

**TAMIL NADU PUBLIC SERVICE COMMISSION**

**BIOLOGY (PG DEGREE STANDARD)**

**Code No.227**

**FOR THE POST OF JUNIOR SCIENTIFIC OFFICER**

**UNIT-I**

General classification and salient features of Invertebrata and vertebrata – Metamorphosis and regeneration in lower forms of animal – Economic importance of oyster, honey bee, Silkworm – Agricultural pests and their control – Larval forms of crustacean and Echinodermata - Classification and identification of poisonous and nonpoisonous snakes and types of snake venom. Evolution: Theories, types and factors influencing evolution Evidences of human evolution – Human genetics: Pedigree analysis, lod score for linkage testing, Karyotyping, Significance of human genome project.

**UNIT-II**

Structural organization and importance of animal cells - Muscle cells – Cardiac, Striated and non-striated muscle cells– Hepatocytes, Neurons, Nephrons, Keratocytes, immune and endocrine cells. Functions of hormones and their receptors – Impact of sex hormones in human behavior. Chronobiology: importance of circadian rhythm and human biological clock – DNA analysis in paternity testing – Cell counting of WBC and RBC. Functions and disorders of Digestive, Respiratory, Cardiovascular Nervous, Muscular, Excretory, Reproductive and Integumentary systems. Developmental biology: production of sperm and egg, Fertilization – Zygote, Cleavage. Blastulation, gastrulation and formation of germ layers in animals and organogenesis – determination of sex by Amniocentesis. Entomology: Insect classification – Beneficial and harmful insects – Role of insects in decomposition of decayed materials – Exploiting insect olfaction in forensic studies – Importance of ants, blowflies and beetles in forensic investigation.

**UNIT – III**

**Fundamentals of Anthropology**

Meaning – Scope and branches of Anthropology – Basic concepts / principles of Physical or Biological Anthropology – Anthropology and its relation with other Social, Biological and Medical Sciences – Analysis of kinship – Health and Ethno medicine – Population dynamics with special

reference to Tamil Nadu – Applied and developmental Anthropology – Tribal, Rural and Urban Communities

Research Methodology- Anthropological research – Fieldwork Tradition, Methods and Techniques, Qualitative and Quantitative research Methods, Observation, Case study, Ethnography, Life histories and Personal documents, Visual Anthropology, Genealogical Methods.

#### **UNIT – IV**

##### **Physical / Biological Anthropology**

Position of human being in the animal kingdom – Human Evolution - Theories of human evaluation, Human growth and development – Factors affecting for growth, Demographic growth variation, Sex and Gender – Bio-cultural dimensions, Race and Ethnicity - Major racial groups of India, Ethnicity and contemporary relevance – Applied physical anthropology - Anthropometry and its uses, DNA Technology, genetic diseases, Forensic Anthropology and criminal investigations.

#### **UNIT-V**

##### **Chemistry of Biomolecules**

**Carbohydrates** – Structure and functions [Mono, Di & Polysaccharides] – Disorders of Carbohydrate Metabolism and its laboratory diagnosis.

**Proteins and Amino acids** – Types, structure and function.

**Lipids** – Types structure and functions. Sterols –Cholesterol. Disorders of lipid metabolism and its laboratory diagnosis.

**Nucleic acid** – DNA – Types, structure and functions  
RNA – Types, structure and functions

**Enzymes** – Classification and properties of enzymes, Coenzymes, Marker enzymes

**Hormones**- Classes and functions of hormones

#### **UNIT-VI**

##### **Biochemical and Molecular Techniques**

Blood and its composition – WBC, RBC and Platelets. Blood clotting, Blood grouping, Cross matching and compatibility tests, Blood smear analysis, HLA typing.

Antigens and Immunoglobins – Classes and functions.

Collection and Preservation of Biological fluids [Blood, Urine, CSF, Amniotic fluid, Semen, Sputum and Saliva]. Normal and Abnormal constituents of Biological fluids.

Isolation of DNA from blood sample, Agarose gel Electrophoresis, PCR, DNA Sequencing, RAPD, RFLP, DNA Finger printing -STR Typing.

Isolation of Proteins from blood sample, SDS PAGE, RIA, ELISA, FISH.

Ames test, Comet Assay.

## **UNIT- VII**

Origin of Microbiology, Contribution of Louis Pasteur, Alexander Flemming, Waksman, Robert Koch. Microscopy; Brightfield, Phase contrast, Fluorescent, Electron Microscopy and Confocal Microscopy. Staining techniques.

Cultivation of Microorganisms, Preparation of culture media, Sterilization techniques, Preservation techniques, Identification of Microorganisms; Conventional and Molecular techniques.

Host parasite interaction, Microbial diseases, Nosocomial infection, Zoonotic diseases, Food borne diseases, Microbial diseases of medical negligence. Bioterrorism and Biohazards.

## **UNIT- VIII**

DNA profiling, Genetic code, Mutation and DNA polymorphism, Microbial nanotechnology, Infectomics.

Biodeterioration of fibres and leather, Bioremediation, Bioconversion - Biogas technology, Environmental microbiology - Microbiology of air, water and soil. Role of microbes in production of fermentation products.

Production of antibiotics, Enzymes, Pigments, Insulin, Interferon, Monoclonal antibodies and Growth Hormones. Recombinants DNA technology.

Microbial biofertilizers, Microbial biopesticides and Microbial degradation of synthetic pesticides.

## **UNIT – IX**

Plant Diversity, Cell Biology – Taxonomy and Paleo botany, Plant Physiology Plant biochemistry, Plant pathology

**Plant Diversity** – Algae, Fungi, Bryophyte, pteridophytes, Gymnosperms, lichen.

**Cell Biology** – Cell structure and functions

**Taxonomy**– Principals of Taxonomy and phylogeny of angiosperms, Nomenclature of plants, Monocotyledons and dicotyledons

**Paleo botany** – Fossil plants

**Plant Physiology and Plant biochemistry** – Ezymes, Protein, Aminoacid and photo synthesis, respiration

**Plant pathology** – Bacterial, Fungal and Viral Diseases of Plants.

## **UNIT- X**

Plant Anatomy, Embryology, Genetics, Economic Botany, Ethnobotany, Environmental Botany

**Plant Anatomy** – Cell cycle, Cell division, Tissue system and secondary growth, Fruit wall and seed coat.

**Embryology** – Embryogenesis, Polyembryony, Double fertilization, Somatic Embryogenesis and Pollen grains.

**Genetics** – Mendelism, Linkage, crossing-over, chromosome mapping, RAPD and RFLP Techniques.

**Economic Botany** – Wood and Wood products, Fatty Oils and Vegetable Oils. Tannins and Dyes.

**Ethnobotany** – Ethno Medicinal Plants, Narcotic Plants.

**Environmental Botany** – Plant adaptations, Hydrophytes, Xerophytes, Mesophytes, Epiphytes, Halophytes and Mangrove vegetation. Ecological Indicators, Forest and Forest Management.



**TAMIL NADU PUBLIC SERVICE COMMISSION****CHEMISTRY (PG DEGREE STANDARD)****Code No.228****FOR THE POST OF JUNIOR SCIENTIFIC OFFICER**

**Unit – I : Quantum Chemistry** :Quantum mechanical postulates – Eigen value and function – the Schrodinger wave equation – elementary applications of Schrodinger's equation – the particle in a box (one, two and three dimensional cases) – particle in a ring. The harmonic oscillator –the rigid rotor – the hydrogen atom – the Schrodinger equation for hydrogen atom – angular momentum – term symbols – Approximation methods – perturbation and variation method – application to hydrogen and helium atoms – R.S. coupling and term symbols for atoms in the ground state – Slater orbital and HF – SCF methods Born open – Heimer approximation – valence bond theory for hydrogen molecule – LACO – MO theory for di and polyatomic molecules – concept of hybridization – Huckel theory for conjugated molecules (ethylene butadiene and benzene) – semi empirical methods.

**Unit – II: Chemical Kinetics and Thermodynamics:** Rate laws – rate constant for first, second, third and zero order reaction – Half life period Temperature dependence on rate – Arrhenius theory – collision theory – Absolute reaction rate theory – ionic reaction – salt effect – catalysis – Laws of photo chemistry, quantum efficiency - photo physical processes of electronic excited molecules.

Partial molar properties – Chemical Potential – Partial molar volume and molar heat content – significance and determination – Thermodynamics of real gases - gas mixture – fugacity definition – determination of fugacity variation of fugacity with temperature and pressure – concept of thermodynamic probability – distribution of distinguishable and non – distinguishable particles. Maxwell – Boltzmann, Fermi-Dirac and Bose Einstein statistics – modes of contribution to energy – partition function – translational, vibrational and rotational partition functions for mono, diatomic and polyatomic ideal gases.

**Unit – III : Nuclear Chemistry** : Nuclear properties –nuclear spin and moments, origin of nuclear forces, salient features of liquid drop and shell models. Types of radioactive decay: Orbital electron capture, nuclear isomerism, internal conversion, detection and

determination of activity by cloud chamber, nuclear emulsion, bubble chamber, G.M., Scintillation and Cherenkov counters; Accelerators – Linear and Cyclotron. Nuclear reaction: Types, reaction cross section, Q-value, threshold energy, compound nucleus theory: nuclear fission and fusion reactions as energy sources: photonuclear and thermo nuclear reactions. Components of nuclear reactor – the fast breeder reactor – nuclear reactors in India. Radioactive tracer – principles of tracer technique – application of tracers in the study of reaction mechanism and in analytical chemistry – neutron activation analysis, isotope dilution analysis – radio chemical determination of age of geological specimen. Tracers as applied to industry and agriculture – radioactive tracer in the diagnosis and treatment in the field of medicine.

**Unit- IV: Electrochemistry** : Mean ionic activity and activity coefficient: concept of ionic strength, Debye-Huckel theory of strong electrolytes – activity coefficient of strong electrolytes-determination – Debye Huckel limiting law at appreciable concentration of electrolytes – Debye Huckel Bronsted equation – qualitative and quantitative verification.  $pH$  &  $pK_a$  of acids and bases – determents and buffer actions conductometric and potentiometric tirations Mechanism of electrode reaction – polarization and overpotential. Corrosion and passivation of metals: Pourbaix and Evans diagrams – fuel cells – electrodeposition – principle, applications and anticorrosion techniques.

### **Unit – V : Spectroscopy**

Electromagnetic radiations and quantization of energy: Rotational spectra of diatomic molecules – isotopic substitution and rotational constants – vibrations spectra of linear symmetric, linear asymmetric and bent tri atomic molecules – electronic spectra – selection rules – nuclear magnetic resonance – chemical shifts – spin – spin coupling – election spin resonance and hyperfine splitting theoretical principles of mass spectroscopy. Application's of UV, IR, NMR, ESR and mass spectroscopy for structural elucidation of organic compounds, inorganic complexes and free radicals.

### **Unit – VI : Organometallic compounds, Bio inorganic chemistry and Polymers:**

Metal carbonyls, Metal nitrosyls, metal alkyl, alkenes and arene compounds – organic metallic compounds in catalysis – Chemistry of porphyrins – chlorophyll hemoglobin, myoglobin, ferredoxin, rubredoxin and cytochromes.

Preparation and uses of polyethylene and uses of polyethylene, poly butylenes PVC, Nylon – Ziegler – Natta catalysts – Inorganic Polymers such as silicones, Borazines and phosphonitrilic compounds.

**Unit – VII : Organic reaction mechanism and Stereochemistry:** General methods of reaction mechanisms (Kinetic and non kinetic)  $S_N1$ ,  $S_N2$  mechanisms – addition substitution, elimination and rearrangements – free radical mechanism – aromatic substitution – formation and stability of reactive intermediates – The arenium ion mechanism. Orientation and reactivity (ortho, meta and para directing groups). Typical reactions to be studied – nitration, halogenations, alkylation, acylation and diazonium coupling. Formylation – Gatterman, Gatterman-Koch, Vilsmeier-Hack & Reimer-Tiemann, Ziegler alkylation, Chichibabin, Aldol condensation – Claisen condensation – Perkin, Cannizzaro, Friedel Craft, Favorski, Stork enamine – Michael addition – Baeyer – Villiger – Chichibabin. Pericyclic reactions – classification and examples Woodward and Hoffmann rules – use of  $OsO_4$ , diborane,  $NaBH_4$ ,  $LiAlH_4$  in organic synthesis. Photo Chemistry of ketones, photo oxygenation, photo reduction, photocycloaddition, Paterno - Buchi reaction, Di-pi-methane rearrangement. Cis-trans isomerisation, Barton reaction and photo-Fries reaction.

Elements of symmetry – optical and geometric isomerism E,Z and R,S notation's – Conformational analysis simple cyclic and acyclic systems – Effects of conformation on reactivity in acyclic compounds and cyclohexanes. Relative stabilities of cis – trans isomers.

**Unit – VIII: Natural Products and Drugs :** Carbohydrates - Classification – configuration and general reactions of monosaccharides – Chemistry of glucose, fructose, sucrose and maltose, important compounds in Chemistry – Dyes – azo triphenylmethane and phthalin groups – indigo – alizarin vitamins, hormones, proteins – structural determination –Terpenoids – classification, isolation, general properties of citral,  $\alpha$ -Terpineol, menthol, camphor.

Alkaloids and Flavonoids – Nomenclature and classification general properties – colour reactions, structure for Nicotine, atropine, cocaine, quinine, morphine and Heroin.

Drugs: Pharmacological actions, therapeutic uses and screening tests of the following drugs – opium alkaloids – morphine, heroin, antibiotics – synthetic analgesics – pethidine, methadone – barbiturates – tranquilizers – phenothiazines, meprobamate, diazepam – stimulants – amphetamines, imipramines – hallucinogens – cannabinoids, LSD – hypnosis and sedatives – antipyretics, analgesic, antiseptics and disinfectants – Alcohol - manufacture of ethyl alcohol and liquors – constituents of liquors – estimation of alcohol contents in liquors – denaturation, denaturants, industrial alcohol and power alcohol.

**Unit - IX : Poisons and Pesticides :** Definition of poisons – Mode of action of poisons – Extraction and purification of poisons in toxicological analysis – Volatile poisons – metallic poisons – non-volatile organic poisons – water soluble compounds – protein precipitation methods. Estimation of the following poisons – Carbon monoxide, cyanide, formaldehyde, methanol, chloral, chloroform, phenols, cresols, phosphorus and amphetamines - Signs and symptoms of  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ ,  $\text{CO}_2$ ,  $\text{H}_2\text{S}$  poisoning. Analytical methods for the estimation of ethyl alcohol. Metallic poison – signs, symptoms of arsenic, mercury, lead and copper – Reinch test - Marsh Berzelius and Gutzeit tests – volumetric, colorimetric and instrumental methods of analysis of the above metals. Pesticides & Insecticides – Definition – general properties poisonous nature – detection & isolation.

**Unit – X : Analytical Chemistry and Instrumental methods:** Significant figures – precision & accuracy – Errors - minimizing methods – estimation of errors – rejection of observation.

Absorption, partition chromatography – Gas Chromatography – HPLC – Solvent extraction and ion exchange methods – atomic absorption spectroscopy – Electron analytical techniques voltammetry, cyclic voltammetry, polarography, amperometry, Coulmetry and conductometry, ion-Selective electrodes – TGA, DTA and DSC.

**TAMIL NADU PUBLIC SERVICE COMMISSION**

**FORENSIC SCIENCE (PG DEGREE STANDARD)**

**Code No.226**

**FOR THE POST OF JUNIOR SCIENTIFIC OFFICER**

**UNIT I**

Forensic Science - Definition - Development of Forensic science in India - Organization and functions of Forensic laboratory

**UNIT II**

Physical evidences - their classification and significance - Locard's Principle of exchange-class and individual characteristics.

Crime Scene examinations - documentation of crime scene- recognition, collection, preservation and transportation of physical evidence for laboratory examinations.

Fundamentals of photography - crime scene photography

**UNIT -III**

Foot and tyre impressions - Walking pattern - Recording and examination of foot prints and tyre prints.

Finger prints - Fundamental principles - Finger print patterns - classification of finger prints - methods of developments of latent finger prints.

**UNIT IV**

Tool marks - identification - restoration of filed off/erased marks - Detection of counterfeit coins and currency.

Fire arms, Bullet and cartridge case identification - pellets and wads - Range of firing.

**UNIT V**

Fire and arson - Natural fires - Arson - Accelerants - Combustible properties of flammable substances.

Explosives - Classification of explosive substances - Combustion, detonation and explosion - Effects of explosion - Military and industrial explosives - Improvised explosive devices - Explosive residues - Residues examination.

**UNIT VI**

Questioned documents, identification of hand writing, type writer and forged signatures - Erasures and alterations on documents and their detection

**UNIT VII**

Broken glass - glass fractures - direction of force - backward fragmentation - comparison of glass fragments.

Forensic examination of soil and paints,

Theory and practice of polygraph and voice identification

## UNIT VIII

Toxicology - classification and mode of action of poisons - narcotic drugs - alcoholic beverages - isolation and identification of poisons, drugs and alcohol

## UNIT IX

Examination of biological fluids - blood, seminal and saliva stains - forensic characterization of the above stains - stain patterns of the blood, Examination of fibres, hair, bones, teeth and skull - Fundamental of DNA typing.

## UNIT X

Instrumental methods of organic analysis - principles of chromatography, spectrophotometry, and mass spectrometry.

Instrumental methods of inorganic analysis - Principles of emission and atomic absorption spectra - X-ray diffraction - Neutron activation analysis.



**TAMIL NADU PUBLIC SERVICE COMMISSION**

**PHYSICS (PG DEGREE STANDARD)**

**Code No.229**

**FOR THE POST OF JUNIOR SCIENTIFIC OFFICER**

**1. UNIT-I MECHANICS – RELATIVITY AND SPACE PHYSICS:-**

Impulse – Impact – Laws of Impact – Direct impact and Oblique impact between two smooth Spheres – Loss of Kinetic theory – Motion of two interacting bodies – Reduced mass – Rigid body dynamics

**RELATIVITY:** Postulates of Special Theory of relativity – Lorentz transformation Equations and its Consequences – Relativity of Simultaneity - Mass Energy Equivalence

**SPACE PHYSICS:** Escape Velocity – Orbital Velocity – Geo Stationary Orbits and Satellite Communication – Remote Sensing.

**2. UNIT-II CLASSICAL MECHANICS:-**

Generalised Co-ordinates – D'Alembert's Principle - Lagrangian Equations and its applications – Hamilton's Equations from Variation Principle – Principle of Least Action – Canonical Transformations and its applications – Hamilton – Jacobi Theory – Action Angle Variable – Kepler's Problem – Theory of Small Oscillations – Eulerian Angles, Euler's Theorem – Coriolis force – Euler Equations of motion.

**3. UNIT-III THERMODYNAMICS – STATISTICAL MECHANICS:-**

Laws of thermodynamics – Entropy – Thermodynamic potentials – Maxwell's equations and its applications Gibbs phase rule – Phase transition – Vanderwaal's equation of State.

**CLASSICAL STATISTICS:** Micro and Macro States – Liouville's theorem – Micro Canonical and grand Canonical ensembles – partition function Gibbs Paradox.

**QUANTUM STATISTICS:** Maxwell's distribution – BE Statistics – Black body radiation – Planck's Radiation Law – FD Statistics – Applications

#### **4. UNIT- IV OPTICS – ATOMIC AND MOLECULAR SPECTROSCOPY:-**

Basic ideas of Interference, Diffraction and Polarisation – Principle of LASER and its applications – Coupling Schemes – Zeeman effect – Paschen – Back effect – Spectra Structure of atomic molecules – Rotation, Vibration and Rotation – Vibration Spectra Frank – Condon principle – Microwave, IR, RAMAN, Mossbauer, NMR, NQR and ESR Spectroscopy – Principle, technique and applications.

#### **5. UNIT-V SOLID STATE AND NUCLEAR PHYSICS:-**

Crystal Classes and Systems – 2D, 3D Lattices – Lattice heat capacity X-rays – X-ray diffraction – Uses – Band theory of Solids – Fermi level – Superconductivity – Basic concepts – application of Super Conductors. Different types of magnetic materials.

Nucleus – Properties and Structure – Nuclear forces – Binding energy – Radioactive decays – Particle detectors and accelerators – Nuclear fission and fusion – Elementary particles – Cosmic Rays

#### **6. UNIT-VI QUANTUM MECHANICS:-**

Basic formalism – Schroedinger time dependent and time independent equations – eigen values and eigen functions – uncertainty principle – Hilbert space - Dirac notation – Schroedinger and Heisenberg interaction picture – WKB Quantisation rule – Time dependent perturbation theory – Fermi golden rule – Born and Sudden approximations – Dirac's relativistic equation – Dirac's equation for a central field – Spin angular momentum – negative energy states.

#### **7. UNIT-VII ELECTRO MAGNETIC THEORY:-**

Gauss Law – Laplace and Poisson equations – Biot and Savart Law – Ampere Law – Faraday's Laws of induction – Maxwell's Equations – Molecular Polarisability and electrical susceptibility – Lorentz force – Equation of Continuity – Propagation of EM Waves in non conducting and conducting medium – reflection and refraction at a plane interface between dielectrics – Radiation from a localised source – oscillating electric dipole.



## **8. UNIT-VIII ELECTRONIC DEVICES AND APPLICATIONS:-**

Semi Conductor diode and Transistor – Optoelectronic devices – photo diode, photo transistor, LDR, LED, LCD, Special Semi conductor devices – JFET, MOSFET, UJT, SCR – Characteristics and applications – Operational amplifier Characteristics and applications – 555 timer – Block diagram and working.

Electrodes and transducers used in ECG and EEG techniques – ultrasound Scan – Basic ideas of CT and MRI Scan.

## **9. UNIT-IX DIGITAL ELECTRONICS AND MICROPROCESSOR:-**

Logic gates – half and full adder and subtractors – Parellel binary adder – 8421 adder – karnaugh map –NAND – NOR networks – flipflops – counters and shift registers - Architecture of 8085 – Addressing models – Instruction set – Programming techniques – Semiconductor memory types – RAMS and ROMS – Interfacing of memory devices and I/o Ports.

## **10. UNIT- X COMMUNICATION ELECTRONICS:-**

Directional high frequency antennas – Sky wave propagation – Ground wave propagation – Modulation and demodulation techniques – Principle of radio communication – AM and FM transmission – RADAR Principle and equation – Television transmission and reception – Fibre optics – Propagation of Light in an Optical fibre – Losses and dispersion - applications