students will understand phenomenon in gas transportation and thermodynamics behind the gas transportation. Also laws of thermodynamics and its importance in engines efficiency.

Paper-II (202): Gravitation, Astrophysics, Magnetism and Magneto statics:

Learning Outcomes:

- The students gets the idea about basic fundamental laws of classical mechanics, it enhance knowledge about planetary motion and their interaction.
- Start-up study of astrophysics increases student interest about space science.
- Microscopic study of atomic magnets increases intellectual skill of students in material research also it gives idea about the relation between electric and magnetic field as future key of power consumption.

B. Sc. Second Year
Semester-III

Paper-I (301): Sound waves, Applied acoustic, Ultrasonic and Power supply

Learning Outcomes:

- Students comes to know about types of waves, their characteristics, Students can understand about Harmonics, Quality of sound, human ear and its response and its audibility to sound. Student can learn about measurement of intensity, effect of temperature on sound.
- Students know about different sound measuring devices like transducers, recording and reproduction of sound.
- Students come to know about Ultrasonic waves, their properties, Methods of generation ultrasonic waves and their applications in research.
- Students learn about Power supply, conversion of A.C. to D. C., importance of voltage, current and load regulation.

PHYSICS - Paper-II (302): Physical optics and Electromagnetic waves:

Learning Outcomes:

- Students able to elaborate the wave nature of light.
- Analyze the intensity variation of light due to, interference and diffraction.
- Know the Application of Michelson and Fabry-Parot Interferometer
- Analyze the polarization and its applications.
- Interpret the Electromagnetic wave, the Maxwell's field equations, and transverse nature of electromagnetic wave.
- Interpret Poyntings theorem and its importance.

Semester IV

PHYSICS - Paper-I (401): Solid state physics, X-ray and Laser:

Learning Outcomes:

- The students will have a basic knowledge of crystal systems and spatial symmetries, Miller indices, able to understand how crystalline materials are studied using different diffraction techniques.
- Understand the concept of reciprocal space lattice and know the significance of Brillouin zones.
- The students able to know the types, properties and production of X-rays with their applications.
- Students elaborate fundamental concepts of LASER and their production along with applications.

PHYSICS - Paper-II (402): Solid state electronics, and Molecular physics:

Learning Outcomes:

- Students will understand fundamental, fabrication along with their applications in day to day life of LED, Solar Cell and BJT.
- Students will also know basics along with applications of FET, JFET and MOSFET and their special features.
- Students able understand and elaborate Quantization of vibrational and rotational energies, types of molecules, Diatomic molecules as harmonic and anharmonic oscillator, Rotational-vibrational spectra, Born Oppenheimer approximation.
- Students able to know the importance and applications of Raman spectroscopy in molecular physics also know the Frank-Condon principle, Elementary ideas of NMR and ESR and their applications in spectroscopy.

B. Sc. Final Year

Semester –V

Paper-I (501): Atomic physics, free electron theory and Statistical physics:

Learning Outcomes:

- Students understand the different theories of atomic model, different quantum numbers. Student also studies, how the momentums and magnetic moments associated with different motion of electron are oriented and their interaction with each other.
- Students learn about electrical and thermal conduction of electron. Fermi Energy, Fermi temperature band. Different theorems, models and experiments regarding free electron theory. Also Classification of materials.
- Student gets idea about μ- space, Gamma space, probability distribution, and thermodynamic probability, Principle of a priori probability, Boltzmann's entropy relation, different states, Maxwell-Boltzmann distribution law, and its application. Students also learn Bose-Einstein statistics, Fermi-Dirac distribution and its application.

Paper-II (502): Quantum mechanics, Nanomaterials and Nanotechnology:

Learning Outcomes:

After completing this course students will able to :

- Be familiar with the main aspects of the historical development of quantum mechanics of quantum mechanics, wave properties of matter.
- Able to correlate the classical mechanics with quantum mechanics,.
- Able solve Schrodinger equation in one to three dimensions and their physical interpretation.
- Able to familiar with basic aspects of Nanoscience and nanotechnology and their importance in day to day life.

Semester VI

Paper-I (601): Relativity, Nuclear physics and Bio Physics:

Learning Outcomes:

- Students understand the concept of Frame of references, Postulates of the special theory of relativity and relativistic variation in, Length, Time, mass, Velocity addition, and Mass energy equivalence.
- They are able to elaborate detectors of radiation, charge accelerators, nuclear reaction along with types of nuclear reactions and their importance in recent technology.
- The students understand and able to explain fundamental concepts of decay particles.
- Students able to know bio physics, and their importance in medical field.

Paper-II (602): Electronics, Fiber optics, Communication and Digital electronics:

Learning Outcomes:

- Students will know the fabrication and working principles of Amplifiers and oscillators and their applications.
- Students will able know the basic principle and working of Fiber optics, Importance of optical fiber, Propagation of light waves in optical fiber and its importance in communication .
- They will also know the Communication types like AM, FM their fundamental theory along with how the broadcasting of television is done by these means.
- The students will able know how the huge data is stored in modern days by using digitalization like Number Systems and theory behind this.

DEPARTMENT OF STATISTICS
PROGRAMME: M.SC.

Statement of Course Outcomes (COs)

M.Sc. sem-I Statistics paper-I (Elements of Mathematical Analysis):-

Students will learn-

- The real valued functions and Riemann Stieltjes Integral, etc.
- The Matrix Algebra.
- The set theory and measurable sets.
- The measurable functions, convergence and dominated convergence theorems and its applications.

M.Sc Sem I - Paper II :-

At the End of this Course Students will be able :

- To apply all the discrete distributions for analyzing the data.
- To use various continuous distributions whenever necessary.
- To describe the practical applications of truncated distribution.
- To apply order statistics for distribution theory.

M.Sc. Statistics Semester I Paper-III :- Estimation Theory

By the end of this Programme, the students will be able to:

- Understand problem of statistical inference, problem of point estimation
- Properties of point estimator such Consistency, Unbiasedness, Sufficiency
- Obtain minimum variance unbiased estimator
- Obtain estimators using estimation methods such as Maximum likelihood, Minimum chi square, method of moments. Method of scoring, Properties of maximum likelihood estimator.
- Quantify information in statistic using Fisher Information
- Constructminimal sufficient statistic and minimal sufficient statistic for exponential family.
- Understand concept of :Rao-Blackwell theorem and complete family
- Explain Pitman's family of distribution.
- Understand problem of statistical inference, problem of Interval estimation
- 10. Construct Confidence Interval (one and two parameter case)

M.Sc Sem I - Paper IV (Sampling Theory)

At the End of this Course Students will be able :

- To apply various sampling methods for agricultural data.

- To explain and to compare various allocations using stratified random sampling.
- To draw a conclusion about the best sampling procedure.
- To use practical applications of ratio and regression method of estimation.

M.Sc. sem-II Statistics paper-I (Probability Theory):-

Students will learn-

- The different probability measures.
- The distribution functions and its properties.
- The different Weak laws and strong laws of large numbers.
- 4. The characteristics functions, inversion theorem, central limit theorem, etc.

M.Sc sem II - Paper II :-

At the End of this Course Students will be able :

- To apply stochastic models for different distributions.
- To use birth and death Poisson processes whenever necessary.
- To study the applications of Gambler's Ruin problems.
- To apply various inequalities in Mathematical as well as Statistical Analysis.

M.Sc. Statistics Semester II Paper-III :-Testing of Hypothesis

By the end of this Programme, the students will be able to:

- Understand problem of statistical inference, problem of testing of hypothesis
- Explain critical regions, test functions, two kinds of errors, size function and power function
- Construct Most Powerful test using NP Lemma
- Understand situation when UMP test exists
- Construct Uniformly Most Powerful testin one parameter exponential family and Pitman family.
- Understand the concept of Non-existence of UMP test.
- Explain Likelihood ratio test., Wald test, Rao's score test, Pearson's chi-square test for goodness of fit and Bartlett's test for homogeneity of variances.
- Understand Sequential testing. Sequential probability ratio test.
- Construct SPRT in case of Binomial, Poisson, Normal Distribution.
- Understand Generalized Neyman Pearson lemma ,unbiased test, UMPUT and their existence in case of exponential family and similar tests and tests with Neyman structure.

M.Sc sem II - Paper VI (Linear Models and Design of Experiments)

At the End of this Course Students will be able :

- To apply various designs for agricultural data/agricultural field.
- To explain which design will give the maximum yield of a crop.
- To use factorial experiment for agriculture data.

- To describe the concept of confounding for different experiment.

M Sc SEM III – Paper I MST 301

Decision Theory and Nonparametric Methods

At the end of third semester ,the students will have knowledge of

- Decision Problem , Bayes Rules and minimax rules
- Advantages and disadvantages of Non parametric tests (NPT)
- Various one sample tests NPT such as test of randomness ,Sign test ,Kolmogorov Smirnov (KS)test
- Various two sample tests such as KS test ,Mann - Whitney U test etc
- Concept of Censoring
- Kaplan –Meier Estimator

Sem III – 3T2- Linear and Nonlinear Modelling

- Regression analysis is the most common statistical modelling approach used in data analysis and it is the basis for advanced statistical modelling.
- In this course, students will learn the use of different useful tools used in regression analysis. They will learn about simple and multiple linear regression, non-linear regression and Generalise linear models (GLM) including logistic regression

After learning this course, students will be able to

- Understand the concept of linear and multiple regression
- Check for the violations of model assumptions using residual analysis and other statistical tests.
- Learn to interpret different types of plots such as residual plots, normal probability plots etc.
- Understand the problems of multicollinearity, variable selection and how to deal with them.
- Differentiate between linear and non-linear regression and how to apply them in real life situations.
- The use of R statistical software will be widely used for solving a wide range of problems. At the end of the course, students will become familiar with the implementation of regression models using R along with the interpretation of results using such implementation.

M.Sc. Statistics Semester III Paper-III :- Mathematical Programming

By the end of this Programme, the students will be able to:

- Understand the concept of Optimization problem, theory of duality .
- Explain and solve Linear programming problem using simplex method, dual simplex method and carry out sensitivity analysis of LPP. Solve optimization problems using

DPP approach.

- Solve Assignment and transportation problems to obtain optimum solution.
- Gain knowledge about concave function, convex function, NLPP, Lagrange's methods for optimality, KT conditions and Beal's and Wolfe's methods to solve QPP.
- Understand basic concepts of game theory and methods of solving game problems .

M Sc SEM III – Paper IV 304 (A)

Industrial Process and Quality Control

At the end of third semester ,the students

- Will be able to draw various types of control charts such as **X bar** and **R** ,**X bar** and **s**, **p** chart ,**EWMA**,**CUSUM** etc and draw conclusions therefrom. Will have knowledge about
- Different performance measures of control chart such as OC,ARL ,ATS etc
- c Chart , its modification ,Q chart
- Multivariate Hotelling's T^2 control chart and its applications.
- Concept of Six sigma, Evolution of six sigma ,DMAIC approach
- Various sampling inspection techniques.

M Sc SEM IV – Paper I MST 301

Multivariate Analysis

At the end of fourth semester , the students will know

- Multiple and Partial Correlation and their tests of significance
- Multivariate Normal Distribution and its properties
- Wishart Distribution -
- Wilks lambda
- Hotelling's T^2 statistic and its null distribution and its applications
- Classification and Discrimination problem
- Sample discriminant function
- Principal components and its applications
- Cannonical correlation and its applications

Sem IV – 4T2- Computational Statistics

Statistical analysis has gained importance over the years. Advanced methods and different types of models can be applied to many types of data. Different types of data including big data can be analyzed using advanced statistical methods applied to different types of models.

This course deals with different computational methods and algorithms necessary for analyzing data . These methods are particularly useful for simulating data from different distributions and analyzing them with the help of computers.

Course outcome: After learning this course, students would have learnt about

- Visualization of data and exploratory data analysis

- Stochastic simulation techniques including MCMC methods
- Jackknife, Bootstrap and other important methods for handling missing dataa nd incomplete data problems.
- Non-parametric Density estimation using kernels
- The use of R statistical software will be widely used for solving a wide range of problems based on the concepts learnt.

Besides, students will be able to work on and present a project on a chosen topic of relevance, under the guidance of a faculty allotted to them.

M.Sc. Statistics Semester IV Paper-III :-Operations Research

By the end of this Programme, the students will be able to:

- Understand basic concepts of inventory problems and solve various types of EOQ models .
- Gain knowledge about sequencing problems,travelling salesman problem and various methods to solve sequencing problems.
- Understand basic concepts of queuing models and will be able to write and solve the steady state equations for various queuing models.
- Understand different concepts of Network Analysis, Construct Network Diagrams, draw conclusion from Network using PERT analysis and CPM analysis.

M Sc SEM IV – Paper IV MST 304 (A)

Industrial Statistics

At the end of fourth semester ,the students

- Will be aware of Quality systems ISO 9000 and QS 9000
- Total Quality Management,PDSA cycle
- Will know how to use various statistical tools such Design of Experiment for quality improvement
- Process Capability Analysis ,various Capability indices
- Taguchi philosophy – system ,parameter and tolerance design
- Signal to Noise Ratio
- FMECA

DEPARTMENT OF ZOOLOGY
PROGRAMME: M.SC.

Statement of Course Outcomes (COs)

M.SC. SEMESTER I

Paper 1T1

Structure and Function of Invertebrates

On completion of the course, students will be able to understand:

- Classical and molecular taxonomy.
- The Ultra structure of locomotary organelles, mechanism of locomotion in protozoans.
- The dermal cells and skeletal organization in sponges.
- Polymorphism and metagenesis in coelenterate
- Theories of origin of metazoa.
- Reproduction in helminthes.
- Formation, evolution and significance of coelom .
- Excretion in annelida.
  Peripatus as connecting link between annelida and arthopoda.
- Respiration in arthopoda.
- Neopilina (monoplacophora): structure, affinities and taxonomic position.
- Neuroanatomy in gastropoda, bivalvia and cephalopoda.
- Echinodermata- water vascular system and larval forms.
- General account and affinities of ctenophora and rotifera.
- General account and affinities of entoprocta and ectoprocta.

Paper-IT2,

General Physiology

On completion of the course, students will be able to understand:

- Enzyme- Classification, its action and regulation.
- Respiratory pigments- types, distribution and properties, structure and mechanism of O2 transport. .
- Physiology of Neurotransmitters, Colour change ,Bioluminescence, Thermoregulation, osmoregulation.
- Molecular mechanism of hormonal action, membrane receptors and signal transduction.
- Types of heart (myogenic and neurogenic), cardiac cycle.
- Classification and metabolism- carbohydrates , lipids, proteins
- Hydromineral metabolism.
- Cerebrospinal fluid: chemistry and functions.
- Mechanism of reflex action.
- Physiology of environmental stress and strain.

Paper-IT3

Cell Biology and Genetics

On completion of the course, students will beable to understand:

- The structure and function of : cell membrane ,cell organelles, microfilaments, microtubules.

- Cell division and cell cycle.
- Cell signaling , signal transduction pathways, cellular communication and cancer.
- Inheritance- mendelian, non-mendelian; extensions of mendelian principles ; quantitative genetics and mutation.
- Alterations of chromosomes and their genetic implications.
- Extra chromosomal inheritance.
- Microbial genetics and human genetics.

Paper-IT4

Advanced Reproductive Biology

On completion of the course, students will be able to understand :

- Methods of reproduction in protozoa.
- Regeneration in hydra, digesia and annelid worms; morphogenesis and hormonal control.
- Mechanism of vitellogenesis and metamorphosis in insects
- Spermatogenesis, mechanism of oogenesis, cytological and molecular events of fertilization.
- Embryology- types of cleavage, blastulation, gastrulation and embryonic induction.
- Male accessory sex glands in mammals.
- Semen, sperm capacitation and decapacitation
- Pheromones and sexual behavior in mammals
- Neurohormonal control of fish reproduction and mechanism of vitellogenesis.
- Molecular induction , cryopreservation ,test-tube baby , in vitro fertilization (ivf) and its significance.

Practical-1P1

Structure and Function of Invertebrates and General Physiology

Section A

On completion of the course, students will be able to

- Classify the animals of all phyla.
- Describe the
- Digestive system of Earthworm, Leech, Cockroach, Silkworm and Honey bee
- Nervous system of Prawn, Cockroach, Silkworm and Honey bee and
- Reproductive system of Earthworm, Leech, Cockroach and Honey bee.
- Prepare Whole mount preparation of plankton.
- Describe the
    - Earthworm – Nerve ring, ovary, spermatheca, nephridia.
    - Leech – jaws, ciliated organ.
    - Cockroach – Mouth parts, Salivary glands, trachea.
    - Prawn –Appendages, Statocyst.
    - Protozoans- rhizopods , flagellates , ciliates (fresh water forms).
    - Porifera – Spicules and gemmules of fresh water sponges.
    - Crustaceans and rotifers - Planktonic copepodes, cladoceran, ostracoderm and rotifers.
    - h. Larval forms of the free living & parasitic invertebrates.

- From the Study of permanent Invertebrate slides, Students can describe :
- larval forms of Coelenterata, Arthopoda , Mollusca, Echinodermata and Hemichordata.
- anatomy and histology of invertebrates.

Section B

Physiology experiments

On performing experiments students will be able

- To counts R.B.C. and W.B.C and haemoglobin concentration.
- Demonstrate the action of salivary amylase, trypsin, pepsin.
- Demonstrate the rate of O2 consumption in aquatic animals, under various environmental stresses.
- Estimate sodium, potassium, glucose, total blood proteins cholesterol and chloride in blood.

Practical- 1P2

Section-A

Cell Biology, Genetics and Advanced Reproductive Biology

On completion of the course, students will be able to:

- Study mitotic metaphasic chromosomes & prepare human karyotypes..
- Demonstrate and identify Barr body in human female leucocytes.
- Identify polytene chromosome in dipteran larvae .
- Solve the Problems on genetics based on monohybrid/dihybrid ratios, sex linked inheritance and blood groups.
- Describe various human genetic traits.

Section-B

On completion of the course, students will be able to:

- Identify and describe meiotic chromosomes and spermatogenesis
- Describe the oogenesis in earthworm/ fish/ rat ovary
- Perform Semen analysis: its physical viscosity, pH, liquefaction time, agglutination test, motility and sperm count and its Hypo-osmotic swelling (HOS)
- Prepare vaginal smear in rat by temporary mounting (methylene blue) and study it.
- Study and describe the Histology of male and female reproductive organs and accessory reproductive glands.

M.SC. SEMESTER-II

Paper- V

Structure and Function of Vertebrates

On completion of the course, students will be able to explain:

- The origin and ancestry of chordate, General organization and affinities of Cephalochordata.
- Vertebrate's- integument , Sense organs , Autonomous nervous system,
- Evolution of urinogenital organs & heart .
- Comparative anatomy in vertebrates -the brain, Appendicular skeleton.
- Organs and mechanism of respiration in Amphibia, Structure, development and metamorphosis of Amoecoetus.
- General characters and affinities of Dipnoi.
- General body organization and classification in Chelonia.

- Origin of Birds.
- Cetacia: general characters and adaptations, Evolution of Man.

Paper-VI

Comparative Endocrinology

On completion of the course, students will be able to explain:

- Hormones and functions in Coelenterata , Helminths, & Echinodermata. structure, hormones and functions of Neurosecretory system in Annelida & Mollusca
- Neuroendocrine system , structure and hormones, Endocrine control of metamorphosis reproduction and colour change mechanisms in crustaceans & insects.
- Structure, hormones and functions of Pineal organ, Hypothalamo hypophysial system, Pituitary, Thyroid, Parathyroid ultimobranchial glands, Gastro-entero-pancreatic endocrine system, Adrenal gland .
- Gonadal hormones in vertebrates and their hormonal actions, feedback mechanisms.

Paper VII

Molecular Biology and Biotechnology

On completion of the course, students are able to explain

- DNA- Cot ½ and Rot ½ values, organelle genome, structure, forms. replication & regulation of replication.
- Different mechanism of DNA damage and repair .
- Prokaryotic and eukaryotic transcription ,its Regulation ,translation, post translational modifications.
- Mobile DNA elements .
- Antisense and ribozyme technology .
- Isolation and sequencing of DNA, gene amplification.
- Splicing and Cloning.
- Hybridization techniques & microarray.
- Biotechnology- Medical, Agricultural , Industrial , Environmental & Immunobiotechnology.

Paper VIII

Advanced Developmental Biology

On completion of the course, students are able to explain

- Mammals-Implantation, Foetal membranes, Placental Hormones , Multiple ovulation and embryo transfer technology (MOET), Application of embryonic stem cells, significance. Embryonic sexing, cloning, screening for genetic disorder diagnosis (ICSI, GIFT etc.), Immunocontraception & Classical contraceptive techniques ,
- Role of mutants and transgenics in human welfare.
- Metamorphosis in Amphibia.
- Regeneration in vertebrate,Apoptosis, Ageing.
- Polymorphism in insect .
- Cloning of animals by nuclear transfer.

Practical III

Structure and Function of Vertebrates and Comparative Endocrinology

Section-A

On completion of the course, students will be able to:

- Explain classification of vertebrates .
- Explain Anatomy of Fish/ Rat. a) Brain and cranial nerves b) Arterial and venous systems c) Urinogenital system d) Reproductive systems e) fish- Internal ear ,Weberian ossicles , accessory respiratory organs.
- Permanent Stained preparation of fish scales, ampullae of Lorenzini, otolith, striated muscles and cartilage .
- Understand the technique of Microtomy**.**
- Explain skeleton of fowl and rabbit.

Section-B

- Histological study of endocrine glands .
- Anatomical Observations of the endocrine glands of Cockroach and fish/rat.

Practical IV

Molecular Biology, Biotechnology and Developmental Biology

Section-A

On completion of the course, students are able to :

- Demonstrate DNA(Feulgen's reaction)DNA: RNA(Methyl Green- Pyronin reaction),
- Demonstrate of carbohydrate(PAS reaction), Lipid(Sudan Black B staining) , Protein(HgBP staining).
- Histochemical analysis of alkaline phosphatase ,acid phosphatase
- Biochemically estimate sugar (O-toluidine method) , protein(Lowrey's method), DNA (Diphenylamine method) & RNA (Orcinol method).
- To perform tests for qualitative analysis of saliva & bile.
- Demonstrate separation of amino acids by paper chromatography and TLC
- Study of the reproductive system in mammals, types of eggs , different types of placenta .
- Study of the developmental stages of live eggs of Lymnea or any gastropod , insects/ fishes, Frog.
- Study of developmental stages of chick through slides and whole mounts. Chick embryo mounting by window method.
- Sperm count from any domestic animal

M.SC. SEMESTER III

Paper- 3T1

Parasitology and Immunology

Under this paper the students will study:

- The study of the relationship between **parasites** and their hosts.
- Students will understand various **important** diseases of human, animals and even plants caused by the parasites.
- Knowledge in **parasitology will also** helps in the manufacturing of drugs to combat **parasites** infections.

- Immunology is an incredibly exciting and broad area of the biomedical sciences where the students will understand the ways animals react to organ transplantation and to infectious agents such as viruses, bacteria, fungi and parasites.
- To understand cell growth and differentiation and how immune responses function.
- The critical role of immunology and immunotherapy play in combating disease and how ultimate survival in today's world is viewed more and more as being dependent on having, protecting and restoring a strong human immune system.

Practical-3P1

Parasitology and Immunology

In this practical the students completing the course, are able to:

A) Parasitology :

- Study different types of parasitic protozoan's ,parasitic helminthes,insect vectors with the help of already available permanent slides/ ICT tools/ Models/ Charts/ Photographs etc.
- Identify and study of various ecto and endo parasites with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.
- 3.Study different types of insect vectors and their mouth parts with the help of already available specimens, permanent slides
- Study of life cycles of various parasites with the help of already available specimens, permanent slides/ ICT tools/ models/ charts/ photographs etc.
- Demonstrate Gram positive and Gram negative bacteria.
- B) Immunology :
- Demonstration of immunoelectrophoresis.
- Immunological diagnosis of pregnancy.
- Preparation of tissue sections of thymus, spleen, and lymph nodes. (Source of tissue: Animal wastes from local recognized slaughter houses/ poultry farms/ fish markets etc.)
- Identify and study T and B cells with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.
- Demonstration of Mast cells. (Source of tissue: Animal wastes from local recognized slaughter houses/ poultry farms/ fish markets etc.)
- Demonstration of ouchterlony double diffusion (ODD).

Paper-3T2

Special Group-Mammalian Reproductive Physiology -I

Reproductive Process in Male

In this special paper the students on completion of the course, are able to:

- Understand the Structure , functions of Sertoli cells, Leydig cells ,Epididymis and sperm.
- Students will understand Spermatogenesis(Molecular changes, hormonal regulation), and spermiogenesis., Sperm capacitation: molecular and biochemical changes, decapacitation.
- Understand the Structure and function of Vas deferens, Seminal Vesicle: Structure, function and regulation, Prostate gland: Structure, function and prostatic cancer, Cowpers gland: Structure, function and anomalies. And Penis: Structure and mechanism of erection.

- Male reproductive behaviour: Mating system, neural and hormonal control.,Pheromones: types, structure and function. and Infertility: causes and remedy.
- Anthologically relevant diseases in advanced age.

Paper-3T3

Special Group-Mammalian Reproductive Physiology-II

Reproductive Process in Female

In this special paper the students on completion of the course, are able to

- study the differentiation of the ovary and female genital tract. The process of folliculogenesis and its hormonal control and signalling for ovulation.
- To understand the Oestrous cycle in mammals, Menstrual cycle and Menopause in female 2 Mechanism and hormonal control of ovulation
- Histology and function of Corpus luteum and structure, regional differentiation and function of Oviduct, Uterus: Types, abnormalities.
- Understand the structure, functions of cervix andVagina .Also detection of various stages of oestrous cycle by vaginal cytology, vaginal plug. Onset of puberty and delayed puberty.
- To study the role of Prostaglandins in reproduction, Anatomy and growth of mammary Glands and Lactogenesis and galactopoiesis.

Paper-X

Special Group-Cell Biology -I

Under this paper the students will be able to:

- To understand the working and applications of various microscopy techniques This will be helpful to them in R & D jobs.
- Students will acquire knowledge of Basic principles , applications and working of various types of centrifuges, Spectroscopy and Chromatography technique used in biophysics.
- Understand the Cell culture techniques and will learn to design and functioning of tissue culture laboratory.
- Students will learn tissue engineering, Enzymology of recombinant DNA technology , Cloning vectors, Gene probes and Gene library – Construction
- Understand gene cloning and its application, detecting DNA polymorphism, DNA chip technology.

Paper-XI

Special Group-Cell Biology-II

Under this paper the students will be able :

- Understand the Chromosome structure , classification ,Chromosomal mutations and Structural abnormalities of human chromosomes and related syndromes:
- To understand Human metabolic disorders,Molecular methods of chromosome studies and applications – in situ hybridization, FISH., Genome organization

- Understanding about Functional genomics, Molecular cytogenetic, DNA sequencing, microarray.
- Students will understand Developmental genetics, Cell specification and determination–Role of segmentation genes,
- To learn Population genetics ,Genetic selection ,Speciation and isolating mechanisms.

Paper-X,

Special Group-Fresh water Zoology -I

Limnology

Under this paper the students will be able :

- To understand the dynamics of Aquatic Ecosystems, Energy flow models,LoticHabitat,Lentic Habitat .
- Understand the physical and Chemical conditions of water.
- To learn the Primary and secondary productivity in aquatic ecosystems, Classification of waterbodies based on productivity ,Methods of measurement of productivity and Factors affecting primary productivity and significance of productivity studies.

Paper-XI

Special Group-Fresh water Zoology-II

Fishery Biology

Under this paper the students will be able :

- To learn the Schemes of classification of fishes by Berg (1940) and Romer (1971)
- Biology of Indian major carps and culturable exotic carps ,Food and feeding habits of some common fresh water fishes. AlsoMethods of gut content (food) analysis.
- Understand the Structure and function of gills. Electroreceptors in fishes ,Growth and age studies on fish
- To understand maturation, spawning periodicity and fecundity of fish. Also Genetic engineering methods for fish stock improvement.
- Understand Fish diseases caused by pathogens and parasites.
- Aquarium-fish keeping and its maintenance ,ornamental fishes , Exotic and larvivorous and Threatened fresh water fishes and conservation measures.

Practical-VI

Special Group- Fresh water Zoology

In this practical the students completing the course, are able to:

Section A

- Measurement of transparency of water body by Secchi disk method.
- Analysis of pH & Turbidity of water.
- Estimation of Dissolved Oxygen (DO) & free carbon dioxide from water.
- Estimation of Alkalinity (Carbonates & Bicarbonates), Hardness (Total, Ca & Mg)
- Estimation of Chlorides, Phosphates & Nitrates from water. 6 Biochemical oxygen demand (BOD) from given water sample.
- Determination of primary productivity of a water body by light and dark bottle method.

Section: B

- Identification of commercially important freshwater fishes and prawns using fishes available in local recognized fish markets or with the help of already available specimens/ ICT tools/ models/ charts/ photographs etc.
- 2, Morphometric study of fish available in local recognized fish markets or with the help of already available specimens/ ICT tools/ models/ charts/ photographs etc.
- Study of spawning periodicity by provided data.
- Determination of length - weight relationship of fish available in local recognized fish markets or with the help of already available specimens/ ICT tools/ models/ charts/ photographs etc.
- Determination of condition factor by using given data.
- Study of maturity stages of fish by using pictures.
- Histological study of fish organs with the help of already available permanent slides/ ICT tools/ charts/ Models / Photographs etc.
- Identification of common parasites of fish with the help of already available permanent slides/ ICT tools/ charts/ models / photographs etc.
- Permanent mounting of fish scales using wastes from local recognized fish markets.
- Visit to a fresh water body for the study of aquatic ecosystem.

Paper XII

Core (Subject centric)-I Wild life and Avian Biology

Under this paper the students will study:

- Wild life sciences that seeks to meet the increasing demand for research and monitoring of wildlife and their habitats and provide trained biologist to further do research in wildlife conservation.
- Student with wildlife course are also free to join different streams like in entomology, foresters, as a zoo curator, in wildlife department , as a conservationist etc.
- Wild life sciences has also another employment area for the students like in sanctuaries, National parks, Wildlife research centres, Environmental monitoring centres etc.
- Avian biology is a new field which allows one to pursue the fascination about birds through the study of topics like physiology, anatomy, nutrition, behaviour etc.
- Study of avian biology has world wide job opportunities that involve domestication of pets, commercial poultry industry, research institute and bird sanctuaries and zoos.

M.SC. SEMESTER-IV

Paper-XIV

Special Group-Mammalian Reproductive Physiology-III

Reproductive Endocrinology

Under this paper the students will be able :

- Understand the Anatomy, cytoarchitecture of Hypothalamus , Neurotransmitters and Feedback regulatory mechanism
- To learn Anatomy and cytology of Pituitary Gland and its hormones.
- To understand the Hypothalamo – hypophyseal testis axis, Thyroid -gonad axis and Hypothalamo- hypophyseal adrenal-gonad axis.

Paper-XV

Special Group-Mammalian Reproductive Physiology-IV

Reproductive Toxicology, Embryology and Fertility

- Students will learn Chemical toxicants and Testicular toxicity,Induction of gonadal toxicity in females and Interruption of pregnancy by pesticides.
- Students will understand Implantation of mammalian blastocyst. ,chorio–allantoicplacenta..Foetal membranes.
- Intrauterine and intra cervical devices (IUDS and IUCDS) medicated and non medicatedIUD's, Pregnancy vaccine ,Recent advances in female contraception .
- Vasectomy and reversible vas occlusion .antagonist,Anti-androgen and anti-spermiogenic compounds

Practical-VII

Special Group-Mammalian Reproductive Physiology

- Demonstration of surgical operation in rat/ mice Ovariectomy or Hysterectomy or Unilateral adrenalectomy with the help of ICT tools/ Charts/ Models / Photographs etc
- Anatomical observations, demonstration and detailed explanation of the female reproductive system of rat or mice with the help of ICT tools/ models/ charts/ photographs etc
- Vaginal smear: Vaginal cytology with relation to estrous cycle with the help of already available permanent slides/ ICT tools/ charts/ models/ photographs etc.
- Pregnancy detection test.
- Study of histochemical localization of proteins in rat/ mouse thyroid by MercuryBromophenol blue method with the help of already available permanent slides/ ICT tools/ charts/ models/ photographs etc.
- Study of histochemical localization of lipids in rat / mouse ovary by Sudan Black–B method (Propylene glycol method) with the help of already available permanent slides/ ICT tools/ charts/ models/ photographs etc.
- Experimental (histological slides for identification) study of the following with the help of already available permanent slides/ ICT tools/ charts/ models/ photographs etc. a) Effects of ovarictomy and oestrogen replacement on pituitary, uterus and vagina. b) Effects of some female antifertility drugs on ovary and adrenal gland 8 Histology: (Identification of slides) Histological changes in female reproductive organs during different phases of oestrous cycle in continuous and seasonal breeder with the help of already available permanent slides/ ICT tools/ charts/ models/ photographs etc
- Embryology: Study of various stages of development of mammalian egg, development of foetal membranes, different types of placenta, progestational changes in uterus with the help of already available permanent slides/ ICT tools/ charts/ models / photographs etc.
- 10 Field work: Visit to laboratory for embryo transfer and family planning clinics.

Paper-XIV

Special Group-Cell Biology-III

Molecular Cell Biology

Under this paper the students will be able :

- To understamdthePrebiological chemical evolution and proto cells.
- Cytoskeleton , Cell-cell interactions and adhesion, Cell-matrix interactions and adhesions and Types of junctions.
- Protein structure ,Ramchandran plot . Molecular chaperons and heat shock proteins.
- Understand Protein synthesis in eukaryotes., Transport of proteins across nuclear membrane.
- To study DNA binding proteins – Leucine zipper, zinc finger, helix turn helix, beta barrel and OB fold.
- Understand Types of cancer, Proto-oncogenes and viral oncogenes, Mechanism of oncogene activation. 3.4 Tumor markers and tumor suppressor genes.
- Model organisms for molecular studies –Importance of Drosophila melanogaster, C. elegans, S. cerevisae, zebra fish studies, Cell senescence and apoptosis.
- To learn Somatic cell hybridization and chromosome mapping, Cell fusion and applications.
- To understand Protein and tissue engineering.

Paper-XV,

Special Group-Cell Biology-IV

Applied Biotechnology

Under this paper the students will be able :

1. Marker assisted improvement of crop , Recent developments in drug delivery.

Nanobiotechnology andbiological warfare.

- To learn Biology, cause, diagnosis and treatment of various diseases like hepatitis, Parkinson's disease, diabetes and cystic fibrosis.
- To learn Properties of stem cells ,Types of stem cells,Haemopoisis, Stem cell disorders. Stem cell therapy, Stem cell and cancer, Stem cell research in ndia.
- Stem cells and tissue engineering, ethical, legal and social implications (ELSI) of Stem cell technology.
- World Trade Organization and trade related intellectual property rights (TRIPS), . Intellectual property rights – Patents and patent documentation.

Practical-VII

Special Group-Cell Biology

- Measurement of maximum absorption of colored solutions & verification of BeerLambert's law.
- Biochemical estimation of blood cholesterol vblood glucose,l (Source of blood: Local recognized pathology laboratory)
- Biochemical estimation of acid phosphatase and alkaline phosphatase (Source of blood: Local recognized pathology laboratory)
- Isolation of lymphocytes.
- Comparison of RBC and WBC in different group of vertebrates with the help of already available permanent slides/ ICT tools/ Charts/ Photographs etc.
- Media preparation for prokaryotic cell culture Methods of Sterlization
- Gram staining of micro-organisms. And Bacterial motility.
- Preparation of neem extract as an antimicrobial agent.

- Separation of amino acids by paper chromatography.
- Uses and functioning of different types of microscopes.
- Study of metaphase chromosomes from rat bone marrow with the help of already available permanent slides/ ICT tools/ charts/ models etc.
- Study of G banding of metaphase chromosome with the help of already available permanent slides/ ICT tools/ charts/ models / photographs etc.
- Study of C banding with the help of already available permanent slides/ ICT tools/ charts/ models/ photographs etc.
- Study of histology of normal tissue and cancerous tissue with the help of already available permanent slides/ ICT tools/ charts/ models / photographs etc.
- Demonstration of tools used for patent search and patent filing system.

Paper XIV

Special Group-Fresh water Zoology-III

Aquatic Biology

Under this paper the students will be able :

- To understand about Plankton , Periphyton , Nekton(Definition,classification.,Collection,preservation and Qualitative and quantitative study, importance)
- To understand theBottom material,Benthos (Definition and collection of benthos. Qualitative and quantitative study,Importance)
- To learn about Aquatic pollution, types & sources of pollutants.Methods of assessment of pollutional status. 2.2 Biological indicators of pollution.
- Understand Heavy metal and pesticide residues from agriculture fields & control measures.
- Drinking water treatment and Disposal of sewage.
- Aquatic toxicology: Toxicants, toxicity concentration response relation and Bioassay study

Paper XV

Special Group-Fresh water Zoology-IV

Inland Fisheries

Under this paper the students will be able :

- To learn Inland fisheries resources ,Fresh water fish culture and management techniques.
- To make Basic experimental designs useful in aquaculture and Population dynamics of fish and stock assessment models.
- Types of Breeding natural& synthetic hormones in breeding.
- Types of Hatchery , Nutritional requirement of carps and supplementary feeding.
- To learn different types of fish cultures, Integrated fish farming with agriculture and live stock. Culture of fresh water mussel for pearls.
- Fisheries extension and Co-operative societies. ,Biochemical composition and economic importance of fishes,Fish spoilage & preservation methods, and HACCP in processing industry

Practical-VII

Special Group- Fresh water Zoology

Section: A

- Qualitative and Quantitative study of fresh water zooplankton.
- Study of fresh water periphyton.
- Study of fresh water benthic organisms with the help of already available permanent slides/ ICT tools/ charts/ models / photographs etc.
- Study of LC50 value of toxicant to aquatic organism by provided data.
- Methodology of oxygen consumption rate of aquatic organisms.
- Camera lucida drawings of zooplankton.
- Study of ecological set up.

Section: B

- Feed formulation by square method.
- Estimation of Maximum sustainable yield (MSY) using surplus production model.
- Study of preparation of pituitary extract with the help of ICT tools/ charts/ models / photographs etc.
- Identification of aquatic weeds, insects and weed fishes with the help of already available permanent slides/ ICT tools/ charts/ models / photographs etc.
- Gram staining of bacteria.
- Estimation of protein (Source of blood: Local recognized pathology laboratory)
- Determination of acid value or free fatty acids (FFAs) in fish oil.
- Identification of egg, spawn, fry & fingerlings of carps with the help of already available permanent slides/ ICT tools/ charts/ models/ photographs etc.
- Estimation of trend by using given data with the help of time series analysis. 10. Visit to a fish farm for studying the culture and breeding activities.

Paper-XIII

Biotechniques, Biostatistics, Ethology, Toxicology and Bioinformatics

Under this paper the students will be able:

- To understand variousSterilization techniques, media for microbial culture, inoculation methods
- Animal cell & tissue culture will be learned by the students.
- To understand Basic principle of sedimentation and centrifugation,Chromatography, and Electrophoretic separation techniques
- Students will learn Bioststistics : Central tendency ,dispersion- mean, mode and median ,Probability , standard error (SE), standard deviation (SD), significance tests - t- test, z- test, Chi square test- assumption, importance and example
- 5.To understand animal behaviour and Animal ethics.
- Understand scope of toxicology , Classification of environmental toxicants; Pesticides, Fertilizers, Heavy and trace metals, radioactive substances, food additives, automobile emission. Toxicity tests- Types (Acute and Chronic), calculation of LC50 and LD 50;
- Antidotalthereapy- Antidotes, type of antidotes and antidotal procedure.
- Students will learn scope of bioinformatics - history, scope of bioinformatics in research, business and employment opportunities; Bioinformatics in India. biological databases– Basic local alignment search tool (BLAST), and FASTA, Variants of

BLAST, PSI-BLAST. And Phylogenetic analysis- Tree style, tree building methods

Paper- 4T4

Radiation and Chronobiology

Under this paper the students will be able:

- To understand Radiation Biology(Definition, scope , Classification , and significance of radiation).
- Principles of radiation dosimetry, direct and indirect effects. Radiations lesions in DNA, radiobiological effect on cell.
- Effect of Radiation on Human Health
- To understand effect of Radiation in the developing embryo and fetus, radiation induced heritable diseases.
- To study Circadian cycle, Concept of central and peripheral clock system,Circadian pacemaker system in invertebrates with particular reference to Drosophila ,rodents.
- Biological clock ,Centers of biological clock – Supra chiasmatic nuclei, pineal gland and optic lobes. Depression and sleep disorders.
- To study Chronopharmacology, chronomedicine, chronotherapy.

DEPARTMENT OF CHEMISTRY
PROGRAMME: B.SC.

Statements of Programme Specific Outcomes (PSOs)

By the end of the course, the students will be able to:

- Join school as Chemistry teacher.
- Prepare for competitive exams like MPSC,UPSC, GATE,CAT.
- Analyze and grasp abstract ideas to apply them to important practical problems.
- Develop strong analytical skills and a broad-based background in the Chemical sciences to join Indian industry.

Statement of Course Outcomes (COs)

B.Sc. Sem-I Paper-CH 101: (Inorganic Chemistry)

By the end of this course, Students will be able to:

- Understand the basic structure of atom.
- Understand the concept nature of chemical bond.
- Overview of periodic table and S,P block elements.

B.Sc. Sem-I Paper-CH 102: Physical Chemistry

By the end of this course, Students will be able to:

- Understand the various states of matter.
- Overview of solid, liquid and gaseous state of matter.
- Understand the concept of different types of surface phenomenon and catalytic property.

B.Sc.I Sem-I Paper- CH-103: Laboratory Course

By the end of this course, Students will 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.Sc. Sem-II CH – 201: Paper- I (Organic Chemistry)

By the end of this course, Students will be able to:

- Understand the concept structure and bonding in organic compounds.
- Understand the concept of stereochemistry.
- Understand different types of reaction mechanism.
- Understand alkanes, alkenes.
- Understand the aromaticity of organic compounds.

B.Sc. Sem-II CH – 202: Paper- II (Physical Chemistry)

By the end of this course, Students will be able to:

- Understand the thermodynamics of chemical reactions.
- Understand the concept of chemical kinetics.

- Understand the concept of phase equilibria.

B.Sc. Sem-II CH-203: Laboratory Course

By the end of this course, Students will be able to:

- Students will able to analyse 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.Sc. Sem-III CH – 301:Paper- I (Inorganic Chemistry)

By the end of this course, Students will be able to:

- Understand the concepts of molecular orbital theory.
- Understand the properties of d and f block elements.
- Understand the role of non aqueous solvents.
- Understand concepts of errors and evaluation in chemical analysis.

B.Sc. Sem-III CH-302 : Paper- II (Organic Chemistry)

By the end of this course, Students will be able to:

- Understand the structure and chemical bonding in aryl ,alkyl halides,aldehydes.
- Understand the structure and chemical bonding in alcohols and phenols..
- Understand chemical reactions of acids, alcohols, phenols etc.

B.Sc. Sem-III CH- 303: Laboratory Course

By the end of this course, Students will 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.Sc. Sem-IV CH – 401:Paper- I (Inorganic Chemistry)

By the end of this course, Students will be able to:

- Understand the properties of coordination compounds.
- Overview of organometallic chemistry.
- Understand the importance of essential elements in living organism.
- To understand the Concept of hard and soft acid base theory.

B.Sc. Sem-IV CH – 402:Paper- II (Physical Chemistry)

By the end of this course, Students will be able to:

- Understand second law of thermodynamics.
- Use spectroscopy for chemical analysis.
- Understand electrochemistry of reversible and irreversible cells.
- Understand the nuclear properties of atom.

B.Sc. Sem-IV CH-403: Laboratory Course

By the end of this course, Students will be able to:

- Perform gravimetric analysis of Ni, Ba.
- To estimate amount of constituents present in given solution by conductometer, potentiometer.

B.Sc. Sem-V CH- 501:Paper- I (Organic Chemistry)

By the end of this course, Students will be able to:

- Understand heterocyclic chemistry.
- Understand the theory behind the organic qualitative analysis.
- Understand the chemistry of organomagnesium and organozinc compound.

B.Sc. Sem-V CH- 502:Paper- II (Physical Chemistry)

By the end of this course, Students will be able to:

- Understand quantum chemistry and its application.
- Understand molecular orbital theory.
- Understand photochemistry and Raman spectroscopy

B.Sc. Sem-V CH- 503: Laboratory Course

By the end of this course, Students will be able to:

- Perform estimation of different functional groups present in organic compound.
- Perform analysis based on viscosity,colorimetry,refractometry.

B.Sc. Sem-VI CH – 601: Paper- I (Inorganic Chemistry)

By the end of this course, Students will be able to:

- Understand metal-ligand bonding in co-ordination compounds.
- Understand electronic spectra of transition metal complexes.
- Understand separation techniques used in analysis and purification.
- Understand the importance of inorganic polymers.

B.Sc. Sem-VI CH- 602: Paper- II (Organic Chemistry)

By the end of this course, Students will be able to:

- Understand the theory behind Nuclear magnetic resonance spectroscopy..
- Understand structure and properties of biomolecules.
- understand the importance of synthetic dyes, synthetic drugs and synthetic polymers .

DEPARTMENT OF COMPUTER SCIENCE
PROGRAMME: B.SC.

Statement of Course Outcomes

B.Sc. Part I Semester I Paper-I :- Programming in C

By the end of this Programme, the students will be able to:

- Understand programming structures like Sequence, Selection, Iteration and Modular.
- Understand development tools such as algorithm, flowchart and pseudo code for any problem to solve them programmatically.
- Understand basic concepts of programming in C such as character set, Operators, Functions etc.
- Understand arrays, strings, functions, structures, unions and pointers.
- Understand the file handling, sequential access and random access programmatically.

Programme: B.Sc. Part I Semester I Paper-II :- Fundamentals of Information Technology

By the end of this Programme, the students will be able to:

- Understand the meaning and basic components of a Digital computer system
- Understand the role of CPU, BUS, Number System, and Language Evaluation
- Understand the concept of Compilers, Interpreters and Assembler
- Understand the concepts and need of primary and secondary memory, different storage devices
- Explain input devices and output devices.
- Explain Network concepts, LAN, WAN Man, Network protocols etc.

Programme: B.Sc. Part I Semester II Paper-I :- Object Oriented Programming using 'CPP'

By the end of this Programme, the students will be able to:

- Understand key structured programming, constructs declaration sequence, selection, repetition evaluating expression.
- Understand C++ functions and the concepts related to good modular designs.
- Understand pointers and reference parameters; understand the creation of class and objects.
- Handle files programmatically creating dynamic objects.
- Understand inheritance virtual functions, need and pure virtual functions.
- Understand mechanism of online function, constructors, destructors, operator overloading and exception handling.

Programme: B.Sc. Part I Semester II Paper-II :- System Analysis and Design

By the end of this Programme, the students will be able to:

- Carry Feasibility Study of system, Gather data to analyze and specify requirements of a system
- Design system components and environment
- Develop data flow diagram and decision tables to design system
- Understand the concept of Implementation, Testing and Conversion of system
- Work as an effective tem member on assigned projects.
- Understand the concept of Software Reliability and Quality Management.

Programme: B.Sc. Part II Semester III Paper-I :- Data Structures

By the end of this Programme, the students will be able to:

- Determine appropriate data structure as applied to specified problem definition.
- Understand the concept of Linked List, Double linked List and their representation
- Explain the different mechanism involved in memory Mgt.
- Understand the concept of avoidance, detection and prevention of Deadlock.
- Explain Trees in Memory, Definition and Representation of Graphs in Memory

Programme: B.Sc. Part II Semester III Paper-II :- Operating Systems

By the end of this Programme, the students will be able to:

- Understand the basic of Structure of Operating System, Characteristics of Modern OS
- Understand the anatomy of Process Management, CPU Scheduling Algorithm
- Understand the concept of deterministic Modelling, Dead Lock Prevention, Dead Lock Detection, Recovery from Deadlock
- Explain paging, segmentation, Segmentation with paging. Protection
- Understand file management, Buffering.

Programme: B.Sc. Part II Semester IV Paper-I :- Java Programming

By the end of this Programme, the students will be able to:

- Understand model of Java Programming language such as Operators, tokens etc.
- Creating a class & subclass, Understand Data members, Invoke a method, passing arguments to a method, calling method.
- Explain Method overloading, Constructor overloading. Java class library
- Understand Decision making & loops, Creating an array, String array,
- Explain the concept of Inheritance and Interfaces
- Evaluate user requirement for software functioning.
- Solve given problems using Java programming.
- Create GUJ applications

Programme: B.Sc. Part II Semester IV Paper-II :- Linux Operating System

By the end of this Programme, the students will be able to:

- Understand the basic set of commands and utilities in Linux, concept of shell
- Understand the anatomy of Linux operating system, editor and procedure of printing files
- Sharing Files with other Users
- Perform backup and to create compress file and decompress them.
- Perform operation on process.
- Understand KDE and GNOME desktop environment.

Programme: B.Sc. Part III Semester V Paper-I :- Visual Basic Programming

By the end of this Programme, the students will be able to:

- Write, compile and execute applications using various controls like text box, command button.
- Write programs using Arrays and functions
- Write, compile and execute applications using database connectivity like ADODC.
- Create database using MS-Access and visual Data managers

- Write, compile and execute Menu driven application.
- Explain Data Environment and Data Reports.

Programme: B.Sc. Part III Semester V Paper-II :- Data Base Management System

By the end of this Programme, the students will be able to:

- Understand basic concepts of DBMS, its objective
- Role of Database Administrator, Database Users, different Data models and network models
- Understand concept of ER model.
- Explain Relational Model, Structure and Extended Relational model
- 5 Understand Functional Dependency and Perform normalization of database.

Programme: B.Sc. Part III Semester VI Paper-I :- Compiler Construction

By the end of this Programme, the students will be able to:

- Understand Compilers and translators and their need.
- Explain Intermediate code Generation.
- 3 Define programming languages, ,High Level programming languages
- Understand the lexical and syntactic structure of a language, the role of the lexical analyser
- Understand Parsers, Shift-reduce parsing and DAG representation of basic blocks

Programme: B.Sc. Part III Semester VI Paper-I :- SQL and PL/SQ

By the end of this Programme, the students will be able to:

- Understand CODD'S Rules, Oracle Database Objects, data types, operators
- Create tables, derive table from existing table, altering, dropping of Tables.
- Check Integrity Constraints and Adding and Dropping Constraints
- Understand types of Views, Create Views, Drop Views, Insert, Update and Delete 5Data using Views,.
- 5Understand basic concepts of PL/SQL Programming
- Create cursors, triggers and Exception Handling

DEPARTMENT OF ELECTRONICS
PROGRAMME: B. SC.

Statements of Programme Specific Outcomes (PSOs)

***Programme: B Sc. Electronics (for the students of Physics, Electronics, and Mathematics group of Subjects*)**

By the end of this programme, the students will be able to:

1. Understand the basic concepts of electronics components, network theorem, digital electronics, solid state semi conductor devices, amplifier theory, Analog and Digital circuits, basic circuits, design using circuit maker software and their application
2. Analyze different parameters of various circuits
3. Understand the use of electronics in the field of computer science.
4. Perform and testing of different electronics components and circuits.
5. Analyze the I/P, O/P V-I characteristics of the circuits.
6. Understand the application of Electronics in domestic appliances
7. Analyze the relationship between analogue and digital circuits.
8. Repair small household electrical and electronics appliances

Statement of Course Outcomes

Programme: B Sc SEM I Course: electronics components, network theorem

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

1. Identify the different electronics components used in electronic circuits.
2. Understand the working of solid state semiconductor devices used in the circuit
3. Understand different concepts of electronics and network theorem.
4. Understand different concepts of semiconductor materials and devices.
5. Determine various parameters and V-I characteristics of diodes and transistors.

Programme: B Sc SEM I Course: Fundamental of Digital Electronics

1. Course Outcomes: By the end of this course, the students will be able to:
2. Understand the concepts of digital electronics
3. Understand the basic working of different logic gates and laws of Boolean algebra, De Morgan theorem, NOR & NAND logic for simplification of circuits.
4. Understand the concepts of K-maps and designing of logic circuits.
5. Understand and design different controlling circuits used in digital electronics.

Programme: B Sc SEM I Course: Practical

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

1. Design the circuits and install it on Bread boards
2. Perform the calculations on combination of basic components such as resistors and capacitor

3. Work on network theorems
4. Analyze the characteristics of different diodes and BJT
5. Perform the binary addition of more than 3 bits
6. Simplify and summarize the given logical circuits.
7. Convert the number in various number systems.
8. Explain the basics and universal gates.

Programme: B Sc SEM II Course: Semiconductor Device

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

1. Describe working, characteristics and applications of semiconductor devices. Understand and describe special high power semiconductor.
2. Analyze different parameters and relation between the different terms related to amplifier.
3. Classification of different amplifier and analyze the concepts of different types of amplifier.

Programme: B Sc SEM II Course: Advance digital electronics

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

1. Understand the concepts of different logic family and comparison of different parameters of logic family.
2. Understand the concept of sequential logic circuits and study of different sequential circuit with reference to storage.
3. Understand different counting circuits and their applications.
4. Understand different digital storage devices, memory, and their classification with expansion.

Programme: B Sc SEM II Course: Practical

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

1. Understand and analyze the characteristics of JFET, MOSFET and high power devices.
2. Explain the working of UJT and Oscillator.
3. Explain the combinational and sequential logic circuits.
4. Explain the working of transistor as a switch.

Programme: B Sc SEM III Course: OP-AMP and power supply

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

1. Understand and compare different amplifier
2. Analyze the different parameters of OP-AMP
3. Understand the application of OP-AMPs for positive and negative feedback concept.
4. Understand the concept of unregulated and regulated power supply
5. Understand the IC regulator, different regulator and their performances.

Programme: B Sc SEM III Course: Electronics circuit design.

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

1. Understand the concepts and ideas of designing circuit using computers.
2. Understand circuit maker software
3. Analyze different parameters of simple circuit and setting of different

parameters using circuit maker
4. Understand the concept of virtual instrumentation and advance virtual instrumentation.

Programme: B Sc SEM III Course: Practical

Course Outcomes: By the end of this course, the students will be able to:
1. Explain the OP-AMP as linear and non-linear device.
2. Understand the working of regulated and unregulated power supply.
3. Identify the circuit symbols and components of circuit maker software.
4. Design and perform the different amplifier circuit maker.

Programme: B Sc SEM IV Course: Analog & digital Techniques

Course Outcomes: By the end of this course, the students will be able to:
1. Describe OPAMP as different types of RC, AC ASCILLATORS
2. Understand OP AMP as multi vibrators
3. Design and explain A to D and D to A convertors.
4. Describe the positive and negative feedback and advantages of positive feedback.

Programme: B Sc SEM IV Course: Electronic Instrumentation

Course Outcomes: By the end of this course, the students will be able to:
1. Classify the transducers and description of their characteristics.
2. Summarize the LM 35 transducer and its application
3. Understand working and block diagram of biomedical instruments.
4. Understand the block diagram for electronic system.

Programme: B Sc SEM IV Course: Practical

Course Outcomes: By the end of this course, the students will be able to:
1. Understand working of Op AMP as vien bridge and phase shift
2. Describe different types of ADC, DAC and sample and hold circuit
3. Summarize the transfer characteristics of different transducers
4. Compare the accuracy of digital multi meters.

Programme: B Sc SEM V Course: Electronics Communication

Course Outcomes: By the end of this course, the students will be able to:
1. Understand the basics of electronics communication and types of communication
2. Describe different propagation modes of signals
3. Understand the concept of digital communication
4. Understand fiber optics communication system and concept of modern communication system.

Programme: B Sc SEM V Course: Fundamental of Microprocessor

Course Outcomes: By the end of this course, the students will be able to:
1. Understand and describe 8085 microprocessor
2. Describe different modes of operation of 8085 microprocessor
3. Understand different instruction set of microprocessor
4. Understand the need of interfacing and different modes of data transfer

Programme: B Sc SEM III Course: OP-AMP and power supply

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

1. Perform communication system practical using PC/ microcontroller
2. Perform ASK and FSK using OPAMP
3. Perform simple assembly language program using instruction of 8085 microprocessor
4. Understand and study the PPI 8255

Programme: B Sc SEM VI Course: Programming in C

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

1. Understand the basic of C language
2. Understand different syntax, keywords and operators used in C
3. Understand different control statement related to C programming
4. Understand the concepts of advanced data types
5. Understand the concept of file structure in C language.

Programme: B Sc SEM VI Course: Microcontroller 8051

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

1. Understand basics of 8051 microcontroller
2. Understand different instruction and addressing modes of microcontroller
3. Understand the concept of subroutines and simple programming
4. Describe interfacing of different I/D devices with personal computer.

Programme: B Sc SEM III Course: Practical

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

1. Perform simple programmes based on I/D functions and operators
2. Perform to understand the concept of file operations in C
3. Perform program related structures
4. Perform ADC and DAC interface with microcontroller applications.

DEPARTMENT OF ENVIROMENT SCIENCE
PROGRAMME: B. SC.

Semester I

Paper I
Fundamentals of Environmental Science

Students shall be able to:

- Explain the basics of Environmental Science and importance of Environmental Education.
- Understand and explain the fundamentals of atmospheric science including formation, depletion and effects of ozone layer on environment.
- Explain the fundamentals of climatology and basic concept of clouds.
- Understand the basics of meteorology and analyze meteorological parameters (Humidity, pressure, wind speed and wind direction).

Paper II
Environmental Ecology

Students shall be able to:

- Explain basic concepts of Ecology and environmental factors: Abiotic, Biotic
- Understand and explain the concept of ecological relationships and ecological adaptations.
- Study the changes in Population by understanding the concept of Population ecology, and explain the concept of Marine ecology.
- Explain community ecology and ecological succession.

Practical

Students shall be able to:

- Determine Relative Humidity of air using Psychrometer consisting of wet and dry bulb thermometers.
- Determine wind speed and wind direction with cup and propeller type of Anemometer.
- Measure light intensity by lux meter.
- Measure solar constant.
- Study characteristics of plant communities (Density, Frequency and abundance) by quadrate method.
- Measure primary productivity in a water body by light and dark bottle method.
- Study food chain in an aquatic ecosystem.

Semester II

Paper III
Introduction to Water and Soil Chemistry

Students shall be able to:

- Explain characteristics of Surface, ground and sea Water and its degradation due to natural and man-made activities.
- Analyze physico-chemical characteristics of water.
- Understand and explain formation of soil and analyze soil for its physical and chemical properties.
- Discern types of soil erosion and apply methods of soil conservation.

Paper IV
Introduction to Ecosystem and Biodiversity

Students shall be able to:

- Explain basic concepts of Ecosystem and understand discern Biochemical cycles.
- Understand and explain basic concepts of Production ecology; measure productivity of an ecosystem and discern biogeochemical cycles.
- Explain types of forests in India and understand and explain concepts of Deforestation, Afforestation, Joint Forest management and Social forestry.
- Understand and explain the concept of Biodiversity and apply the methods of biodiversity conservation.

Practical

Students shall be able to:

- Sample ground and surface water and store them.
- Analyze physico-chemical parameters (Colour, temperature, turbidity) for characterization and evaluation of water quality.
- Determine hydrogen ion concentration (pH) of water and wastewater.
- Estimate Total solids, Total dissolved solids and total suspended solids from water and wastewater by gravimetric method.
- Estimate conductivity, chlorides, alkalinity, acidity and total hardness of water and wastewater.
- Sample soil by quartering method.
- Analyze soil for bulk density, moisture content, water holding capacity and soil texture.

Semester III

Paper V
Environmental Chemistry and Instrumentation

Students shall be able to:

- Explain characteristics of Water; chemistry and structure of Surface and Ocean Water.
- Explain the Fundamentals of Atmospheric Chemistry and explain the sources and effects of Green House Gases and Global Warming.
- Discern basic instrumental methods and analyze pH and Conductivity.
- Understand advanced instrumental methods of Chromatography, Colorimetry and Flame photometry along with their principle and applications.

Paper VI
Environmental Microbiology and Water Treatment

Students shall be able to:

- Understand basics of Environmental Microbiology and discern Air, Soil and Water micro flora.
- Explain the Water supply and distribution system, spread awareness about water borne diseases and explain importance of Environmental Sanitation.
- Discern the unit operations, processes, mechanisms and significance involved in water treatment: Aeration, Coagulation, Flocculation, Sedimentation, Filtration and Disinfection.
- Understand the basic concepts and application of Modern water treatment techniques:

Water Softening (Lime Soda process, Zeolite Process, Demineralization Process), Defluoridation, and Reverse Osmosis.

Practical

Section A

Students shall be able to:

- Analyze water for its potability.
- Determine residual chlorine, demand and dose for provided water sample.
- Separate copper by Solvent extraction method (Cu-DDC).
- Separate Nickel by Solvent extraction method (Ni-DMG).
- Demonstrate principle, working, standardization and application of pH meter.
- Demonstrate principle, working, standardization and application of Turbidity meter.
- Demonstrate principle, working, standardization and application of Conductivity meter.
- Detect Ni_2^+, Co_2^+ and Cu_2^+ from a provided mixture by paper chromatography.
- Determine alkali metals (Sodium and Potassium) from various samples by Flame Photometry.
- Demonstrate principle, working, standardization and application of Gas Chromatography.
- Determine Alum dose for Defluoridation by Nalgonda Technique.

Section B

Students shall be able to:

- Enumerate bacteria from air, water and soil.
- Demonstrate bacteria from air, water and soil.
- Observe motility of organisms by Hanging drop technique.
- Apply differential gram staining.
- Determine total coliforms of water by MPN technique.
- Study microorganisms by standard plate count (SPC) method.
- Determine optimum coagulant dose, pH and time by Jar Test Apparatus.

Semester IV

Paper VII

Soil Pollution and Waste Management

Students shall be able to:

- Explain the basic concepts of Soil Pollution, soil pollutants, pesticide pollution and land protection.
- Understand the basic concept of Municipal solid waste and collect, handle, treat and dispose Municipal Solid Waste (MSW).
- Discern the solid waste management methods and explain the processing of solid waste.
- Explain the basic concepts and apply various methods of Hazardous and Biomedical Waste management.

Paper VIII

Natural Resources and GIS

Students shall be able to:

- Explain the concept of Natural Resources: Renewable, Non-Renewable.

- Understand and explain the Earth's Resources: Land, Mineral, Water.
- Discern the natural catastrophes, interpret risk assessment and apply disaster management methods.
- Understand and apply the concept of Remote sensing, Image processing and GIS.

Practical

Section A

Students shall be able to:

- Sample soil by quartering method.
- Sample soils from different polluted sites.
- Determine cation exchange capacity of provided soil sample.
- Determine sodium adsorption ratio.
- Determine nitrogen, phosphorous and potassium of soil.
- Determine total organic carbon and present organic matter from the given soil sample.
- Analyze soil sample for micronutrients (Fe, Zn, Mn).
- Determine solid waste index.
- Determine moisture content of a solid waste sample by gravimetric method.
- Determine calorific value of Municipal solid waste sample by bomb calorimetry.
- Determine volatile and non-volatile matter in a Municipal solid waste sample.

Section B

Students shall be able to:

- Demonstrate non-conventional energy resource system: Solar cooker, solar water heater.
- Determine solar intensity by Lux meter.
- Study biogas plant and analyze biogas slurry for acidity, alkalinity and solids (Total solids, total suspended solids).
- Analyze vermicompost for physico-chemical parameters with respect to total nitrogen and phosphate.
- Measure rainfall by Rain gauze.
- Analyze ground water quality for Total solids, Fluoride and Iron for its potability test.
- Study remote sensing techniques.
- Interpret techniques for aerial photographs and satellite imageries.
- Map vegetation by using Aerial Photographs.
- Map vegetation by using Satellite imageries.
- Demonstrate land use pattern of the region.

Semester V

Paper IX

Principles of Air and Noise Pollution

Students shall be able to:

- Explain the basic concepts of Air Pollution, air pollutants and meteorology.
- Understand the global problems, prevention and control measures of air pollution
- Interpret the legislative measures of Air pollution and genesis of vehicular pollution
- Understand and explain the basic concepts of noise pollution along with its prevention and control

Paper X

Environmental Management

Students shall be able to:

- Explain the basic concepts of Environmental impact Assessment (EIA) and Environmental impact Statement (EIS) , Public Participation.
- Apply the impact assessment methodologies, its assessment and legislation of EIA
- Analyze and carry Environmental Audit (EA) for industries and interpret the significant Environmental Acts.
- Understand the concept of sustainable development and people's participation in Environmental protection and environmental issues.

Practical

Section A

Students shall be able to:

- Determine the suspended particulate matter (SPM) and (RSPM) in ambient air by using High Volume Sampler.
- Carry-out comparative analysis of air sampling from Residential, Commercial and Industrial zone using key parameters like SO_X and NO_X.
- Determine settleable particles in air using Dust fall jar apparatus.
- Prepare and interpret wind roses.
- Determine the concentration of carbon monoxide (CO) in a given auto exhaust air sample.
- Determine the concentration of acid rain in air sample.
- Measure and compare the noise pollution by noise meter in silent, industrial, residential, commercial zones with standards specified.
- Demonstrate electrostatic precipitators, scrubbers, cyclone collector, gravity settling chamber and its working.

Section B

Students shall be able to:

- Prepare Environmental Audit Report, model of EIA report.
- Carry out the study of natural environment of the area with respect to the air, noise, water, soil, and socio-economics.
- Carry out the study of EIA legislation for environmental protection.
- Concentration of hydrocarbons in a given auto exhaust air sample.
- Determine the sulphonation rate by lead peroxide method.
- Determine ammonia in atmosphere.
- Determine Air Pollution Index (API).
- Study the impact of air pollution on photo density flux of plant leaves.
- To estimate the effect of exhaust gases on chlorophyll content in different plants.

Semester VI

Paper XI

Water Pollution: Monitoring and Management

Students shall be able to:

- Explain the basic concepts of Water Pollution, water pollutants and water quality monitoring with its management.
- Understand the global problems associated with water pollution: Marine and Oil

Pollution, and the concept of eutrophication.

- Interpret the basic concepts, effects and mitigation measures of thermal pollution.
- Understand and explain the basic concepts, effects of radioactive pollution and discern the various disposal methods of radioactive waste.

Paper XII
Water Supply and Wastewater Treatment

Students shall be able to:

- Explain the water distribution system, methods of water supply, design consideration in distribution system and the concept of environmental sanitation.
- Understand the general aspect of wastewater treatment and discern the preliminary and primary treatment methods
- Discern the biological wastewater treatment: secondary and tertiary treatment methods, and interpret the sludge handling treatment and disposal methods.
- Understand the concept of industrialization and the types of industrial effluents, and explain the unit operations for industrial wastewater treatment.

Practical

Section A

Students shall be able to:

- Determine Zn^{++}, Cd++, Pb++ by complexometric titration.
- Determine sulphate and phosphate in given water sample.
- Estimate nitrate by PDA method and total Kjeldahl's nitrogen in giver water sample.
- Estimate BOD_3 and determine COD in given sample.
- Demonstrate eutrophication of polluted lakes.

Section B

Students shall be able to:

- Determine Sludge Volume Index (SVI) of waste water sample.
- Estimate Phenol in given waste water sample.
- Estimate Sodium and potassium in sewage sample.
- Demonstrate UV-Visible spectrophotometer, AAS and Gas chromatography.
- Determine oxygen consumption in normal fish/snail at different temperature.
- Estimate the toxicity of heavy metals using fish/snail as test animal and determine LC_{50} value.
- Estimate chromium in a waste water sample.
- Demonstrate Poly aromatic hydrocarbon (PAH) in water and wastewater.

DEPARTMENT OF MATHEMATICS
PROGRAMME: B. SC.

Statements of Programme Specific Outcomes (PSOs)

By the end of the course, the students will be able to:

- Join school as mathematics teacher.
- Prepare for competitive exams like MPSC,UPSC, GATE,CAT.
- Analyze and grasp abstract ideas to apply them to important practical problems.
- Develop strong analytical skills and a broad-based background in the mathematical sciences to join Indian industry.

Statement of Course Outcomes (COs)

B.Sc. Sem-I Paper-M 1: Algebra & Trigonometry

By the end of this course, Students will be able to:

- Use Matrices to solve system of linear equations.
- Understand the concept of Eigen value & Eigen vectors and method to find it.
- Find roots of polynomial equation in one variable.
- Understand the basic concept of complex analysis.
- Understand the basic concept of Group Theory.

B.Sc. Sem-I Paper-M 2: Calculus

By the end of this course, Students will be able to:

- Understand the concept of limit, continuity and differentiability of function of one variable, successive differentiation and Lebinitz's theorem.
- Understand the concept series expansions (Maclaurin & Taylor Series).
- Find limits of Indeterminate forms by using L'Hospital Rule.
- Understand the concept of partial differentiation, Euler's theorem, Jacobians.
- Solve definite integrals.

B.Sc. Sem-II Paper- M 3: Geometry, Differential & Difference Equations

By the end of this course, Students will be able to:

- Understand the concept of Geometry (line, Plane, Circle, Sphere, cone, cylinder).
- Solve first order exact differential equation, first order linear differential equation.
- Study Bernoulli's differential equation.
- Study higher order linear differential equation.
- Study Difference equation.

B.Sc. Sem-II Paper- M 4: Vector Calculus & Improper Integrals

By the end of this course, Students will be able to:

- Understand the concept of vector calculus (Gradient, Divergence, Curl).
- Understand the concept of line Integral, work done, conservative vector field.
- Use double integration to find area.
- Solve problems on vector Integration (Surface Integral, Volume Integral).
- Evaluate Improper Integrals.

B.Sc. Sem-III Paper-M 5: Advanced Calculus, Sequence & Series

By the end of this course, Students will be able to:

- Understand Mean Value Theorems, Limit & continuity of functions of two variables.
- Understand the concept of Minima & maxima of functions of two variables.
- Understand the concept of sequence.
- Understand the concept of series.

B.Sc. Sem-III Paper-M 6: Differential Equations & Group Homomorphism

By the end of this course, Students will be able to:

- Understand Bessel's & Legendre's functions with their properties.
- Understand the concept Laplace Transform & Inverse Laplace Transform.
- Solve Ordinary and Partial Differential Equations using Laplace transform.
- Understand the concept of Fourier Transform.
- Understand the concept of Group.

B.Sc. Sem-IV Paper-M 7: Partial Differential Equations & Calculus of Variation

By the end of this course, Students will be able to:

- Solve simultaneous differential equations.
- Form partial differential equations of first order.
- Use suitable method to find solution of partial differential equations of first order.
- Solve linear partial differential equations of higher order.
- Study calculus of variation.

B.Sc. Sem-IV Paper-M 8: Mechanics

By the end of this course, Students will be able to:

- Understand the concepts of equilibrium of coplanar forces, virtual work, catenary.
- Understand the concept of radial & transverse velocity, radial & transverse acceleration.
- Understand the concept of simple harmonic motion.
- Understand Mechanics of a system of particles.
- Study equations of motion.

B.Sc. Sem-V Paper-M 9: Analysis

By the end of this course, Students will be able to:

- Understand the concept of fourier series.
- Understand the concept Riemann-Stieltjes integral.
- Understand fundamental theorem of calculus.
- Understand basic concept of analytic functions.
- study Mobius transformation.

B.Sc. Sem-VI Paper-M 10: Metric Spaces, Complex Integration & Algebra

By the end of this course, Students will be able to:

- Examine countable and uncountable sets.
- Understand the concept Metric spaces.
- Understand the concept of Ring.
- Study complex integration.

M.Sc. Sem-V Paper-M 11: Abstract Algebra

By the end of this course, Students will be able to:

- Understand the concept of Group Automorphism.
- Give examples of vector spaces.
- Understand the concept of linear transformation.
- Link linear transformations with matrices.
- study inner product spaces.

B.Sc. Sem-V Paper-M 12 (Optional)

Special Theory of Relativity

By the end of this course, Students will be able to:

- Study Newtonian Relativity, Galilean Transformation.
- Understand failure of Newtonian Relativity.
- Study Einstein's Theory of Relativity, Lorentz Transformation.
- study Tensors, Riemannian metric, metric tensor.
- 5) Study Maxwell's equations of electromagnetic theory, equivalence of mass and energy $E=mc^2$.

B.Sc. Sem-V Paper-M 12 (Optional)

Discrete Mathematics and Elementary Number Theory

By the end of this course, Students will be able to:

- Distinguish between equivalence relation and partial order relation.
- Understand Boolean algebra.
- Study basic concept of Number Theory.
- Understand Greatest Integer Function, Quadratic Residues and Reciprocity.
- Study the Diophantine equations $ax+by=c$, the equations $x^2+y^2=z^2 \wedge x^4+y^4=z^4$.

B.Sc. Sem-V Paper-M 12 (Optional)

Differential Geometry

By the end of this course, Students will be able to:

- Study curve in space, its parametric representation, curvature of curve.
- Understand the concept of Envelopes, developable surfaces.
- Study curves on a surface, normal curvature.
- study differential equation of Geodesic, Curvature of Geodesic, Gaussian curvatu

1T1-Algebra I and 2T1-Algebra II

After completion of this course, students will be able to classify numbers into number sets. To

combine polynomial by addition or subtraction. To simplify algebraic expressions, using the commutative, associative and distributive properties.

It is the part of foundation for further studies in the field of computer science, cryptology, protection of financial accounts with encrypted codes, scheduling tasks on processors in a heterogeneous multiprocessor computing work, alteration of pattern pieces for precise seam alignment, crystal symmetry in chemistry.

Students after completing above course can think for above options.

1T2-Real Analysis I and 2T2-Real Analysis II

After completion of this course, students will be able to describe fundamental properties of the real numbers that lead to the formal development of real analysis. Construct rigorous mathematical proofs of basic results in real analysis. Appreciate how abstract ideas and methods in mathematical analysis can be applied to important practical problems

It is the part of foundation for further studies in the field of physics, engineering, optimization theory and economic analysis and research.

Students after completing above course work can work in above fields.

1T3-Topology I and 2T3-Topology II

After completion of this course, students will be able to analyze complex networks

Ex: Social networks, Biological networks, Internet etc.

But it is the part of foundation for above studies.

1T4-Linear Algebra and Differential Equations

Students after completing above course is able to do advance course in dynamical systems.

1T5-Integral Equations

Students after completing above course work will be able to do/solve the various problems in engineering sciences by using integral equations.

2T4-Differential Geometry

It is the part of foundation for further studies in the field of computer aided design of mechanical parts and assemblies, terrain modeling, colour balance in a photographic system ,optics for design of a reflector, cryptology, airflow patterns in the respiratory tract.

Students after completing above course have above options.

3T1-Complex Analysis

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

- Justify the need for a Complex Number System and explain how is related to other existing number systems
- Define a function of complex variable and carry out basic mathematical operations with complex numbers.
- know the condition(s) for a complex variable function to be analytic and/or harmonic

- State and prove the Cauchy Riemann Equation and useit to show that a function is analytic.
- Define singularities of a function, know the different types of singularities, and be able to determine the points of singularities of a function
- Explain the concept of transformation in a complexspace (linear and non-linear)and sketch associated diagrams.
- Understand the concept of sequences and series with espect to the complex numbers system and establish whether a given series/ sequences is convergent/divergent at a specified point or interval.

2T5-Classical Mechanics

Students after completing above course work can work in the field of

3T2- Functional Analysis

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

- Explain the fundamental concepts of functional analysis and their role in modern mathematics and applied contexts
- Demonstrate accurate and efficient use of functional analysis techniques.
- Demonstrate capacity for mathematical reasoning through analysing proving and explaining concepts from functional analysis.
- Apply functional analysis technique to diverse situations in physics, engineering and other mathematical context.

3T3-Mathematical Methods

3T5-Operations Research-I and 4T5- Operations Research-II

After studying this course, students will be able to:

- Give an appreciation of strategic importance of operations and supply chain management in a global business environment.
- Understand how an operation relates to other business function.
- Develop a working knowledge of concepts and methods related to designing and managing operations and supply chains.
- Develop a skill set for quality and process improvement.
- Develops how to manage and control the resource allocation.

4T1-Dynamical Systems

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

- Play an important role in modeling virtually every physically technical or biological process
- Assess differential equations widely used in formulating many fundamental laws of physics and chemistry.
- Use the theory to model the behavior of complex systems in economics and biology.

- Differential equations have a remarkable ability to predict the world around us. They can describe exponential growth and decay population growth of species or change in investment return over time.

DEPARTMENT OF STATISTICS
PROGRAMME: B.SC.

Statement of Course Outcomes (COs)

B Sc SEM I – Paper I Probability Theory

The concept of probability is extremely important ,as it has very extensive applications in the development of all physical sciences.

At the end of first semester , the students will be aware of

- Evolution of Theory of Probability
- Different approaches ,different definitions of probability along with their drawbacks
- Various terms used in the theory of probability
- Additive and multiplicative laws of probability
- Various results ie theorems in probability
- Conditional Probability, Bayes theorem ,its applicatons
- Chebyshev's inequality and its importance
- Concept of Random variable ,pmf, pdf, pgf, distribution function,mgf and its uses
- Moments ,measures of location ,dispersion ,skewness and kurtosis

B.Sc. sem-I Statistics paper II (Descriptive Statistics-I):-

Students will learn-

- To collect, tabulate and analyse the different types of data.
- To understand population census and analysis of categorical data.
- The presentation of data using MS-Excel and R-commands.
- To draw different types of diagrams and graphs.

B Sc SEM II – Paper I Probability Distributions

- The syllabus of second semester covers various discrete and Continuous distributions. Therefore at the end of Second Semester , the students will have the knowledge of
- Discrete Distributins such as Bernoulli , Binomial, Poisson, Uniform , Hypergeometric and Geometric ,Negative Binomial with their properties and applications.
- Lack of memory property of Geometric distribution Continuous Distributions such as Uniform , Beta ,Gamma , Normal and their properties

B.Sc. sem-II Statistics paper II (Descriptive Statistics-II):-

Students will learn-

- The concepts of central tendency and location.
- The different concepts and measures of dispersion.
- The different types of partition values and the concepts of skewness and kurtosis
- The concept of bivariate data and correlation coefficient as well as regression.

B.Sc. II year Sem. III, Paper I Statistical Methods

At the end of course the student will be able

Unit I:

- To extend the concept of uni variate distribution to bivariate distribution in case of both discrete and continuous random variables.
- To study the concept of joint distribution and the independence of two random variables.
- To implement the variation and the relation between two random variables by using the concept of covariance and correlation between two random variables.
- To study the practical utility of these topics by solving various numerical problems attached with each concept studied in this unit.

Unit II:

- To implement the basic concepts to bivariate normal distribution and study various properties of bivariate normal distribution.
- To derive the marginal and conditional distributions of the bivariate normal distribution and also study the independence of two random variables.
- To define a tri variate discrete random variable and application of multinomial distribution in various practical situations.
- To study different properties of multinomial distributions such as mean, variance and solve numerical problems based on it.

Unit III:

- To understand the concept of random sample and its sampling distribution.
- To draw samples from various probability distributions such as Binomial, Poisson and Normal distribution etc. .
- To transform variables from one probability distribution to another by using the variable transformation technique in case of both the discrete and continuous random variable.
- To understand the concept of sampling and its transformation in detail by solving various numerical problems based on it.

Unit IV:

- To find the sampling distribution of sum of variables from some probability distributions (Binomial, Poisson and Normal distribution).
- To define and derive the probability density function of exact sampling distributions like chi-square distribution and study its properties.
- To define Student's 't' and Snedecor's F distribution and to derive its different properties such as mean, variance and mode.
- To establish the relationship between various distributions such as relation between chi-square distribution and 'F' distribution, Student's 't' and 'F' distribution etc.

B.Sc Sem III paper II: - Course Outcome:

Students will be able :

- To have detailed knowledge about various types of index numbers related to Economic Statistics.
- To use Consumer Price index for regulation of D.A.
- To apply time series analysis in various fields.

- To apply demand analysis, Pareto's income distribution, Lorenz curve etc.

B.Sc. Part III Semester VI Paper-I :-Operations Research

By the end of this Programme, the students will be able to:

- Understand different concepts of Network Analysis
- Construct Network Diagram
- Draw conclusion from Network using PERT analysis and CPM analysis
- Optimize network using time – cost algorithm
- Understand concept of Duality in LPP, relationship between primal and dual problem and its economic interpretation
- Explain General transportation problem, its LPP formulation
- Solve transportation problem to obtain initial basic feasible solution and optimum solution.
- Understand Assignment problem, its LPP formulation
- Solve Assignment problemto obtain optimum solution.
- Understand basic concepts of Game theory, two person zero sum game and solution of game

B.Sc. Part III Semester VI Paper-II :-Experimental designs

By the end of this Programme, the students will be able to:

- Gain knowledge about theory of linear estimation, analysis of variance (ANOVA).
- Analyse data using various ANOVA techniques and draw conclusions.
- Understand basic principles of designs of experiments.
- Analyse data using various experimental designs CRD, RBD, LSD and draw conclusions.
- Explain factorial experiments, Yates' method to calculate main effects and interaction effects in 2^2 and 2^3 factorial experiments.

B.Sc. Part III Semester V Paper-I :- Statistical Quality Control and Linear Programming Problem

By the end of this Programme, the students will be able to:

- Understand basic concepts ofStatistical Quality Control, causes of variation and Uses of SQC.
- Explain Process and product control
- Use tools of SQC, Draw control charts for mean, standard deviation and range
- Draw conclusion about whether process is in statistical quality control or not.
- Understand Acceptance Sampling concepts, Single and double sampling
- Explain Continuous sampling inspection plans
- Understand the concept of Optimization problem, linear theory of Convex set
- Explain Linear programming problem, General form of LPP and Standard form of an LPP
- Understand concept of Optimum solution of LPP
- Solve Linear Programming problem using Graphical method and Simplex Method

B.Sc. Part III Semester V Paper-II :- Survey Sampling Techniques

By the end of this Programme, the students will be able to:

- Gain knowledge about official statistics ; purpose and functions of CSO, NSSO.
- Understand basic concepts of sample survey, sampling and types of sampling and non sampling errors. They will be able to plan, execute and analyse a sample survey.
- Explain SRSWOR, SRSWR, sampling for proportions.
- Understand concept of stratified sampling, systematic sampling and cluster sampling and compare various sampling techniques.
- Analyse data using various sampling techniques and draw conclusions.

DEPARTMENT OF ZOOLOGY
PROGRAMME: B. SC.

Statement of Course Outcomes (COs)

B.SC. SEMESTER I

Paper – I

Life and Diversity of Animals - Nonchordates (Protozoa to Annelida)

By the end of this program, the students will acquire knowledge and they will understand the:

- General characters and classification of Protozoa, Porifera, Helminthes, Annelida.
- Structure and reproduction of Paramoecium, Plasmodium, Sycon, Obelia, Ascaris, Leech
- life cycle of Plasmodium, Obelia, Ascaris, Taenia solium.
- Parasitic Protozoans of Man- Mode of infection and its control, parasitic adaptations in helminthes.
- Trochophore larva- significance
- Canal system in sponges, corals and coral reef formation, Vermiculture and its importance.

Paper – II

Environmental Biology

By the end of this program, the students will understand the:

- Atmosphere (Hydrosphere, Lithosphere): Major zones and its importance, energy sources, Energy flow in an ecosystem.
- Ecosystem - Definition and types - pond ecosystem, Food chain, food
- web and ecological pyramids.
- Biodiversity and its conservation , causes of reduction , Hot spots in India, Wildlife conservation acts (1972 and 1984), national parks and sanctuaries .
- Sources, effect and control measures - air pollution, water pollution, noise pollution.
- Toxic effects of heavy metals- Bioaccumulation and biomagnifications

PRACTICAL – I

By the end of this programme, the students will be able to

- Study and Classify Life and Diversity of Animals – Nonchordates with the help of museum specimens, permanent slides, diagrams.
- Prepare temporary and permanent slides.
- Estimate DO, free CO2, pH, total hardness of water sample.
- Study of pond ecosystem – analyze plankton quantitatively.
- Observe animals in natural habitat of National park and Sanctuary.

B.Sc. Semester – II

Paper – III

Life and Diversity of Animals – Nonchordates (Arthropoda to Hemichordata)

By the end of this programme, the students will be able to understand

- General characters and classification up to classes: Arthropoda , Mollusca, Echinodermata, Hemichordata

- study the Morphology and anatomy of Cockroach , Pila, Asterias, Balanoglossus.
- Insects as Vectors , Social behavior in honey bees & Pearl formation in Mollusca
- Study the larval forms -crustacea, Mollusca, Echinoderms.
- Affinities of Balanoglossus.

Paper – IV

Cell Biology

By the end of this programme, the students will get knowledge and they will understand the:

- Ultra structure of prokaryotic and eukaryotic cell ,
- structure and function of Cell organelles.
- Oxidative phosphorylation, Glycolysis and Kreb's cycle & Electron Transport Chain and
- terminal oxidation.
- Giant chromosomes: Lamp-brush and polytene chromosome
- Cell cycle and Mitosis ,Meiosis (different phases and significance),
- 6)Cellular ageing and cell death, Elementary idea of cancer and its causative agents.

PRACTICAL – II

By the end of this programme, the students will be able to :

Section A

- Study and classify Life and Diversity of Nonchordates .
- Prepare temporary and permanent slides.

Section B: Cell Biology

- Study the ultra structure of prokaryotic cell & eukaryotic cell .
- observe osmosis in human RBCs , Barr body in blood smear.
- prepare and observe the mitotic cell division in onion root tips , meiosis in Tradescantia bud/ Grasshopper testis by squash method .
- study the salivary gland chromosome in Chironomous larva.
- prepare and observe the mitochondria in buccal epithelium/ lip mucosa .
- Use ocular micrometer to measure micro objects.

B.Sc. Semester – III

Paper – V

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

By the end of this programme, the students will be able to understand

- General characters and classification up to classes: Protochordata, Pisces, Amphibia, & Agnatha
- The Morphology and anatomy of Herdmania, Amphioxus.
- *R*etrogressive metamorphosis of ascidian tadpole of Herdmania.
- Scales of fishes ,origin of paired fins ,migration and accessory respiratory organs and Embryology.
- Parental care and Neotony in Amphibia .
- Frog Embryology & Development of respiratory organs & Aortic arches in frog .

Paper – VI

Genetics

By the end of this programme, the students will be able to understand

- Mendelian Principles& laws.

- Interaction of genes, quantitative genetics & extra nuclear genome .
- Cytoplasmic inheritance, Linkage and crossing over.
- Concepts of genes & Genetic disorders in human.
- Sex determination.
- Gene mutations & Lethal genes.
- Population genetics, Genetic counseling & Applied genetics

PRACTICAL – II

Section A :Life and Diversity of Animals – Chordates (Protochordata to Amphibia)

By the end of this programme, the students will be able to

- Identify, classify and distinguish the characters and adaptive features of animals from Urochordata , Cephalochordata ,Cyclostomata , Pisces & Amphibia .
- Describe Digestive system ,Reproductive system &Brain of locally available culturable Fish.
- Explain the histology of Amphioxus and embryology of Frog from the permanent slides .
- Prepare the permanent stained slide .

Section B : Genetics

- Uunderstand monohybrid and dihybrid ratio
- Study of normal human karyotype (Normal male and female)
- Study characters and karyotypes of Syndromes.
- Study the genetic traits .

B.Sc. Semester IV

Paper - VII

Life and Diversity of Animals – Chordates (Reptilia, Aves and Mammals)

By the end of this programme, the students will be able to

- Identify, classify and distinguish the characters and adaptive features of animals from
- Reptilia, Aves & Mammals.
- understand Poison apparatus, biting mechanism, snake venom and its importance.
- understand Comparison of Ratitae and Caranitae, Flight adaptations and migration .
- understand theories of evolution & genetic basis of evolution.
- understand Adaptations in animals.
- understand Races in Man
- understand Comparative account of aortic arches and heart in Reptiles, Birds and Mammals
- understand embyology of Mammals & chick
- understand Stem cells .
- understand Biological clock : Diurnal and rhythmic behavior in birds and mammals
- understand the Role of pheromones in reproductive behavior

Paper VIII

Molecular Biology and Immunology

By the end of this programme, the students will be able to understand

- Structure & properties of DNA, RNA as genetic material ; DNA replication.
- Recombination in Bacteria.
- Genetic code & Protein synthesis.
- Gene regulation .
- Concepts of immunity, Structure, types and functions of Antigen & Antibody.

- Antigen-antibody interaction .Types of immune response.
- Complement system, Cytokines.
- Autoimmunity and immunodeficiency.

PRACTICAL – IV

Section A : Life and Diversity of Animals – Chordates

(Reptilia, Aves and Mammals)

By the end of this programme, the students will be able to understand

- Identify, classify and distinguish the characters and adaptive features of animals from
- Chordates (Reptilia, Aves and Mammals)
- skeleton of Rabbit and Fowl .
- chick embryology from W.M.
  Filoplume & skin of Bird, Skin of Mammal.

Section B: Molecular Biology and Immunology

Molecular Biology

By the end of this programme, the students will be able to

- perform staining of DNA and RNA from blood smear of various animals.
- understand basic laboratory instruments and equipments.
- 3) perform calculations of Molarity and normality of solutions .
- Isolate Genomic DNA from any available source.

Immunology

- Determine blood groups in humans.
- Perform Antigen – Antibody interaction by double diffusion method (Ouchterlony).
- Study of histological slides of organs of immune system.

B.Sc. Semester V

Paper IX

General Mammalian Physiology

By the end of this program, the students will understand the:

- Importance of vitamins & Enzymes-biocatalyst,
- Glands and hormones associated with digestion.
- and explain the physiology of digestion , respiration, circulation
- Blood pressure, E.C.G. & working of Heart.
- Composition of blood, respiratory pigments in mammals.

Paper X

Applied Zoology

Students will get knowledge and will be able to:

- Establish their own aquaculture unit, aquarium .
- Culture prawn and oyster (for pearl).
- Identify insects pest (agriculture and veterinary).apply ways to control them
- Understand the types of Silkworm, their Life cycle and economic importance.
- Establish their own sericulture , apiculture, lac culture units.

PRACTICAL V

Section A: General Mammalian Physiology - I

Section A: General Mammalian Physiology – I

By the end of this programme, the students will be able to:

- Detect the action of salivary amylase on starch.
- Detect the presence of carbohydrates, proteins, Lipids, Vitamin A and Vitamin C in given sample.
- Measure lung capacity .
- Prepare slide of Haemin crystal.
- Total WBC and RBC count from blood.
- Understand histology of digestive and lungs.

Section B : Applied Zoology –I (Aquaculture and Economic Entomology)

Aquaculture:

By the end of this programme, the students will be able to:

- 1. Collect and identify Freshwater edible fishes & Aquarium fishes .
- 2. explain the digestive, reproductive systems and brain with pituitary of culturable fishes & the Gonosomatic index
- 3. Fabricate and set up own aquarium
- 4. Mount the Scales of fishes, zooplankton .

B.Sc. Semester VI

Paper -XI

General Mammalian Physiology

By the end of this program, the students will receive knowledge and they will be able to understand the:

- E.M. structure ,types of Neurons & conduction of nerve impulse .
- Ultrastructure & properties of striated muscle .
- Muscle contraction- sliding filament theory.
- Structure & function of uriniferous tubule.
- Normal and abnormal constituents of urine, dialysis.
- Structure and functions of endocrine glands.
- Oestrous and menstrual cycle ,male and female sex hormones , Contraceptives .
- Causes of infertility ,In-vitro fertilization.

Paper - XII

Applied Zoology II

(Biotechniques, Microtechnique, Biotechnology, Bioinformatics and Biostatistics)

By the end of this programme students will able to understand :

- Sterilization methods, Separation of biomolecules; Chromatography (Elementary idea) ,Electrophoresis.
- Pprinciples of colorimeter and spectrophotometers.
- The microtechnique procedure.
- Histochemical staining techniques for carbohydrates, proteins and lipids .
- Recombinant DNA technology, application of biotechnology: Insulin and vaccine

production.

- Bioinformatics: Definition, Basic concepts ,importance and its role in life sciences & Bioinformatics databases.
- Biostatistics.

PRACTICAL VI

By the end of this programme, the students will be able

- To detect of urea, albumin, sugar and creatinin from urine .
- To count the sperms from given semen sample .
- To describe the endocrine glands of culturable fishes
- To identify and explain the histology of kidney, endocrine glands, uterus, placenta, nerve fibre, muscles of mammals.
- To separate amino acids by paper chromatography
- To separate proteins by electrophoresis technique
- To develop skill in microtechnique.
- To demonstrate the carbohydrates, proteins and lipids by histochemical methods
- To determine mean, mode, median from a given biostatistical data
- To represent statistical data graphically using computers.

Physiology helps to understand the mechanism or working of body, its systems , its tissues, the cells and the biomolecules .

It helps to understand how homeostasis is maintained in body, in response to changes in environmental factors.

It helps to understand processes of life in healthy and diseased states.

- Bioinformatics is the currently popular term for **the application of computational and analytical methods to biological problems.**
- To study the origin of diseases at molecular level the study of molecular data (i.e DNA, RNA & Proteins), its analysis and interpretation is done with the help of computational biology or bioinformatics .
- The information of gene structure, gene sequence and expression, protein structure and function can then be applied to gene-based drug discovery and development, development of anti microbial agents and vaccines.
- application of bioinformatics programs is very ***useful, easier, and shorter process*** and at much ***lower cost.***

DEPARTMENT OF BOTANY
PROGRAMME: B. SC.

Statements of program me Specific Outcomes (PSOs)

By the end of this course, the students will be able to:

1.Understand the basic concepts of lower group plants and morphology of higher groups.
2.Understand the evolution, Classification ,anatomical details of higher group plants.
3.Analyze the cell organells and application of genetics, molecular biology in plant breeding.
4.Identify the bacteria, viruses and plant pathogen.
5.Analyze metabolic activities of plants.
6.Understand the application of genetic engineering for the improvements of plants.
7.Understand the basic concepts of ecology.
8.perform the procedure of laboratory technique in biochemistry, biotechnology and utilization of plants.

Statements of course outcomes (Cos)

B.Sc.Course:SEM-I Paper -1

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

1.Understand the basic concept of bacteria, virus and mycoplasma.
2.Student will understand types of bacteria, viruses and mycoplasma.
3 Student will able to describe Classification and general characteristic of Algae.
4 Analyze economic importance of bacteria, virus and algae.
5.Student will describe life-cycle of micro organism and Algae.
6.Student differentiated between bacteria and Algae.

B.Sc.Course:SEM-I Paper -2

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

1. Compare lower group of plants with higher.
2. Students understand Fungi ,Lichen, Plant diseases and Bryophytes.
3. Identify the different plant diseases.
4.Understand the Economic importance fungi, lichens and bryophytes.
5.Discuss the classification of fungi and Bryophytes.

B.Sc.Course:SEM-I Lab

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

1.Student will understand working and precaution while handling microscope.
2.Understand the basic technique in lab e.g. Slide preparation and Section cutting.
3.Identify bacterial, cynobacterial ,algal, fungal lichens and Bryophytic plant.
4.Comparative study of lower groups and lower higher groups.
5.Understand and identify the algal, bryophyte, fungal, plant pathology and lichens under natural habitat.

B.Sc.Course:SEM-II Paper-1

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

1.Explain the classification pteridophyta and gymnosperm.

2 Describe the economic importance of pteridophyta and gymnosperm.

3.Discuss the alternation of generation pteridophyta and gymnosperm.

4.Critize the concept of heterospory and seed habit.

5 .Discuss morphology and anatomy of cycadeoidea.

B.sc. course:SEM II Paper -2

Course outcomes: By the end of this course, the students will be able to:

1.Understand the paleobotany and geological time scale.

2.Identify the different type of fossils.

3.Explain the morphology and modification of plants.

4.Compare the types inflorescence and fruits.

5.Desribe the parts of flower.

6.Student will understand the process of fossilization.

7.Student will understand fossil types in the field.

8.Student will describe vegetative and floral parts in scientific language.

9.Students will identify types of root,stem,leaves and flowers.

B.Sc.Course:SEM-II Lab

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

1.Describe the various parts of flower.

2.Identify the anatomy of plants material by making temporary mount.

3.Identify the different types of fossils.

4.Identify various Plant specimen.

5.Understand and Identify the morphological characters of plants in natural environment.

6.Students will understand the structure of *Enigmocarpon* fruit.

2.Students will identify types of roots, stem, leaves, inflorescence, flower and fruits in the field visit.

B.Sc.Course:SEM-III Paper-1

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

1.Describe general taxonomic rule of plant classification.

2.Acquire the basic knowledge of taxonomy.

3.Made aware with local flora.

4.Discuss the principal of botanical nomenclature.

5.Criticize the classification of angiosperms.

6.Justify the merits and demerits of systems of classification.

7.Understand the fossil angiosperm *sahanianthus*

B.Sc.Course:SEM-III Paper-2

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

1.Describe the structure of plant cell and its organelles.

2.Analyze the morphology of chromosome organization.

3.Explain the plant cell-division and its significance.

4.Evaluate the biostatic formulas.

5.Understand the method of plants breeding.

6.structure of typical plant cell and plant membrane.

7.Objectives and application of plant breeding statistical methods used in biology.

B.Sc.Course:SEM-III lab

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

1.Preparation of herbarium.

2.Analyze the floral formula of monocot and dicot families.

3.Perform the procedure of cytological techniques.

4.Analyze the biostatics data.

5.Understand and identify the plants under natural environment.

6.Enriched with fundamental aspects of botany.

B.Sc.Course:SEM-IV paper-1

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

1.Classify the meristimatic and permenant tissue based on origin and position.

2. Compare the different theories of tissue.

3.Understand primary,secondary and anomalous ,anatomical structure of plant parts.

4.Understand the various types of pollination mechanism.

5.Explain the types of ovules.

6.Students will understand double staining technique.

B.Sc.Course:SEM-IV paper-2

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

1.Describe the laws of mendelism.

2.Summarize the theories of linkage.

3.Design and construct the variation in chromosome structure and number.

4.Understand the concept of gene.

5.Discuss the types of mutations and its application in crop –improvement.

B.Sc.Course:SEM-IV Lab

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

1.Perform double-stained permenant slide mounting.

2.Calculate the percent germination of pollen-grains.

3.Solve the Mendel's law of inheritance through color beads.
4.Solve interaction of gens from the given data.

B.Sc.Course:SEM-V Paper-1

Course Outcomes: By the end of this course,the students will be able to:
1.Classify and describe about bimolecular.
2.Describe about the basic of enzymes.
3.Understand plant water relation.Write about mineral nutrients.
4.Summerize the cycle of respiration and photosynthesis.

B.Sc.Course:SEM-V Paper-2

Course Outcomes: By the end of this course,the students will be able to:
1.Define and explain about ecology branches and its significance.
2.Summarize the environmental factors.
3.Understand and explain the nitrogen cycle.
4.Compare the various Phytogeographic regions of india.
5.Describe the types of ecosystem.
6.Student will explain the effect of climatic factors on vegetation.
7.Students will understand food chain,food web and ecological pyramids.

B.Sc.Course:SEM-V Lab

Course Outcomes: By the end of this course,the students will be able to:
1.Perform major and minor physiology experiment.
2.Perform micro-chemical and bio-chemical test.
3.Understand ecological adaptations of plants.
4.Compare different types of soil.
5.students able to measure the water holding capacity and moisture content.

B.Sc.Course:SEM-VI Paper-1

Course Outcomes: By the end of this course,the students will be able to:
1.Describe the plant growth and its growth regulators.
2.Describe the seed –dormancy.
3.Describe the plant-defense and role of secondary metabolites.
4.Discuss plant tissue culture technique and its application.
5.Discuss the advantages and disadvantages of genetic-engineering.

B.Sc.Course:SEM-VI Paper-2

Course Outcomes: By the end of this course,the students will be able to:
1.Compare the various ecological successions.
2.Explain different types of environmental pollution and its management.
3.Understand about the renewable and non-renewable natural sources.

4.Analyze the principal,types and application of instruments.
5.Explain morphology utilization and chemical-constituents of different plants.

B.Sc.Course:SEM-VI lab

Course Outcomes: By the end of this course, the students will be able to:
1.perform principles and working of instruments.
2.Study and identity the types and Characteristic of soil.
3.Study the physical and chemical properties of water.
4.Study the plants of ethnobotanical importance.
5.Understand and identify ethno-botanical plants under natural habitat.

DEPARTMENT OF BOTANY
PROGRAMME: M. SC.

Statements of Programme Specific Outcomes (PSOs)

By the end of this course, the students will be able to:

1. Learn about practical technique in lab for detail study of plant cell structure, reproduction, anatomy, breeding procedures for hybridization
2. To utilize the knowledge of mycology and plant pathology to satisfy the need of farmers
3. Procure the knowledge of importance of plant to human being and all organisms.
4. Prepare the students for many competitive exams like MPSC, UPSC NET SET GATE
5. Enable the students to be resourceful in identifying the plants.

Statements of Course Outcomes (COs)

MSc I Course: SEM-1 Core 1((1T1)

By the end of this course, the students will be able to:

1. Understand the structure, function of virtues and bacteria
2. Describe the life cycle, structure and functions of algae
3. Students will classify and describe the life, cycle, structure and function of fungi around them.
4. Comparative study of different fungi with special reference to diseases in crop plant and symptoms of fungal diseases.
5. Identify algae and fungi in their natural habitat on the basis of characters
6. Develop the cultures of algae and fungi.

MSc I Course: SEM-I paper II (1T2)

By the end of this course, the students will be able to:

1. Understand the structure and life cycle of different bryophytes
2. Identify the members of Hepatocopsida and Bryopsida
3. Study of evolutionary trends of Sphenopsida and filicopsida
4. Study of distribution and classification of rhyniopsida, psilopsida and Lycopsida
5. Identify bryophyte and pteridophyte material for specimens

MSc I Course: SEM-I paper III (1T3)

By the end of this course, the students will be able to:

1. Study the different types of fossils of extinct plants/ flora
2. Study the origin of gymnosperm by living fossil genera.
3. Study the evolutionary affinity between cordiattes, caytonicles and pentoxylales.
4. Study of living gymnosperm and fossil forms.
5. Identify fossil and living form of gymanosperm.

MSc I Course: SEM-I paper IV (1T4)

By the end of this course, the students will be able to:

1. Study Mendelian law including incomplete dominance, penetrance , expressivity in Drosophila

2. Explain the study of chromatin organization, karyotype analysis
3. Discuss the breeding behavior of duplicator, deficiency, inversion and translocator.
4. Detail study of spontaneous and indeed mutation of chromosomes on the basis of karyotype
5. Gain knowledge about actual mutations happens in plants.

MSc I Course: SEM-I Practical-I (1P1)

By the end of this course, the students will be able to:

1. Identify cyanobacteria and algae
2. Prepare and identify the fungal culture
3. Identify bryophytes and plant disease
4. Identify fungi and bryophytes

MSc I Course: SEM-I Practical-II (1P2)

By the end of this course, the students will be able to:

1. Identify pteridophyte and gymnosperm material
2. Study the anatomical preparation of pteridophyte and gymnosperm.
3. Describe the fossil specimens
4. Perform the experiments on cytology and genetics
5. Prepare the botanical excursion report.

MSc I Course: SEM-II paper I (2T1)

By the end of this course, the students will be able to:

1. Students will understand how the process of photosynthesis feed all organism and balancing Co_2 and O_2 ratio.
2. Explain the mechanism of growth hormones, auxin, gibberellins.
3. Classify enzymes and regulation of their activity
4. Compare the structure and function of carbohydrate lipid and protein metabolism

MSc I Course: SEM-II paper II (2T2)

By the end of this course, the students will be able to:

1. Understand photo morphogenesis and seedling development
2. Evaluate the root developments, flower development in plants
3. Study the reproduction in plants with the help of male female gametophyte
4. Study of microsporogenesis and megasporogenesis.
5. Understand pollen-pistil interacting and seed development.

MSc I Course: SEM-II paper III (2T3)

By the end of this course, the students will be able to:

1. Describe cell wall, plasma membrane and plasmodesmata
2. Understand cell organelles Golgi complex, lysosomes, peroxysomes etc
3. Study the nucleus-ultra structure and function
4. Study the stress biology, biotic and abiotic stress

5. Correlate the theoretical description of cell components with microscopic ultra structures.

MSc I Course: SEM-II paper IV (2T4)

By the end of this course, the students will be able to:

1. Study of floral symmetry of dicot and monocot flowers.
2. Discuss about the principles of taxonomy and major system of plant classification.
3. Understand anatomy, embryology, palynology and photochemistry.
4. Discuss the principles of biosystematics numerical taxonomy.
5. Collect the ethno botanical museum specimens.

MSc I Course: SEM-II Practical- I (2P1)

By the end of this course, the students will be able to:

1. Perform the experiments on photosynthesis, respiration and growth of plants
2. Identify amount of metabolic-protein, amino acids, fat, carbohydrate, present in plants
3. Classify different kind of cytohistological zonation of shoot and root meristem
4. Understand the process of micro and megasporogenesis
5. Understand physiological effects of temperature, humidity, CO_2 level on plants.

MSc I Course: SEM-II Practical-II (2P2)

By the end of this course, the students will be able to:

1. Study the salivary gland chromosome of chiranomas larva
2. Isolate DNA and prepare cot curve
3. Study the different families of dicot
4. Prepare cardiogram of different species of Ficus
5. Collect the different types of inflorescence and fruits
6. Collect the museum specimens of morphology of plants

MSc II Course: SEM-III paper I (3T1)

By the end of this course, the students will be able to:

1. Understand the concept of community and vegetable development and succession
2. Organize the ecosystem and mechanism of biogeochemical cycle
3. Students will differentiate hydrophytes, mesophytes, and xerophytes and discussing the concept of ecosystem stability.
4. Know about IUCN, red data book, sanctuaries, national park
5. Study of topography of an area and sampling of plant community by quadrate method.
6. Study of composition of wetlands and mangroves.

MSc II Course: SEM-III paper II (3T2)

By the end of this course, the students will be able to:

1. Study of taxonomic classification- croquets (1968)
2. Study of systematic position of Alismatidae, commeliadae, Asteraceae and

Lemnaceae

3. Explain the fossil angiosperm and global Biodiversity
4. Study of socio-economic importance of diversity of plants
5. Collect the herbarium specimens
6. Collect the morphological specimens- cones, flowers, fruits and seeds etc.

MSc II Course: SEM-III paper III (3T3)

3T3 -Core Elective I : (Palaeobotany –I)

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

1) Understand the science of petrology.
2) Understand geological time scale and type of fossil preservation its age determination and technique to study them.
3) Details of early land plant.
4) Understand the concept of plant of Devonian, Carboniferous and its concept.
5) Know the origin and evolutionary consideration of Sphenopsida, Filicopsida and Ferns.

3T3 & 4T3 -Core Elective I & II : (Algae-I & II)

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

1) Describe the lifecycle structure and functions of algae.
2) Comparative study of different algae with special reference to evolution.
3) Identify algae in their natural habitat.
4) Develop the culture of algae.
5) Able to know the importance of algae.

3T3 & 4T3 -Core Elective I & II : (Palynology-I & II)

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

1) Gained the knowledge of reproductive parts of plant and embryological aspects. In addition students has learned palynotaxonomy, palynophysiology, pollination biology, pollen biotechnology, melissopalynology / bee biology with its applications in conservation of bee flora, exploration of pollen/ nectar sources of honey bees, enhancing honey production and various economic and medicinal uses of honey and bee pollen palaeopalynology particularly its role in coal and oil exploration , aerobiology & allergy, forensic palynology with stating role of this subject in solving criminal problems.
2) Learn the wonderful science of pollen and its importance to people, scientists, and academicians in biology, biotechnology agriculture, pharmacy, law and medical sciences through basic and applied aspects of the subject.

MSc II Course: SEM III paper IV (3T4)

By the end of this course, the students will be able to:

1. Introduce to Aesthetic botany in syllabus to study phytogeography and forest types in India
2. Understand the technique of grafting, budding, industrial gardening, terrace gardening etc.
3. Develop nurseries and other management for cultivation of flowers
4. Design landscape in commercial, residential bungalows
5. Develop the technique to set up playhouses and ornamental succulents.

MSc II Course: SEM-III Practical-I (3P1)

By the end of this course, the students will be able to:

1. Study of frequency, abundance and density by quadrate method
2. Study of statistical problems based o biometry
3. Identify morphological and floral characters of different plants
4. Use of generic key and species key for plant
5. Collect the herbarium specimens for herbarium record in the department for UG and PG students.

MSc II Course: SEM-III Practical-II (3P2)

By the end of this course, the students will be able to:

1. Identify the Algae from the culture.
2. Identify the macronutrient content of algae.
3. Estimation of chlorophyll, carbohydrates, amino acids.
4. Develop the skills for drawing camera Lucida diagrams of algae.

M. Sc. Sem-III Palaeobotany Practical (3P2)

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

1. Understand the stratigraphical and geological maps of India.
2. Different techniques of fossil study.
3. Plant fossils of Pteridophytes, Gymnosperms and Angiosperms.
4. Field visit gives the knowledge of types of preservation.

MSc II Course: SEM-IV paper I (4T1)

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

1. Students will understand and compare the process of protein synthesis in prokaryotes and eukaryotes.
2. Students will perceive structure and functions of sub cellular components.
3. Understand the mechanism of gene mapping and genetic recombination.
4. Students will draw cell cycle-mitosis and meiosis.
5. Understand signal transduction, sensor, regulator system in bacteria and plants.

MSc II Course: SEM-IV paper II (4T2)

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

1. Understand the application of DNA recombination technology in genetic engineering
2. Discuss about polymerase chain reaction and DNA fingerprinting
3. Describe detail of tissue culture technique and its application
4. Study bioinformatics, data base sequences DNA nomenclature and taxonomy database
5. Study methods of plant breeding technique
6. Study the technique of hybridization.

M. Sc. Sem-IV Palaeobotany Paper- XV (4T3)

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

1. Understand the origin of Progymnospermopsida.

2. Heterospory and evolution of seed habit.
3. Phylogeny and diversification in primilini gymnosperm.
4. Understand the age formation and floristic composition of Deccan intertraps.
5. Importance of Paleo-palynology and Indian Gondwana.

MSc II Course: SEM-IV paper IV Centric Plant Resources (4T4)

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

1. Study Fiber, gum, resin, timber, spice and condiments plants.
2. Study of medicinal plants anatomy and evaluation of herbal drugs
3. Study of structure of alkaloids, terpenoids, steroids, glycoside etc.
4. Study of preparation of dyes, paper, tea, coffee and coca etc.
5. Study of rubber industry and its product
6. Identify the medicinal plants and collect them during the botanical tour.

MSc I Course: SEM-IV Practical-I (4P1)

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

1. Students will understand the technique of SDS-PAGE and ELISA.
2. Perform the experiment on restriction digestion of DNA
3. Study of media for plants tissue culture
4. Study of oil, rubber, medicinal plants, dyes etc.
5. Identify medicinal and economical plants.
6. Students will understand the concept of conjugation in bacteria.
7. Students will prepare gene maps on the basis of cross over data.

MSc I Course: SEM-IV Practical-II Project (4 PROJ 1)

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

1. Learn different techniques of research used in anlaysis.
2. Perpare ppt presentation.
3. Improve presentation skill and teaching communication skill.