Talent Search Test in Mathematics and Science (TSTMS)
SYLLABUS

The Talent Search Test in Mathematics and Science (TSTMS) is a prestigious competition organised by **the Indian Mathematics and Science Association** that challenges students to enhance their knowledge and skills in various areas of Science and Mathematics. The exam pattern consists of multiple-choice questions and problem-solving tasks to assess understanding of students scientific temperament. The syllabus for TSTMS covers a variety of topics. Participants must apply theoretical knowledge to solve real-world problems and think critically about complex problems.

TSTMS (SCIENCE)
SYLLABUS
CLASS-6

Physics
Physical Quantities of Measurement, Motion and Measurement of Distances, Light, Shadows and Reflections, Electricity and Circuits, Fun with Magnets, Our Environment.

Chemistry

Sorting and Separation of Materials, States of Water, Compounds and Mixture, Changes Around Us, Fibre to Fabric, Garbage in Garbage Out, Natural Resources (Air, Water, Forests, Sun: The Source of Energy, Soil, Rocks and Minerals, Fossil Fuels, Renewable and Non-Renewable Resources).

Biology

Living Organisms and Their Surroundings, Healthy diet: The foundation of healthy body, Food and its Components, The Cell, Living Organisms and Their classifications, Movement in living beings, Life Cycle of Plants and Animals), Nature's invaluable wealth.

TSTMS (SCIENCE)
SYLLABUS
CLASS-7

Physics
Heat, Motion and Time, Electric Current and its Effects, Winds, Storms and Cyclones, Light.

Chemistry

Acids, Bases and Salts, Physical and Chemical Changes, Fibre to Fabric.

Biology

Nutrition in Plants and Animals, Respiration in Organisms, Transportation in Plants and Animals, Reproduction in Plants and Animals, Natural Resources and Their Conservation, Foresh : Our life line, Weather, Weather and Adaptations of Animals to Climate.

TSTMS (SCIENCE)

SYLLABUS

CLASS-8

Physics

Force and Pressure, Friction, Sound, Chemical Effects of Electric Current, Some Natural Phenomena, Light, Stars and the Solar System.

Chemistry

Metals and Non-metals, Coal and Petroleum, Combustion and Flame, Pollution of Air and Water, Synthetic Fibres and Plastics.

Biology

Crop Production and Management, Microorganisms: Friend and Foe, but Conservation of Plants and Animals, Cell-Structure and Function, Reproduction in Animals, Reaching the age of Adolescence.

TSTMS (SCIENCE)

SYLLABUS

CLASS-9

Physics

Motion, Force and Laws of Motion, Gravitation, Work and Energy, Sound.

Chemistry

Matter in our Surroundings, Is Matter Around Us Pure, Atoms and Molecules, Structure of Atoms.

Biology

Cell - The Fundamental Unit of Life, Tissues, Diversity in Living Organisms, Why Do We Fall ill , Natural Resources, Improvement in Food Resources.

TSTMS (SCIENCE)

SYLLABUS

CLASS-10

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Physics

Light-Reflection and Refraction, Human Eye and Colourful World, Electricity, Magnetic Effects of Electric Current.

Chemistry

Chemical Reactions and Equations, Acids, Bases and Salts, Metals and Non-metals, Carbon and its Compounds, Periodic Classification of Elements, .

Biology

Life Processes, Reproduction in Organisms, Control and Coordination in plants and animals, Heredity and Evolution, Our Environment and Its Management.

TSTMS (PHYSICS)
SYLLABUS
Class-11

Chapter–1: Units and Measurements

UNIT 1: Units and Measurements Units of measurements, System of units, SI Units, fundamental and derived units, Dimensions of Physics quantities, dimensional analysis and its applications.

Unit 2-Kinematics

Motion in a Straight Line

The frame of reference, motion in a straight line, speed and velocity, uniformand non-uniform motion, average speed and instantaneous velocity, uniformly accelerated motion, velocity-time, position-time graph, relations for uniformly accelerated motion, relative velocity. Motion in a plane, projectile motion, uniform circular motion.

Chapter–3: Motion in a Plane

Scalar and vector quantities; position and displacement vectors, general vectors and their notations; equality of vectors, multiplication of vectors by a real number; addition and subtraction of vectors, relative velocity, Unit vector; resolution of a vector in a plane, rectangular components, Scalar and Vector product of vectors.
Motion in a plane, cases of uniform velocity and uniform acceleration-projectile motion, uniform circular motion.

Chapter–5: Laws of Motion

Force and inertia, Newton's first law of motion, momentum, Newton's second Law of motion, impulse, Newton's third Law of motion. Law of conservation of linear momentum and its applications, equilibrium of concurrent forces. Static and Kinetic friction, laws of friction, rolling friction. Dynamics of uniform circular motion, centripetal force and its applications: vehicle on a level circular road, vehicle on a banked road.

Chapter–6: Work, Energy and Power

Work done by a constant force and a variable force, kinetic and potential energies, work-energy theorem, power. The potential energy of a spring, conservation of mechanical energy,

conservative and non- conservative forces, motion in a vertical circle. Elastic and inelastic collisions in one and two dimensions

Chapter–7: System of Particles and Rotational Motion

Centre of mass of a two-particle system, centre of mass of a rigid body. Basic concepts of rotational motion, moment of a force, torque, angular momentum, conservation of angular momentum and its applications. The moment of inertia, the radius of gyration, values of moments of inertia ,radius of gyration, value of moments of inertia for simple geometrical objects, parallel and perpendicular axes theorems and their applications. Equilibrium of rigid bodies, rigid body rotation and equations of rotational motion, comparison of linear and rotational motions

Chapter–8: Gravitation

The universal law of gravitation. Acceleration due to gravity and its variationwith altitude and depth. Kepler’slaw of planetary motion. Gravitational potential energy, gravitational potential. Escape velocity, motion of a satellite, orbital velocity, time period and energy of satellite

Chapter–9: Mechanical Properties of Solids

Stress-strain relationship, Hooke's law, Young's modulus, bulk modulus

Chapter–10: Properties of Solid and Fluids

Elastic behaviour, stress-strain relationship, Hooke's Law, Young's modulus, bulk modulus and modulus of rigidity. Pressure due to a fluid column, Pascal's law and its applications, effect of gravityon fluid pressure, viscosity, Stoke’s law, terminal velocity, streamline andturbulent flow, critical velocity, Bernoulli's principle and its applications. Surface energy and surface tension, angle of contact, excess of pressure across a curved surface, application of surface tension: drops, bubbles and capillary rise. Heat, temperature, thermal expansion, specific heat capacity, calorimetry, change of state, latent heat. Heat transfer: conduction, convection and radiation.

Chapter–11: Thermal Properties of Matter

Heat, temperature,(recapitulation only) thermal expansion; thermal expansion of solids, liquids and gases, anomalous expansion of water; specific heat capacity; Cp, Cv - calorimetry; change of state - latent heat capacity.
Heat transfer-conduction, convection and radiation (recapitulation only), thermal conductivity, qualitative ideas of Blackbody radiation, Wein's displacement Law, Stefan's

law, Greenhouse effect.

Chapter–12: Thermodynamics

Thermal equilibrium and the concept of temperature, zeroth lawof thermodynamics, heat, work and internal energy. The first lawof thermodynamics, isothermal and adiabatic processes. The second lawof thermodynamics: reversible and irreversible processes

Chapter–13: Kinetic Theory

Equation of state of a perfect gas, work done on compressing a gas, kinetic theory of gases: assumptions, the concept of pressure, kinetic interpretation of temperature, RMS speed of gas molecules, degrees of freedom, law of equi-partition of energy and applications to specific heat capacities of gases, mean free path, Avogadro's number.

Chapter–14: Oscillations and Wave

Oscillations and periodic motion: time period, frequency, displacement as a function of time, periodic functions. Simple harmonic motion (S.H.M.) and its equation, phase, oscillations of a spring: restoring force and force constant, energy in S.H.M.:
kinetic and potential energies, simple pendulum: derivation of expression for its time period.
Wave motion, longitudinal and transverse waves, speed of the travelling wave, displacement relation for a progressive wave, principle of superposition of waves, reflection of waves, standing waves in strings and organ pipes, fundamental mode and harmonics, beats.

TSTMS PHYSICS
SYLLABUS
Class-12

Unit I: Electrostatics

Electrostatics Electric charges: conservation of charge, Coulomb's law forces between two point charges, forces between multiple charges, super position principle and continuous charge distribution.
Electric field: electric field due to a point charge, electric field lines, electric dipole, electric field due to a dipole, torque on a dipole in a uniform electric field. Electric flux, Gauss's law and its applications to find field due to infinitely longuniformly charged straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell.

Electric potential and its calculation for a point charge, electric dipole andsystem of charges, potential difference, equipotential surfaces, electrical potential energy of a system of two point charges and of electric dipole in an electrostatic field. Conductors and insulators, dielectrics and electric polarization, capacitors andcapacitance, the combination of capacitors in series and parallel and capacitance of a parallel plate capacitor with and without dielectric medium between the plates, energy stored in a capacitor.

Unit II: Current Electricity

Current Electricity Electric current: drift velocity, mobility and their relation with electric current, Ohm's law, electrical resistance, I-V characteristics of Ohmic and non-ohmic conductors, electrical energy and power, electrical resistivity and conductivity, series and parallel combinations of resistors, temperature dependence of resistance. Internal resistance, potential difference and emf of a cell, a combination of cells in series and parallel. Kirchhoff’s laws and their applications, Wheatstone bridge, Metre Bridge.

Unit III: Magnetic Effects of Current and Magnetism

Magnetic Effects of Current and Magnetism Biot - Savart law and its application to the current carrying circular loop, Ampere's law and its applications to infinitely long current carrying straight wire and solenoid. Force on a moving charge in uniform magnetic and electric fields, force on a current-carrying conductor in a uniform magnetic field, the force

between twoparallel currents carrying conductors-definition of ampere, torque experiencedby a current loop in a uniform magnetic field: Moving coil galvanometer, its sensitivity and conversion to ammeter and voltmeter. Current loop as a magnetic dipole and its magnetic dipole moment, bar magnet as an equivalent solenoid, magnetic field lines, magnetic field due to a magnetic dipole (bar magnet) along its axis and perpendicular to its axis, torque on a magnetic dipole in a uniform magnetic field, para-, dia- and ferromagnetic substances with examples, the effect of temperature on magnetic properties.

Unit IV-Electromagnetic Induction and Alternating Currents

Electromagnetic induction: Faraday's law, induced emf and current, Lenz's law, eddy currents, self and mutual inductance. Alternating currents, peak and RMS value of alternating current/voltage, reactance and impedance, LCR series circuit, resonance, power in AC circuits, wattless current, AC generator and transformer.

UNIT V: Electromagnetic Waves

Displacement current, electromagnetic waves and their characteristics, transverse nature of electromagnetic waves, electromagnetic spectrum(radiowaves, microwaves, infrared, visible, ultraviolet, X-rays, Gamma rays), applications of electromagnetic waves.

UNIT VI-Optics

Reflection of light, spherical mirrors, mirror formula. Refraction of light at plane and spherical surfaces, thin lens formula and lens maker formula, total internal reflection and its applications, magnification, power of a lens, combination of thin lenses in contact, refraction of light through a prism, Scattering of light-blue colour of sky and reddish appearance of the sun at sunrise and sunset , microscope and astronomical telescope (reflecting and refracting) and their magnifying powers.

Wave optics: wavefront and Huygens 'Principle, laws of reflection and refraction using Huygens principle. Interference: Young's double-slit experiment and expression for fringe width, coherent sources and sustained interference of light. Diffraction due to a single slit, width of central maximum. Polarization: plane-polarized light, Brewster's law, uses of plane-polarized light and Polaroid

Unit VII: Dual Nature of Radiation and Matter

Dual Nature of Matter and Radiation Dual nature of radiation, Photoelectric effect, Hertz and Lenard's observations, Einstein's photoelectric equation, particle nature of light. Matter waves: wave nature of particle, de- Broglie relation.

Unit VIII: Atoms and Nuclei

Alpha-particle scattering experiment, Rutherford's model of atom, Bohr model, energy levels, hydrogen spectrum. Composition and size of nucleus, atomic masses, mass-energy relation, mass defect, binding energy per nucleon and its variation with mass number, nuclear fission and fusion.

Unit IX: Electronic Devices

Semiconductors, semiconductor diode: I-V characteristics in forward andreverse bias, diode as a rectifier; I-V characteristics of LED, the photodiode, solar cell, Zener diode, Zener diode as a voltage regulator. Logic gates (OR. AND. NOT. NAND and NOR).

Chapter–14: Semiconductor Electronics: Materials, Devices and Simple Circuits Energy bands in conductors, semiconductors and insulators (qualitative ideas only) Semiconductor diode - I-V characteristics in forward and reverse bias, diode as a rectifier; Special purpose p-n junction diodes: LED, photodiode, solar cell and Zener diode and their characteristics, zener diode as a voltage regulator.

TSTMS CHEMISTRY
SYLLABUS
Class-11

1.PHYSICAL CHEMISTRY

Unit I:

Some Basic Concept in Chemistry: Matter and its nature, Dalton's atomic theory, Concept of atom, molecule, element and compound, Laws of chemical combination, Atomic and molecular masses, mole concept, molar mass, percentage composition, empirical and molecular formulae, Chemical equations and stoichiometry.

Unit II: Atomic Structure

Nature of electromagnetic radiation, photoelectric effect, spectrum of the hydrogen atom, Bohr model of a hydrogen atom - its postulates, derivation of the relations for the energy of the electron and radii of the different orbits, limitations of Bohr's model, dual nature of matter, de Broglie's relationship, Heisenberg uncertainty principle, elementary ideas of quantum mechanics, the quantum mechanical model of the atomand its important features, concept of atomic orbitals as one-electron wave functions, variation of ψandψ^2 with r for 1s and 2s orbitals, various quantum numbers (principal, angular momentum and magnetic quantum numbers) and their significance, shapes of s, p and d - orbitals, electron spin and spin quantumnumber, rules for filling electrons in orbitals – Aufbau principle, Pauli's exclusion principle and Hund'srule, electronic configuration of elements and extra stability of half-filled and completely filled orbitals.

Unit III: Classification of Elements and Periodicity in Properties

Modern periodic law and the present form of periodic table, periodic trends in properties of elements -atomic radii, ionic radii, inert gas radii, Ionization enthalpy, electron gain enthalpy, electronegativity, valency. Nomenclature of elements with atomic number greater than 100.

Unit IV: Chemical Bonding and Molecular Structure:

Kossel-Lewis approach to chemical bond formation, the concept of ionic and covalent bonds. Ionic Bonding: Formation of ionic bonds, factors affecting the formation of ionic bonds; calculation of lattice enthalpy. Covalent Bonding: Concept of electronegativity, Fajan’s rule, dipole moment, Valence Shell Electron Pair Repulsion (VSEPR) theory and shapes of simple molecules. Quantum mechanical approach to covalent bonding: Valence bond theory - its important features, the concept of hybridization involving s, p and d orbitals, resonance. Molecular Orbital Theory - Its important features, LCAOs, types of molecular orbitals (bonding, antibonding), sigma and pi-bonds, molecular orbital electronic configurations of homonuclear di atomic molecules, the concept of bond order, bond length and bond energy. Elementary idea of metallic bonding, hydrogen bonding and its application.

Unit V: States of Matter: Gases and Liquids

JEE-Three states of matters, Gas laws and ideal gas equation, absolute scale of temperature;Boyle's law, Charles law, Gay Lussac's law, Avogadro's law, ideal behaviour, empirical derivation of gas equation, Avogadro's number,ideal gas equation and deviation from ideal behavior. Deviation from ideality, van der Waals equation; Kinetic theory of gases, average, root mean square and most probable velocities and their relation with temperature; Law of partial pressures; Diffusion of gases. Intermolecular interactions: types, distance dependence, and their effect on properties; Liquids: vapour pressure, surface tension, viscosity.

Unit VI: Chemical Thermodynamics

JEE-Fundamentals of thermodynamics: System and surroundings, extensive and intensive properties, state functions, entropy, types of processes. The first law of thermodynamics - Concept of work, heat, internal energy and enthalpy, heat capacity, molar heat capacity, Hess's law of constant heat summation, Enthalpies of bond dissociation, combustion, formation, atomization, sublimation, phase transition, hydration, ionization and solution. The Second law of thermodynamics; Entropy; Gibbs energy; Criteria of equilibrium and spontaneity.

Unit VII: Chemical and Ionic Equilibrium

Chemical and Ionic Equilibrium Law of mass action; Significance of ΔG and $\Delta G^{\ominus}$ in chemical equilibrium; Equilibrium constant (Kp and Kc) and reaction quotient, Le Chatelier's principle (effect of concentration, temperature and pressure); Solubility product and its applications, common ion effect, pH and buffer solutions; Acids and bases (Brønsted and Lewis concepts); Hydrolysis of salts.

Unit VIII: Redox Reactions

Concept of oxidation and reduction, redox reactions, oxidation number, balancing redox reactions, in terms of loss and gain of electrons and change in oxidation number.

Unit IX: Hydrogen

Position of hydrogen in periodic table, occurrence, isotopes, preparation, properties and uses of hydrogen; hydrides – ionic, covalent and interstitial; physical and chemical properties of water, heavy water; hydrogen peroxidepreparation, reactions, use and structure; hydrogen as a fuel.

Unit X: s-Block Elements (Alkali and Alkaline Earth Metals)

General introduction, electronic configuration, occurrence, anomalous properties of the first element of each group, diagonal relationship, trends in the variation of properties (such as ionization enthalpy, atomic and ionic radii), trends in chemical reactivity with oxygen, water, hydrogen and halogens, uses.

Alkali and alkaline earth metals-reactivity towards air, water, dihydrogen, halogens, acids; their reducing nature including solutions in liquid ammonia; uses of these elements; general characteristics of their oxides, hydroxides, halides, salts of oxoacids; anomalous behaviour of lithium and beryllium; preparation, properties, and uses of compounds of sodium (sodium carbonate, sodium chloride, sodium hydroxide, sodium hydrogen carbonate) and calcium (calcium oxide, calcium hydroxide, calcium carbonate, calcium sulphate).

Unit XI: Some p-Block Elements

p-Block Elements Oxidation state and trends in chemical reactivity of elements of groups 13-17; anomalous properties of boron, carbon, nitrogen, oxygen, and fluorine with respect to other elements in their respective groups.
Group 13: Reactivity towards acids, alkalis, and halogens; preparation, properties, and uses of borax, orthoboric acid, diborane, boron trifluoride, aluminium chloride, and alums; uses of boron and aluminium.
Group 14: Reactivity towards water and halogen; allotropes of carbon and uses of carbon; preparation, properties, and uses of carbon monoxide, carbon dioxide, silicon dioxide, silicones, silicates, zeolites.

Unit XII: Organic Chemistry -Some Basic Principles and Techniques

General introduction, classification and IUPAC nomenclature of organic compounds .Electronic displacements in a covalent bond: inductive effect, electromericeffect, resonance and hyper conjugation. Homolytic and heterolytic fission of a covalent bond: free radicals, carbocations, carbanions, electrophiles andnucleophiles, types of organic reactions.
Hybridisation of carbon; σ and π-bonds; Shapes of simple organic molecules; aromaticity; Structural and geometrical isomerism; Stereoisomers and stereochemical relationship (enantiomers, diastereomers, meso) of compounds containing only up to two asymmetric centres (R,S and E,Z configurations excluded); Determination of empirical and molecular formulae of simple compounds by combustion method only; Acidity and basicity of organic compounds.

Unit XIII: Hydrocarbons

Classification of Hydrocarbons Aliphatic Hydrocarbons:

Alkanes-Nomenclature, isomerism, conformation (ethane and butane only), physical properties, chemical reactions.

Alkenes - Nomenclature, structure of double bond (ethene), geometrical isomerism, physical
properties, methods of preparation, chemical reactions: addition of hydrogen, halogen, water, hydrogen halides (Markovnikov's addition and peroxide effect), ozonolysis, oxidation, mechanism of electrophilic addition.

Alkynes - Nomenclature, structure of triple bond (ethyne), physical properties, methods of preparation, chemical reactions: acidic character of alkynes, addition reaction of - hydrogen, halogens, hydrogen halides and water.

Aromatic Hydrocarbons:

Introduction, IUPAC nomenclature, benzene: resonance, aromaticity, chemical properties: mechanism of electrophilic substitution. Nitration, sulphonation, halogenation, Friedel Craft's alkylation and acylation, directive influence of functional group in monosubstituted benzene.

Carcinogenicity and toxicity.

TSTMS CHEMISTRY
SYLLABUS
Class-12

Unit I: Solutions

Different methods for expressing the concentration of solution - molality, molarity, mole fraction, percentage (by volume and mass both), the vapour pressure of solutions and Raoult's Law- Ideal and nonideal solutions, vapour pressure - composition, plots for ideal and non-ideal solutions, Colligative properties of dilute solutions - a relative lowering of vapour pressure, depression of freezing point, thee elevation of boiling point and osmotic pressure, determination of molecular mass using colligativ eproperties, abnormal value of molar mass, van't Hoff factor and its significance. Henry's law;

Unit II: Electrochemistry

Redox reactions, conductance in electrolytic solutions, specific and molar conductivity, variations of conductivity with concentration, Kohlrausch's Law, electrolysis and law of electrolysis (elementary idea), dry cell-electrolytic cells and Galvanic cells, lead accumulator, EMF of a cell, standard electrode potential, Nernst equation and its application to chemical cells, Relation between Gibbs
energy change and EMF of a cell, fuel cells, corrosion.

Unit III: Chemical Kinetics

Rate of a chemical reaction, factors affecting the rate of reactions: concentration, temperature, pressure and catalyst, elementary and complex reactions, order and molecularity of reactions, rate law and specific rate constant and its units, differential and integral forms of zero and first-order reactions, their characteristics and half-lives, the effect of temperature on the rate of reactions, Arrhenius theory, activation energy and its calculation, collision theory of bi-molecular gaseous reactions (no derivation). Catalysis: Homogeneous and heterogeneous, activity and selectivity of solid catalysts, enzyme catalysis and its mechanism.

Unit IV: Surface Chemistry

Elementary concepts of adsorption: factors affecting adsorption of gases on solids, catalysis, homogenous and heterogenous activity and selectivity; enzyme catalysis colloidal state distinction between true solutions, colloids and suspension; lyophilic, lyophobic multi-molecular and macromolecular colloids; properties of colloids; Tyndall effect, Brownian movement, electrophoresis, coagulation, emulsion - types of emulsions.

Unit V: General Principles and Processes of Isolation of Elements

Principles and methods of extraction - concentration, oxidation, reduction -electrolytic method and refining; occurrence and principles of extraction of aluminium, copper, zinc and iron

Unit VI: p -Block Elements

Group 15: Reactivity towards hydrogen, oxygen, and halogen; allotropes of phosphorous; preparation, properties, and uses of dinitrogen, ammonia, nitric acid, phosphine, phosphorus trichloride, phosphorus pentachloride; oxides of nitrogen and oxoacids of phosphorus.

Group 16: Reactivity towards hydrogen, oxygen, and halogen; simple oxides; allotropes of sulfur; preparation/manufacture, properties, and uses of dioxygen, ozone, sulfur dioxide, sulfuric acid; oxoacids of sulfur.

Group 17: Reactivity towards hydrogen, oxygen, and metals; preparation/manufacture, properties, and uses of chlorine, hydrogen chloride and interhalogen compounds; oxoacids of halogens, bleaching powder.

Group 18: Chemical properties and uses; compounds of xenon with fluorine and oxygen

Unit VII: ‘d’ and ‘f’ Block Elements

Transition Elements: General introduction, electronic configuration, occurrence and characteristics of transition metals, general trends in properties of the first row transition metals -metallic character, ionization enthalpy, oxidation states, ionic radii, colour, catalytic property, magnetic properties, interstitial compounds, alloy formation, preparation and properties of K2Cr2O7 and KMnO4.

Lanthanoids - Electronic configuration, oxidation states, chemical reactivity and lanthanoid contraction and its consequences.

Unit VIII: Coordination Compounds

Coordination compounds - Introduction, ligands, coordination number, colour, magnetic properties and shapes, IUPAC nomenclature of mononuclear coordination compounds. Bonding, Werner's theory, Valence Bond Theory and Crystal Field Theory; structure and stereo isomerism, importance of coordination compounds (in qualitative inclusion, extraction of metals and biological system).

Unit IX: Haloalkanes and Haloarenes

Haloalkanes: Nomenclature, nature of C-X bond, physical and chemical properties, mechanism of substitution reactions, optical rotation.

Haloarenes: Nature of C-X bond, substitution reactions, Reactions: Fittig, Wurtz-Fittig; Nucleophilic aromatic substitution in haloarenes and substituted haloarenes (excluding benzyne mechanism and cine substitution).

Uses and environmental effects of - dichloromethane, trichloromethane, tetrachloromethane, iodoform, freons, DDT.

Unit X: Alcohols, Phenols and Ethers

Alcohols: Nomenclature, methods of preparation, physical and chemical properties (of primary alcohols only), identification of primary, secondary and tertiary alcohols, mechanism of dehydration, uses with special reference to methanol and ethanol.Reactions with: sodium, phosphorus halides, ZnCl2/concentrated HCl, thionyl chloride; Conversion of alcohols into aldehydes, ketones and carboxylic acids.

Phenols: Nomenclature, methods of preparation, physical and chemical properties, acidic nature of phenol, Electrophilic substitution reactions of phenol (halogenation, nitration, sulphonation); Reimer-Tiemann reaction, Kolbe reaction; Esterification; Etherification; Aspirin synthesis; Oxidation and reduction reactions of phenol.

Ethers: Nomenclature, methods of preparation, physical and chemical properties, uses. Preparation by Williamson's synthesis; C-O bond cleavage reactions

Unit XI: Aldehydes, Ketones and Carboxylic Acids

Aldehyde and Ketones: methods of preparation, physical and chemical properties, mechanism of nucleophilic addition, reactivity of alpha hydrogen in aldehydes, uses.

Nature of carbonyl group, nucleophilic addition to >C=Ogroup, relative reactivities of aldehydes and ketones, important reactions such as - Nucleophilic addition reactions (addition of HCN, NH3 and its derivatives), Grignard reagent, oxidation, reduction (Wolf Kishner and Clemmensen), the acidity of α -hydrogen. Aldol condensation, Cannizzaro reaction, Haloform reaction, chemical tests to distinguish between aldehydes and ketones. Carboxylic Acids: Physical properties; Preparation: from nitriles, Grignard reagents, hydrolysis of esters and amides; Preparation of benzoic acid from alkylbenzenes; Reactions: reduction, halogenation, formation of esters, acid chlorides and amides.

Unit XII: Organic compounds containing Nitrogen

General methods of preparation, properties, reactions and uses. Amines: Nomenclature, classification, structure, basic character and identification of primary, secondary and tertiary amines and their basic character.

Diazonium Salts: Importance in synthetic organic chemistry.

Cyanides and Isocyanides - will be mentioned at relevant places in text.

Diazonium salts: Preparation, chemical reactions and importance in synthetic organic chemistry.

Verify: Preparation from nitro compounds, nitriles and amides; Reactions: Hoffmann bromamide degradation, Gabriel phthalimide synthesis; Reaction with nitrous acid, Azo coupling reaction of diazonium salts of aromatic amines; Sandmeyer and related reactions of diazonium salts; Carbylamine reaction, Hinsberg test, Alkylation and acylation reactions.

Unit XIII: Biomolecules

Carbohydrates- Classification (aldoses and ketoses), monosaccahrides (glucose and fructose), D-L configuration oligosaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose, glycogen); Importance of carbohydrates.

Proteins -Elementary idea of - amino acids, peptide bond, polypeptides, proteins, structure of proteins - primary, secondary, tertiary structure and quaternary structures (qualitative idea only), denaturation of proteins; enzymes. Hormones - Elementary idea excluding structure.

Vitamins- Classification and functions. Nucleic Acids – Chemical constitution and structure of DNA and RNA, biological functions of nucleic acids.

Unit XIV: Polymers

Types of polymerization (addition, condensation); Homo and copolymers; Natural rubber; Cellulose; Nylon; Teflon; Bakelite; PVC; Bio-degradable polymers; Applications of polymers.

Unit XV: Chemistry in Everyday life

Chemicals in medicines - analgesics, tranquilizers antiseptics, Therapeutic action, analgesics,disinfectants, antimicrobials, antifertility drugs, antibiotics, antacids, antihistamines. Chemicals in food - preservatives, artificial sweetening agents, elementary idea of anti oxidants. Cleansing agents- soaps and detergents, cleansing action.

TSTMS BIOLOGY
SYLLABUS
Class-11

Unit I: Diversity of Living Organisms

Chapter 1: The Living World Characteristics of living organisms. Taxonomy and systematics. Binomial nomenclature. Concept of species and taxonomic hierarchy. Taxonomical aids: herbaria, botanical gardens, museums, and zoological parks.

Chapter 2: Biological Classification Five Kingdom classification by R.H. Whittaker. Features of Monera, Protista, Fungi, Plantae, and Animalia. Viruses, viroids, and lichens.

Chapter 3: Plant Kingdom Classification and characteristics of algae, bryophytes, pteridophytes, gymnosperms, and angiosperms. Life cycle patterns (alternation of generations).

Chapter 4: Animal Kingdom

Basis of classification: symmetry, coelom, segmentation, notochord. Features of non-chordates (up to phyla) and chordates (up to classes) (salient features and distinguishing features of a few examples of each category). **(No live animals or specimens should be displayed.)**

Unit II: Structural Organisation in Animals and Plants

Chapter 5: Morphology of Flowering Plants Root, stem, leaf, inflorescence, flower, fruit, and seed morphology. Description of families: Fabaceae, Solanaceae, and Liliaceae.

Chapter 6: Anatomy of Flowering Plants Tissues: meristematic and permanent. Anatomy of dicot and monocot roots, stems, and leaves. Secondary growth.

Chapter 7: Structural Organisation in Animals Animal tissues: epithelial, connective, muscular, and nervous. Morphology and anatomy of earthworm, cockroach, and frog.

Unit III: Cell: Structure and Function

Chapter 8: Cell – The Unit of Life Cell theory, prokaryotic and eukaryotic cells. Cell organelles and their functions. Plasma membrane structure and transport mechanisms.

Chapter 9: Biomolecules Structure and function of carbohydrates, proteins, lipids, nucleic acids. Enzymes, their properties, and mechanism of action.

Chapter 10: Cell Cycle and Cell Division, Phases of the cell cycle. Mitosis and meiosis: stages, significance, and differences.

Unit IV: Plant Physiology

Chapter 11: Transport in Plants Transport mechanisms: diffusion, facilitated diffusion, active transport. Water potential and osmotic relations. Transpiration and long-distance transport.

Chapter 12: Mineral Nutrition Essential minerals and their roles. Mineral deficiency symptoms.

Nitrogen cycle and nitrogen fixation.

Chapter 13: Photosynthesis in Higher Plants Photosynthetic pigments. Light and dark reactions. C4 pathway and photorespiration. Factors affecting photosynthesis.

Chapter 14: Respiration in Plants

Glycolysis, Fermentation, Krebs cycle, and electron transport system. Aerobic and anaerobic respiration. Energy production and respiratory quotient, Amphibolic pathway.

Chapter 15: Plant Growth and Development. Phases and rate of growth. Plant growth regulators- Auxin, Cytokinin, Gibberellin, Ethylene and Absissic acid. Photoperiodism and vernalization.

Unit V: Human Physiology

Chapter 16: Digestion and Absorption Human digestive system. Digestive enzymes. Absorption of nutrients and associated disorders.

Chapter 17: Breathing and Exchange of Gases.

Respiratory system anatomy. Mechanism of breathing and its regulation in humans. Exchange of gases and regulation of respiration, respiratory volume. Disorders related to respiration - asthma, emphysema, occupational respiratory disorders.

Chapter 18: Body Fluids and Circulation

Composition of blood and lymph and its function. Idea of blood group and coagulation of blood. Anatomy of the circulatory system. Cardiac cycle and ECG. Structure of human heart and blood vessels; cardiac cycle, double circulation; disorders of circulatory system - hypertension, coronary artery disease, angina pectoris, heart failure.

Chapter 19: Excretory Products and Their Elimination. Human excretory system. Urine formation. Regulation of kidney function. Modes of excretion - ammonotelism, ureotelism, uricotelism.

Osmoregulation; regulation of kidney function.

Chapter 20: Locomotion and Movement Types of movement. Human skeletal system. Joints and muscle contraction. Skeletal muscle, contractile proteins.

Chapter 21: Neural Control and Coordination Structure and functions of neurons. Human nervous system. Reflex actions. Generation and conduction of nerve impulse, Neurotransmitters.

Chapter 22: Chemical Coordination and Integration Endocrine glands – Hypothalamus, pituitary, pineal, thyroid, parathyroid, adrenal, pancreas, gonads;

Role of hormones in body functions as messengers and regulators, hypo - and hyperactivity and related disorders; dwarfism, acromegaly, cretinism, goitre, exophthalmic goitre, diabetes, Addison's disease.

Note: Diseases related to all the human physiological systems to be studied in brief.

TSTMS BIOLOGY
SYLLABUS
Class-12

Unit I: Reproduction

Chapter 1: Reproduction in Organisms

Asexual Reproduction: Understanding methods like binary fission, budding, fragmentation, and spore formation.

Sexual Reproduction: Comprehending the phases of sexual reproduction -pre-fertilization, fertilization, and post-fertilization events.

Life Cycles: Studying different life cycle patterns—haplontic, diplontic, and haplodiplontic.

Chapter 2: Sexual Reproduction in Flowering Plants

Flower Structure: Detailed study of the parts of a flower and their roles in reproduction.

Gametogenesis: Development of male (pollen grains) and female (embryo sac) gametophytes.

Pollination: Types (self and cross), agents (wind, water, insects), and mechanisms promoting outbreeding.

Fertilization: Process of double fertilization unique to angiosperms.

Post-Fertilization Events: Formation of endosperm, embryo, seed, and fruit.

Chapter 3: Human Reproduction

Reproductive Systems: Anatomy and functions of male and female reproductive systems.

Gametogenesis: Spermatogenesis and oogenesis processes.

Menstrual Cycle: Phases and hormonal regulation.

Fertilization and Pregnancy: Events from fertilization to implantation, embryonic development, and parturition.

Chapter 4: Reproductive Health

Reproductive Health: Importance and strategies for maintaining reproductive health.

Contraception: Various methods and their significance.

Infertility and ART: Causes of infertility and assisted reproductive technologies like IVF and ICSI.

Unit II: Genetics and Evolution

Chapter 5: Principles of Inheritance and Variation Mendelian Genetics: Laws of inheritance, monohybrid and dihybrid crosses.

Chromosomal Theory: Linkage and recombination concepts.

Sex Determination: Mechanisms in humans and other organisms.

Genetic Disorders: Understanding disorders like hemophilia, thalassemia, and color blindness.

Chapter 6: Molecular Basis of Inheritance DNA and RNA: Structure, function, and differences.

Replication: Semi-conservative method of DNA replication.Transcription and Translation: Processes of protein synthesis. Genetic Code: Features and significance. Gene Expression Regulation: Operon concept and its applications.

Chapter 7: Evolution

Origin of Life: Theories and experiments supporting abiogenesis.Evolution Theories: Lamarckism, Darwinism, and modern synthetic theory.Evidence of Evolution: Fossils, embryology, and molecular evidence.Human Evolution: Evolutionary trends and fossil records.

Unit III: Biology and Human Welfare

Chapter 8: Human Health and Disease Diseases: Types, causes, and prevention of common diseases.

Immunity: Innate and acquired immunity, vaccines, and immunization. Pathogens: Study of bacteria, viruses, and other pathogens causing diseases.

Chapter 9: Strategies for Enhancement in Food Production Plant Breeding: Objectives and methods for crop improvement. Animal Husbandry: Techniques in dairy, poultry, and fishery management.

Biotechnology in Agriculture: Use of GMOs and biofortification.

Chapter 10: Microbes in Human Welfare Microbes in Industry: Role in fermentation and antibiotic production.

Microbes in Environment: Use in sewage treatment and biocontrol agents.

Biofertilizers: Importance in sustainable agriculture.

Unit IV: Biotechnology and Its Applications

Chapter 11: Biotechnology – Principles and Processes

Genetic Engineering: Tools like restriction enzymes, cloning vectors, and PCR.

Recombinant DNA Technology: Steps involved in gene cloning.

Chapter 12: Biotechnology and Its Applications

Agricultural Applications: Development of pest-resistant and high-yield crops.

Medical Applications: Production of insulin, vaccines, and gene therapy.

Ethical Issues: Concerns related to GMOs and biopiracy.

Unit V: Ecology and Environment

Chapter 13: Organisms and Populations

Ecological Adaptations: Behavioral and physiological adaptations in organisms.

Population Ecology: Growth models, life history variations, and population interactions.

Chapter 14: Ecosystem

Ecosystem Structure: Components and energy flow.

Ecological Pyramids: Types and significance.

Nutrient Cycles: Carbon and nitrogen cycles.

Chapter 15: Biodiversity and Conservation

Biodiversity Levels: Genetic, species, and ecosystem diversity.

Conservation Strategies: In-situ and ex-situ methods.

Biodiversity Hotspots: Importance and examples.

Chapter 16: Environmental Issues

Pollution: Types, causes, and control measures.

Global Environmental Changes: Ozone depletion, global warming, and deforestation.

Waste Management: Strategies for sustainable development.

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TSTMS PHYSICS SYLLABUS

B.Sc./UPSC/JAM/NET

Unit 1: Mechanics and Properties of Matter:

Newtonian mechanics, rotational dynamics, simple harmonic motion, fluid mechanics, elasticity, surface tension, viscosity, gravitation.
Classical Mechanics: Mechanics of particles (Newton’s laws, conservation laws, central force motion, Kepler’s laws), mechanics of rigid bodies (moments of inertia, Euler’s theorem), special relativity (Lorentz transformations, relativistic kinematics, mass-energy equivalence).

Unit 2: Waves and Optics:

Wave motion, superposition of waves, sound waves,
interference, diffraction, polarization, optical instruments, lasers.
Simple harmonic motion, damped and forced oscillations, waves (travelling and standing), geometrical optics (Fermat's principle, matrix method, aberrations), interference, diffraction, polarization, lasers, fiber optics.

Unit 3: Electricity and Magnetism:

Electrostatics (Gauss's law, Laplace and Poisson equations, boundary value problems, dielectrics), magnetostatics (Biot-Savart law, Ampere's law), electromagnetic induction, Maxwell's equations (in vacuum and isotropic media, Poynting theorem), electromagnetic waves. Maxwell's equations (in vacuum and matter, gauges), electromagnetic waves (reflection, refraction, interference, diffraction, polarization, Poynting vector).

Unit 4: Thermal Physics and Thermodynamics:

Kinetic theory of gases, laws of thermodynamics, entropy, heat engines, heat transfer, statistical mechanics (basic concepts).
Laws of thermodynamics, entropy, thermodynamic potentials, Maxwell's relations, kinetic theory of gases, velocity distribution, equipartition theorem, classical and quantum statistics (Maxwell-Boltzmann, Fermi-Dirac, Bose-Einstein), blackbody radiation, phase transitions.

Unit 5: Modern Physics:

Special relativity (basic postulates, length contraction, time dilation), Wave-particle duality, Schrödinger equation, uncertainty principle,
operators, angular momentum, hydrogen atom, perturbation theory, identical particles, Pauli exclusion principle.

Atomic spectra, spin-orbit interaction, LS and JJ coupling, fine and
hyperfine structures, Zeeman and Stark effects, rotational, vibrational, and electronic spectra of diatomic molecules, Raman effect, lasers.
Basic nuclear properties (size, binding energy, angular momentum), semi-empirical mass formula, nuclear models (liquid drop, shell model), nuclear forces, radioactivity (alpha, beta, gamma decay), nuclear reactions, fission, fusion, particle accelerators and detectors, elementary particles (classification, interactions, conservation laws, quark model).

Unit 6: Electronics:

Semiconductor devices (diodes, transistors, rectifiers,
amplifiers), operational amplifiers, digital electronics (logic gates,
Boolean algebra).

Unit 7: Mathematical Physics:

Vector calculus, differential equations, matrices, complex numbers, Fourier series, special functions.

Unit 11: Solid State Physics:

Crystal structures, X-ray diffraction, bonding in solids, free electron theory, band theory (metals, semiconductors, insulators).

TSTMS PHYSICS
SYLLABUS
M.Sc./UPSC/JAM//NET

Unit 1: Classical Mechanics : Lagrangian and Hamiltonian formalism, canonical transformations, Hamilton-Jacobi theory, rigid body dynamics (advanced), small oscillations, continuum mechanics, non-linear dynamics and chaos.

Unit 2: Quantum Mechanics : Postulates, symmetries, relativistic quantum mechanics (Dirac equation), scattering theory (partial wave analysis, Born approximation), approximation methods (perturbation theory, variational method, WKB), identical particles, Bell's inequalities, density matrix, quantum information theory (basic concepts).

Unit 3: Electrodynamics: Maxwell's equations (relativistic formulation, gauge transformations), electromagnetic waves in various media, waveguides, radiating systems, multipole radiation, interaction of EM fields with matter, plasma physics (basic concepts).

Unit 4: Statistical Mechanics: Review of thermodynamics, ensembles (micro-canonical, canonical, grand-canonical), partition function, classical and quantum statistics (Fermi-Dirac, Bose-Einstein, ideal Bose gas, Fermi gas), phase transitions (critical phenomena, Ising model, Landau theory).

Unit 5: Mathematical Physics: Vector calculus, differential equations, matrices, complex numbers, Fourier series/transforms, Group theory and its applications in physics, tensor analysis, advanced differential equations, complex analysis (residue theorem, contour integration), integral transforms (Fourier, Laplace), Green's functions, numerical methods in physics.

Unit 6: Solid State Physics : Crystal structure, X-ray diffraction, lattice dynamics (phonons), electronic properties (band theory, metals, semiconductors, insulators), superconductivity (BCS theory), magnetism, dielectric properties, low-dimensional systems (nanomaterials).

Unit 7: Nuclear and Particle Physics: Nuclear structure, nuclear models (shell model, liquid drop model), nuclear reactions, radioactivity (advanced topics), elementary particles (standard model, strong, weak, electromagnetic interactions, symmetries, conservation laws, quark model), particle accelerators and detectors.

Unit 8: Atomic and Molecular Physics: Detailed atomic and molecular spectra, quantum mechanical treatment of fine and hyperfine structures, Zeeman and Stark effects, molecular spectroscopy (rotational, vibrational, electronic, Raman effect), lasers (advanced topics).

TSTMS CHEMISTRY SYLLABUS

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INORGANIC CHEMISTRY

Unit I: Atomic Structure and Periodic Properties

Quantum numbers and electronic configuration, Schrödinger wave equation and hydrogen atom, Radial and angular wave functions, Effective nuclear charge, shielding effect, Slater rules. Periodic properties: atomic and ionic radii, ionization energy, electron affinity, electronegativity

Unit II: Chemical Bonding and Molecular Structure

Ionic bond and lattice energy, Born-Haber cycle, Covalent bond, bond polarity, dipole moment, Valence bond theory, resonance, hybridization, Molecular orbital theory and bonding in diatomic species, VSEPR theory and shapes of molecules, Radius ratio rule, lattice types, theories of metallic bonding, Hydrogen bonding, van der Waals forces.

Unit III: Chemistry of s- and p-Block Elements

General characteristics and trends, Hydrogen and its compounds, Alkali and alkaline earth metals, Boron, carbon, nitrogen, oxygen, halogens and noble gases, Oxides, hydrides, halides, and interhalogens, Structure and bonding in boranes and silicates

Unit IV: Chemistry of d- and f-Block Elements

Transition elements: electronic configuration, oxidation states, Color and magnetic properties, Lanthanides and actinides: properties, lanthanide contraction, Coordination complexes of transition metals

Unit V: Coordination Chemistry

Werner’s theory and coordination number, Nomenclature and isomerism in coordination compounds, Crystal Field Theory (CFT) and its applications, Spectrochemical series and magnetic properties, Stability of complexes, chelation

Unit VI: Bioinorganic and Organometallic Chemistry

Role of metal ions in biological systems: hemoglobin, myoglobin, cytochromes, Introduction to organometallic compounds, 18-electron rule and metal carbonyls

ORGANIC CHEMISTRY

Unit I: Structure and Bonding in Organic Molecules

Hybridization, bond lengths and angles, Resonance and inductive effects, Aromaticity: Huckel's rule, aromatic, anti-aromatic, and non-aromatic compounds,

Unit II: Reaction Mechanisms and Intermediates

Types of organic reactions: addition, substitution, elimination, Reaction intermediates: carbocations, carbanions, free radicals, carbenes, nitrenes, benzynes, Energy profiles and transition states.

Unit III: Aliphatic and Aromatic Hydrocarbons

Alkanes, alkenes, alkynes: preparation and reactions, Electrophilic and nucleophilic additions, Benzene and aromatic compounds: electrophilic aromatic substitution

Unit IV: Functional Group Chemistry

Alcohols, phenols, ethers, epoxides, Aldehydes and ketones: nucleophilic addition reactions,

Carboxylic acids and derivatives, Amines: basicity, preparation, and reactions, Nitro compounds and diazonium salts

Unit V: Stereochemistry

Chirality and optical activity, Configurational and conformational isomerism, Geometrical isomerism, Fischer, Newman and Sawhorse projections.

Unit VI: Named Reactions and Reagents

Aldol condensation, Claisen condensation, Cannizzaro, Perkin, Reimer–Tiemann, Sandmeyer, Reagents: $LiAlH_4$, $NaBH_4$, PCC, PDC, NBS, Grignard reagent

PHYSICAL CHEMISTRY

Unit I: Gaseous and Liquid States

Kinetic theory of gases, Real gases: Van der Waals equation, Critical phenomena and liquefaction of gases, Properties of liquids: surface tension, viscosity

Unit II: Solid State Chemistry

Crystal lattices and unit cells, Types of crystals and packing in solids, Bragg’s law and X-ray diffraction, Crystal defects and electrical properties

Unit III: Chemical Thermodynamics

First law, internal energy, enthalpy, Second law: entropy, spontaneity, Third law, Gibbs and Helmholtz free energies, Maxwell relations, Joule–Thomson effect

Unit IV: Chemical and Ionic Equilibria

Equilibrium constant and Le Chatelier’s principle, Ionic product of water, pH, buffer solutions, Solubility product and common ion effect, Hydrolysis of salts

Unit V: Electrochemistry

Electrolytic and galvanic cells, Nernst equation and standard electrode potential, Electrochemical series and applications, Conductance and Kohlrausch’s law

Unit VI: Chemical Kinetics and Catalysis

Rate of reactions and order, Arrhenius equation and activation energy, Mechanism of complex reactions, Homogeneous and heterogeneous catalysis

Unit VII: Surface Chemistry and Colloids

Adsorption isotherms (Langmuir and Freundlich), Catalysis and enzyme activity, Colloids: classification, properties, and emulsions

TSTMS CHEMISTRY SYLLABUS

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INORGANIC CHEMISTRY

Unit I: Advanced Coordination Chemistry

Crystal Field Theory (CFT), Ligand Field Theory (LFT), and Molecular Orbital Theory (MOT), Tanabe–Sugano diagrams and electronic transitions, Jahn-Teller distortion, Substitution mechanisms in octahedral and square planar complexes, Stability constants and complexometric titrations

Unit II: Organometallic Chemistry

Classification and types of organometallic compounds, Structure and bonding in metal carbonyls, nitrosyls, metallocenes, 18-electron rule and hapticity, Catalysis: hydroformylation, hydrogenation, olefin metathesis, cross-coupling reactions, Oxidative addition, reductive elimination, insertion and elimination reactions

Unit III: Main Group and f-Block Elements

Electron-deficient compounds: boranes, carboranes, silicates, Interhalogen and noble gas compounds, Phosphazenes, sulphur-nitrogen compounds, Lanthanides and actinides: redox behavior, magnetic and spectral properties, Separation techniques and analytical applications

Unit IV: Bioinorganic and Supramolecular Chemistry

Metal ions in biological systems: metalloenzymes, oxygen transport, Nitrogen fixation, electron transfer in biological systems, Role of metal complexes in medicine and diagnosis (e.g., cisplatin, MRI contrast agents), Supramolecular chemistry: host-guest systems, crown ethers, cryptands, molecular recognition

rations, Acid-base titrations in aqueous and non-aqueous media

Unit V: Inorganic Reaction Mechanisms

Substitution reactions in coordination complexes: associative, dissociative, interchange mechanisms, Electron transfer reactions: outer and inner sphere mechanisms, Reaction

kinetics in octahedral and square planar complexes, Stereochemical aspects of ligand substitution and rearrangements

Unit VI: Metal Clusters and Cages

Metal-metal bonding, classification of clusters, Wade's rules and polyhedral boranes, carboranes, Polynuclear carbonyl clusters: synthesis, structure, reactivity, Metal nitrosyl and dinitrogen complexes

Unit VII: Solid State and Materials Chemistry

Crystal defects, non-stoichiometric compounds, Band theory, conductors, semiconductors, insulators, Magnetic and optical properties of solids, Preparation and properties of advanced inorganic materials

Unit VIII: Analytical Inorganic Chemistry

Gravimetric and volumetric analysis methods, Spectrophotometric methods for metal ions. Electroanalytical techniques: potentiometry, conductometry, voltammetry, Atomic absorption (AAS), ICP-AES, and XRF for trace metal detection, Chromatographic techniques in inorganic separations

ORGANIC CHEMISTRY

Unit I: Reaction Mechanisms and Reactive Intermediates

Nucleophilic and electrophilic substitution reactions (SN1, SN2, E1, E2), Free radical substitution and addition reactions, Addition reactions of alkenes and alkynes, Elimination reactions: orientation and mechanism

Rearrangement reactions: Beckmann, Hofmann, Baeyer–Villiger, Pinacol–Pinacolone, Wagner–Meerwein

Unit II: Stereochemistry and Asymmetric Synthesis

Chiral molecules, enantiomers, diastereomers, R/S and E/Z nomenclature, stereospecific and stereoselective reactions, Conformational analysis of acyclic and cyclic systems, Asymmetric synthesis: chiral auxiliaries and catalysts

Unit III: Pericyclic and Photochemical Reactions

Electrocyclic, cycloaddition, and sigmatropic rearrangements, Woodward–Hoffmann rules, Photochemical reactions: Norrish Type I and II, photo-Fries, Paterno–Büchi reactions.

Unit IV: Heterocyclic and Natural Product Chemistry

Five- and six-membered heterocycles containing one or more heteroatoms (O, N, S), Synthesis and reactivity of pyrrole, furan, thiophene, indole, quinoline, isoquinoline, Natural products: structure, biosynthesis, and reactivity of terpenes, steroids, alkaloids, and flavonoids

Unit V: Organic Synthesis and Name Reactions

Functional group transformations, Retrosynthetic analysis, umpolung, protecting groups, Named reactions: Wittig, Claisen, Michael, Mannich, Reformatsky, Stobbe, Sandmeyer, Vilsmeier–Haack

PHYSICAL CHEMISTRY

Unit I: Quantum Chemistry

Postulates of quantum mechanics, Schrödinger equation for model systems: particle in a box, harmonic oscillator, hydrogen atom, Operators and commutation, angular momentum, Approximate methods: perturbation theory and variational principle

Unit II: Thermodynamics and Statistical Mechanics

Thermodynamic functions and relations, Free energy, chemical potential, entropy, and equilibrium, Partition function and statistical interpretation of thermodynamic properties, Maxwell–Boltzmann, Bose–Einstein, and Fermi–Dirac statistics

Unit III: Chemical Kinetics and Dynamics

Complex reaction mechanisms, steady-state and pre-equilibrium approximations, Fast reactions, relaxation methods, chain reactions, and explosions, Transition state theory and potential energy surfaces

Unit IV: Molecular Spectroscopy

Principles and applications of UV-Vis, IR, Raman, NMR, ESR, and mass spectrometry, Selection rules and transitions, Rotational and vibrational spectra of diatomic molecules

Unit V: Electrochemistry and Surface Chemistry

Electrode potentials, concentration cells, electrochemical series, Polarography, voltammetry, and amperometry, Double-layer, adsorption isotherms (Langmuir, BET), micelles and emulsions, Catalysis and surface reactions

ANALYTICAL CHEMISTRY

Unit I: Classical Analytical Methods

Gravimetric and volumetric analysis, Complexometric titrations, redox and precipitation titrations, Acid-base titrations in aqueous and non-aqueous media

Unit II: Instrumental Methods of Analysis

Principles, instrumentation, and applications of UV-Vis, IR, NMR, AAS, AES, ICP-MS, GC, HPLC, Chromatographic techniques: TLC, GC, HPLC, column, ion-exchange, and paper chromatography

Unit III: Electroanalytical Techniques

Conductometry, potentiometry, voltammetry, Ion-selective electrodes and sensors,

Unit IV: Environmental and Green Analytical Chemistry

Green chemistry principles and sustainable analytical practices, Analysis of pollutants in air, water, and soil, atomic absorption and emission techniques in environmental analysis

Unit V: Data Analysis and Quality Control

Statistical treatment of data: mean, standard deviation, confidence limits, error analysis, Calibration methods, regression analysis, Quality control, validation, and standardization in analytical chemistry

TSTMS ZOOLOGY
SYLLABUS
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Unit 1: Cell Biology

Cell theory

Prokaryotic and eukaryotic cells – structural and functional differences Ultrastructure and function of cell organs

Nucleus, Mitochondria, Endoplasmic Reticulum, Golgi Apparatus, Lysosomes Ribosomes, Peroxisomes

Plasma membrane – models (Fluid Mosaic), transport mechanisms (passive, active, facilitated, bulk), cell junctions

Cytoskeleton – microtubules, microfilaments, intermediate filaments

Cell cycle, mitosis, meiosis – stages and regulation Apoptosis and necrosis

Cancer biology – causes, types, oncogenes, tumor suppressor genes

Unit 2: Molecular Biology & Genetics

DNA – structure, replication, repair mechanisms

RNA – types, structure, transcription, post-transcriptional modifications Genetic code, translation, post-translational modifications

Regulation of gene expression – prokaryotes and eukaryotes

Recombinant DNA technology – tools, vectors, applications

Mendelian genetics, gene interactions

Linkage, recombination, chromosome mapping

Mutations – types, causes, consequences

Chromosomal aberrations – numerical and structural

Sex determination mechanisms and sex-linked inheritance

Pedigree analysis, genetic disorders

Epigenetics – basic concept

Unit 3: Developmental Biology

Gametogenesis – spermatogenesis and oogenesis, Fertilization – process and changes

Cleavage and blastulation

Development of frog and chick embryos

Extra-embryonic membranes

Organogenesis – eye, heart

Embryonic induction and organizer concept

Metamorphosis and regeneration

Unit 4: Animal Physiology

Digestion – organs, enzymes, hormones, absorption

Circulatory system – open and closed systems, blood composition, clotting, blood groups, heart structure, ECG, cardiac cycle

Respiratory system – organs in vertebrates, gas transport, regulation of breathing

Excretory system – nephron, urine formation, osmoregulation

Thermoregulation – mechanisms in endotherms and ectotherms

Endocrine system – glands, hormones and functions

Reproductive system – male and female anatomy, menstrual & oestrus cycles, fertilization, implantation, pregnancy, parturition

Neurophysiology basics – synapse, neurotransmitters, reflex arc

Unit 5: Biochemistry

Carbohydrates – types, structure, functions

Proteins – levels of structure, types, functions

Lipids – classification, structure, biological roles

Enzymes – kinetics, inhibition, coenzymes

Metabolism – glycolysis, Krebs cycle, oxidative phosphorylation

Nitrogen metabolism (urea cycle – basic)

Unit 6: Invertebrate Zoology (Non-Chordates)

General characters and classification up to order for:

Protozoa, Porifera, Cnidaria (incl. polymorphism), Ctenophora

Platyhelminthes, Nemathelminthes – parasitic adaptations

Annelida – excretion and reproduction

Arthropoda – vision, social behavior in insects

Mollusca – shell diversity, torsion in gastropods

Echinodermata – water vascular system, larval forms

Hemichordata – characteristics, affinities, larval forms

Unit 7: Chordates

General characters and classification of chordates

Origin and evolution of chordates

Protochordates – *Herdmania*, *Branchiostoma*, Cyclostomes (*Petromyzon*)

Fishes – classification, scales, gill and accessory respiration, adaptations

Amphibia – classification, parental care, neoteny, evolutionary significance

Reptiles – classification, adaptive radiation, snakes of India

Birds – origin, flight adaptations, migration

Mammals – classification, primates, dentition, skin derivatives, locomotion

Unit 8: Evolutionary Biology

Origin of life

Theories of evolution – Darwin, Lamarck, Modern Synthetic Theory

Evidences of evolution – morphological, embryological, molecular

Natural selection, genetic drift, gene flow

Speciation and isolation mechanisms

Molecular phylogenetics and evolution

Evolution of Horse and Man

Unit 9: Ecology & Environmental Biology

Ecosystem – structure and function, energy flow, food chains/webs, productivity

Population ecology – growth models, survivorship curves

Community ecology – succession, stratification

Biodiversity – types, hotspot regions (esp. India), conservation strategies (in-situ/ex-situ)

Zoogeography – major zoogeographic regions and their faunal features

Environmental issues – pollution, climate change, global warming, bioindicators

Conservation biology basics

Unit 10: Endocrinology and Reproductive Biology

Endocrine glands – structure, hormones, disorders

Hormonal regulation of metabolism and growth

Male and female reproductive anatomy

Hormonal control of reproduction

Assisted reproductive technologies (IVF, ICSI)

Infertility – causes and solutions

Unit 11: Comparative Anatomy

Comparative anatomy of: Heart (fish to mammals) Kidney, Brain , Aortic arches and cranial nerves (basic)

Unit 12: Economic Zoology & Applied Branches

Apiculture, Sericulture, Lac culture – biology, techniques, economic value

Aquaculture – types, importance, scope in India

Common freshwater fishes – classification, anatomy, physiology

Breeding and hatchery management

Fish diseases – identification and control

Fisheries – national policies and management

Ornamental fishes and their commercial potential

Unit 13: Biotechnology

Genetic engineering – tools (vectors, enzymes), techniques (PCR, blotting)

GMOs – benefits, risks, ethical concerns

Molecular diagnostics – ELISA, PCR, rapid tests

Vaccines – traditional and recombinant

Stem cells – types and applications

Animal cell culture

Transgenic animals – examples and applications

Unit 14: Biostatistics & Research Methodology

Measures of central tendency and dispersion

Probability distributions – basic types

Hypothesis testing – t-test, chi-square, ANOVA

Data collection – methods (survey, experimental)

Research ethics, plagiarism

Report writing and referencing styles

Useful Additions for Olympiad

Nobel prize discoveries in Zoology-related fields

Model organisms in research (e.g., *Drosophila*, *C. elegans*, *Xenopus*, *Zebrafish*)

Concept of biomarkers and their applications

Recent advancements in CRISPR, synthetic biology, biodiversity conservation

Indian contributions in zoological sciences (e.g., Salim Ali – ornithology, Homi Bhabha – biology interfaces)

Basic bioinformatics – sequence alignment, BLAST, databases

TSTMS ZOOLOGY
SYLLABUS
M.SC/UPSC/JAM//NET

Unit 1: Cell and Molecular Biology

cell theory; Prokaryotic vs Eukaryotic cells Microscopy: light, fluorescence, confocal, electron Structure and functions of organelles: Nucleus, mitochondria, ER, Golgi apparatus, lysosomes, peroxisomes, cytoskeleton

Fluid mosaic model, membrane transport (passive, active), ion channels, membrane potential

Organization of genes and chromosomes; nucleosomes, heterochromatin/euchromatin Cell cycle: phases, regulation, checkpoints; Mitosis and meiosis

Apoptosis and cell death mechanisms; Cancer biology: oncogenes, tumor suppressor genes

DNA structure, replication, mutations, DNA damage and repair mechanisms Transcription, RNA processing, splicing, editing Translation and post-translational modifications

Regulation of gene expression in prokaryotes and eukaryotes

Unit 2: Genetics and Genomics

Mendelian principles, epistasis, polygenic inheritance Linkage, crossing over, and chromosome mapping Chromosomal abnormalities: aneuploidy, structural alterations Cytogenetics and karyotyping Mitochondrial and maternal inheritance Microbial genetics: conjugation, transformation, transduction Human genetic disorders: monogenic and complex traits

Genomic tools: DNA sequencing, transcriptomics, epigenetics Molecular markers: RFLP, AFLP, SSR, SNPs; QTL mapping Genomic databases and bioinformatics basics

Unit 3: Animal Physiology

Comparative physiology of major systems Digestive and metabolic regulation

Neurophysiology: nerve impulse, synapses, reflexes

Endocrinology: hormonal axes, feedback, disorders

Reproductive physiology: hormonal control, neuroendocrine integration

Muscle contraction and physiology of stress

Unit 4: Developmental Biology

Basic concepts: fate maps, induction, morphogens

Fertilization to organogenesis

Axis formation and patterning

Model organisms: Drosophila, C. elegans, chick, Xenopus

Stem cells and regeneration

Teratogenesis and aging

Unit 5: Ecology and Environmental Biology

Ecosystem structure and function

Population and community ecology

Biomes and Indian ecological zones

Wildlife and conservation biology

Ramsar sites, Project Tiger, climate change

Human impact and sustainability

Unit 6: Evolutionary Biology and Animal Behaviour

Evolutionary theories and molecular phylogeny

Population genetics, Hardy-Weinberg equilibrium

Speciation and adaptive radiation

Human evolution

Animal behaviour: mating, migration, altruism

Learning and cognition in animals

Unit 7: Animal Diversity and Functional Morphology

Classification and phylogeny of invertebrates and vertebrates

Protostomes vs deuterostomes

Functional anatomy and comparative systems

Larval forms, parasitism, adaptations

Zoogeography and distribution patterns

Unit 8: Cell Communication, Cell Signaling, and Immunology

Modes of cell communication

Signaling pathways: GPCR, RTK, JAK-STAT, MAPK, second messengers

Immune system: innate and adaptive

MHC, immunoglobulins, TLRs, clonal selection

Hypersensitivity, autoimmunity, vaccines

Monoclonal antibodies and therapeutic uses

Unit 9: Applied Zoology

Parasitology: Plasmodium, Leishmania, helminths

Zoonoses: rabies, bird flu, brucellosis

Apiculture, sericulture, aquaculture, lac culture

Transgenics and animal biotechnology

Gene therapy, biofertilizers, biopesticides

Unit 10: Biostatistics and Research Methodology

Data types, sampling, and presentation

Descriptive statistics: mean, median, SD

Probability distributions: binomial, normal, Poisson

Hypothesis testing: t-test, ANOVA, chi-square

Regression, correlation, multivariate tools

Research design, ethics, and animal welfare

Unit 11: Techniques in Modern Biology

Histology, tissue staining, immunocytochemistry

Molecular tools: PCR, qPCR, blotting, ELISA

Gene manipulation: CRISPR, RNAi, knockouts

Electrophoresis, sequencing, cloning

Spectroscopy: UV-Vis, NMR, XRD

Imaging: EEG, MRI; Radiolabeling

Unit 12: Emerging Trends and Special Topics

Climate change effects on wildlife

Vector-borne diseases in a warming world

Coral bleaching, eDNA, plastic pollution

CRISPR in disease monitoring, metagenomics

Wildlife tracking, AI, DNA barcoding

Space biology, urban ecology, ethical concerns

Unit 13: Biotechnology and Its Applications

Molecular Biotechnology

Recombinant DNA technology: restriction enzymes, ligases

Vectors: plasmids, cosmids, BACs, YACs

Cloning strategies: genomic and cDNA libraries

PCR and its variants: qPCR, RT-PCR

Blotting techniques: Southern, Northern, Western

DNA fingerprinting and molecular markers: RFLP, RAPD, AFLP, SSRs

Genetic Engineering and Genomics

Gene editing: CRISPR-Cas9, ZFNs, TALENs

Gene therapy: vectors and delivery strategies

Functional genomics: transcriptomics, proteomics, metabolomics

Whole genome sequencing, annotation, comparative genomics

Applications in livestock, aquaculture, conservation

Animal Cell Culture and Tissue Engineering

Basics of cell culture: types, media, aseptic conditions

Primary and continuous cell lines

Biotechnological applications: monoclonal antibodies, vaccine production

Organoids and artificial organs

Tissue engineering in regenerative biology

Environmental and Aquatic Biotechnology

Bioremediation and bioaugmentation

Biosensors and environmental monitoring

DNA barcoding, cryopreservation of endangered gametes

Aquatic biotech: biofloc technology, immunostimulants, disease control

GM fish and transgenic models for toxicity

Developmental and Reproductive Biotechnology

ART: IVF, ICSI, embryo transfer, surrogacy

Somatic cell nuclear transfer and cloning

Gamete and embryo preservation

Transgenic and knock-out animals in developmental studies

Stem cell-based therapies

Bioinformatics and Computational Tools

Biological databases: GenBank, PDB, UniProt

Sequence alignment: BLAST, FASTA

Phylogenetic tree construction, evolutionary inferences

Protein structure prediction and docking

Tools for comparative and functional genomics

Biotechnology in Human and Veterinary Health

Molecular diagnostics: microarrays, RT-PCR, ELISA

Vaccine development: DNA vaccines, subunit and mRNA vaccines

Therapeutic proteins: insulin, interferons, growth factors

Biotechnology in zoonotic disease control

Antimicrobial resistance and diagnostic biotechnology

TSTMS BOTANY
SYLLABUS
B.SC/UPSC/JAM//NET

I. Cell Biology

1. Cell as a unit of structure and function.
2. Characteristics of prokaryotic and eukaryotic cells and their differences.
3. Origin of eukaryotic cells (Endosymbiotic theory).
4. Mitosis and meiosis.
5. Molecular regulation of cell cycle.
6. Plasma Membrane: chemistry, structure, function.
7. Overview of membrane function; fluid mosaic model.
8. Membrane transport – Passive, active and facilitated transport.
9. Endocytosis and exocytosis.
10. Cell signaling pathways and membrane receptors.
11. Chemistry, structure and function of Plant Cell Wall and extracellular matrix.
12. Structure and function of Nucleus, nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus and chromatin structure.
13. Chromosomal variations (numerical and structural).
14. Polytene and B-chromosomes.
15. Cytoskeleton and microtubules.
16. Cytoskeleton: Role and structure of microtubules, microfilaments and intermediary filament.
17. Chloroplast, mitochondria and peroxisomes: Structural organization and Function.
18. Semiautonomous nature of mitochondria and chloroplast.
19. Endoplasmic Reticulum: RER and SER.
20. Golgi Apparatus
21. Lysosomes
22. Vacuole

II. Genetics, Molecular Biology and Evolution

1. Mendelian, non-Mendelian, and polygenic inheritance.
2. Pseudoalleles, epistasis, multiple alleles.
3. Linkage, recombination, and gene mapping.

4. Sex determination and inheritance.
5. Cytoplasmic inheritance and male sterility.
6. Structure and replication of DNA/RNA.
7. Genetic code and protein synthesis.
8. Regulation of gene expression; gene silencing.
9. Molecular basis of mutation.
10. Lamarkism, Darwinism, Neo-Darwinism, and other evolutionary theories.

II. Biomolecules and Bioenergenetics

1. Enzymes: Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group.
2. Classification of enzymes; Features of active site, substrate specificity, mechanism of action (activation energy, lock and key hypothesis.
3. Induced - fit theory, Michaelis – Menten equation, enzyme inhibition and factors affecting enzyme activity.
4. Carbohydrates: Nomenclature, classification and function of Monosaccharides; Disaccharide, Oligosaccharides and polysaccharides.
5. Lipids: Definition and major classes of storage and structural lipids.
6. Fatty acids structure and functions. Essential fatty acids. Triacyl glycerols structure, functions and properties.
7. Proteins: Structure of amino acids; Peptide bonds; Levels of protein structure-primary, secondary, tertiary and quaternary; Isoelectric point; Protein denaturation and biological roles of proteins.
8. Nucleic acids: Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of A, B, Z types of DNA; Types of RNA; Structure of tRNA.

IV. Plant Physiology and Biochemistry

1. Water and mineral uptake and transport.
2. Photosynthesis: Light & dark reactions, C3, C4, CAM.
3. Respiration: Glycolysis, Kreb's cycle, ETC, Fermentation.
4. Phloem transport and photorespiration.
5. Enzyme action and kinetics
6. Lipid, nitrogen, and secondary metabolism.
7. Growth regulators: auxin, gibberellin, cytokinin, ABA, ethylene.
8. Growth indices, vernalization, photoperiodism.
9. Physiology of flowering, seed dormancy, germination.

V. Plant Breeding, Biotechnology and Biostatistics

1. Classical breeding methods: selection, hybridization, polyploidy.
2. Mutation breeding, heterosis, apomixis.
3. Totipotency, differentiation, polarity, symmetry
4. Plant tissue culture techniques
5. Somatic hybridization, cybrids.

6. Haploidy and Triploidy.
7. Embryo rescue, somaclonal variation.
8. Experimental embryology (pollen storage, IVF)
9. Cryopreservation.
10. Genetic engineering techniques (vectors, gene transfer).
11. Molecular markers, transgenic crops, biosafety.
12. Embryo rescue, somaclonal variation, micropropagation.
13. Biostatistics: SD, CV, Z/t/χ^2-tests, probability distributions.
14. DNA sequencing, fingerprinting, PCR, FISH, blotting methods.

VI. Archegoniates

1. Bryophytes: General Characteristics, Habit; Classification (upto family), Vegetative reproduction, Range of Thallus Organization, Life history and Affinities of the following genera: Marchantia, Anthoceros Sphagnum, Economic Importance.
2. Pteridophytes: General Characteristics, Habit; Classification (upto family), anatomy, reproduction, Life history and Affinities of the following genera: Psilotum, Selaginella, Equisetum, and Marcilia.
3. Fossil Pteridophyte: *Rhynia.*
4. Ecological and economic importance of Pteridophytes.
5. Stelar Organization, Apogamy and Apospory in Pteridophytes.
6. Gymnosperms: Distribution, structure, reproduction in Cycas, Pinus, Gnetum and Ginkgo.
7. Fossil gymnosperm: *Lyginodendron* and geological timescale.

VII. Plant Systematics

1. Taxonomy, anatomy, embryology, palynology, ICBN, Numerical taxonomy, Chemotaxonomy
2. Classification of plants as proposed by Bentham & Hooker and Hutchinson.
3. Floral characteristics and economic importance of following families: Ranunculaceae, Asclepiadaceae, Apocynaceae, Amrantheceae, Euphorbiaceae, Lamiaceae, Cyperaceae and Poaceae.
4. Phylogeny, Homology and Analogy,
5. Origin and Evolution of of Angiosperms.
6. Phylogenetic Tree, Cladogram.

VIII. Ecology and Plant Geography

1. Ecosystem structure, types and dynamics.
2. Succession, community concepts
3. Forest types of India, social forestry
4. Endangered plants, conservation strategies
5. Environmental pollution & phytoremediation
6. Red Data Book, IUCN categories, Biodiversity Act
7. Global warming, EIA, invasive species
8. Phytogeography of India, biogeochemical cycles

IX. Plant Resource Development

1. Domestication, origin of cultivated plants
2. Vavilov's centers of origin
3. Plants as sources: food, fibre, oils, timber, drugs, dyes
4. Industrial products: latex, starch, gums, resins
5. Ethnobotany in Indian context
6. Botanical gardens, herbaria and energy plantations.

X. Microbiology, Plant Pathology and Phycology

1. Discovery of microorganisms, origin of life, spontaneous biogenesis, Pasteur experiments, germ theory of disease.
2. Classification of microorganisms – R.H. Whittaker's five kingdom concept, Carl Woese's- Domain system.
3. Brief account of special groups of bacteria- Archaebacteria, Mycoplasma, Chlamydia, Actinomycetes, Rickettsias and Cyanobacteria.
4. Bacteria: Discovery, General characteristics, cell structure and nutrition.
5. Genetic recombination in bacterial (Conjugation, Transformation, Transduction).
6. Economic importance of Bacteria.
7. Viruses- Discovery, general account, structure & replication of DNA Virus - Bacteriophage (Lytic, Lysogenic), RNA Virus-–TMV, Corona Virus(elementary idea), Viroids, Prions and Virions.
8. Plant diseases caused by viruses– Symptoms, transmission and control measures (Brief account only).
9. Study of Tobacco Mosaic, Bhendi Vein clearing and Papaya leaf curl diseases.
10. General Features, Thallus Organization, Nutrition, Cell wall composition, Reproduction and Classification in Fungi.
11. Fungal toxins, modeling and forecasting of disease.
12. General symptoms; Hist- Pathogens relationship; and Disease Cycle in fungi.
13. Control methods: quarantine, fungicides, biological control of fungi.
14. Agricultural, medical, industrial, and environmental microbiology.
15. Important crop diseases (causative agents, mode of infection, dissemination).
16. Structure, reproduction and life history of Rhizopus (Zygomycota), Penicillium (Ascomycota), and Puccinia, Agaricus (Basidiomycota).
17. General characteristics, Classification and Range of thallus Organization in Algae.
18. Structure, reproduction and life history and affinities of following genera: Nostoc, Volvox, Oedogonium, Ectocarpus, Vaucheria, Polysiphonia, Chara and Batrachospermum.
19. Economic Importance of Algae.
20. Lichens: Structure and reproduction; ecological and economic importance of lichens.

TSTMS BOTANY SYLLABUS

M.SC/UPSC/JAM//NET

Unit I: Phycology, Mycology and Bryology

1. Thallus organization in algae.
2. Ultra-structure of algal cells.
3. Reproduction: Vegetative, asexual and sexual.
4. Role of pigments, reserve food, cell wall, flagella, eye spot and pyrenoids in classification and evolution of algae.
5. Algal bloom, algae as biofertilizers.
6. Use of algae as food, feed and in industry.
7. Salient features of Chlorophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta.
8. Lichen: General Account, Classification, Distribution, Morphology, Anatomy, Reproduction.
9. Economic importance of Lichens.
10. General characters of fungi, substrate relationship in fungi.
11. Ultra structure of cell, unicellular and multicellular organization, cell wall composition, nutrition (saprobic, biotrophic, symbiotic).
12. Reproduction: vegetative, asexual and sexual.
13. Heterothallism, heterokaryosis and parasexuality.
14. General account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina
15. Economic importance of fungi- Fungi in industry, medicine and as food. Fungi as biocontrol agents.
16. General features of Marchantiales, Jungermanniales, Anthocerotales, Sphagnales and Polytrichales.
17. Evolutionary trends in sporophytes.
18. Vegetative propagation and perennation in bryophytes.
19. Mechanism of dehiscence of capsules and dispersal of spores.
20. Conducting tissues in Bryophytes.
21. Economic importance of Bryophytes.

Unit- II: Microbiology and Plant Pathology

1. General introduction, history and scopes of microbiology, theory of spontaneous generation,
2. Methods of microbiology: Different types of sterilization (moist heat, dry heat, filtration, radiation and chemicals).
3. Diversity of microorganisms: Archaea, Bacteria, Cyanobacteria, Rickettsia.
4. Ultra structure of Gram positive and Gram negative bacteria, reproduction (vegetative, asexual and genetic recombination).
5. Nutritional classification of bacteria.
6. Economic importance of bacteria.
7. Viruses: Nature, characteristics and ultrastructure (TMV, Bacteriophages and Cyanophages).
8. Multiplication (Lytic and Lysogenic cycles), Transmission of viruses.
9. Economic importance of Virus.
10. A brief account of Virion, Viroids and Prions.
11. Agriculture Microbiology: Biological nitrogen fixation and Biofertilizer.
12. Industrial Microbiology: Industrial production of organic acids (citric acid), antibiotics (penicillin) and enzymes (amylase).
13. Classification of Plant disease and appearance of symptoms due to different microbes.
14. Role of enzyme and toxin in pathogenesis.
15. Host defence mechanism with special reference to structural and biochemical defence.
16. Seed pathology with special reference to seed-borne mycoflora, mycotoxin and its hazard
17. Quarantine regulation and seed certification
18. Rhizosphere and rhizoplane microflora and its significance in soil borne disease
19. Etiology, symptoms and control measures of the following plant diseases: Rust of linseed, Leaf blight of maize, Tikka disease of groundnut, Bunchy top of banana, black tip of mango, Yellow vein mosaic of bhindi, Little leaf of brinjal and Citrus canker.

UNIT-III: Pteridophyta, Gymnosperm & Paleobotany

1. Detailed characteristic features, its relative position in the plant kingdom as well as emerging concepts and classification of Pteridophytes
2. Reproductive and development
3. Spore producing organs of the sporophytes and sexuality of the gametophytes in the **following classes/orders:**

   Psilopsida – Psilotales

Lycopsida – Lycopodiates, Selaginellales and Isoetates

4. Stelar and Telome
5. Heterospony vs. seed habit, with special reference to Selaginellales
6. Cytology vs. phylogeny of ferns
7. Role of polyploidy in evolution of ferns
8. Economic importance of pteridophytes
9. Characteristic features, distribution and economic importance of gymnosperms
10. Comparative morphology, anatomy, reproductive structures and interrelationships of the following living orders: Cycadales, Ginkgoales, Taxales
11. Coniferales: Characteristic features, families of modern conifers and their distinguishing features
12. Comparative account of reproductive structures of Ephedrals, Gnetales and Welwitchiales.
13. Angiospermic features within the gymnospermic group.
14. Types and Nomenclature of fossils.
15. Fossilization process and geological time-scale.
16. Principles and objectives of fossil study.
17. Comparative morphology, anatomy, reproductive structure and affinities of the ***following fossil groups:***

Psilophytales, Lepidodendrales, Cycadaeoidales, Cordaitales, Pentoxylales.

UNIT-IV: Taxonomy, Anatomy & Embryology

1. Classification: A historical account of Pre-Linnaean, Linnaean, Post-Linnaean and Pre-Darwinian Natural Systems and Post-Darwinian Phylogenetic Systems
2. Contemporary Systems of Angiosperm Classification: Arthur Cronquist, Armen Takhatajan, Robert F. Thorne and Rolf M.T. Dahlgren
3. K.R. Sporne's Advancement Index
4. Concept of taxa: Species, sub-species, variety and form; genus, family and higher categories.
5. Binomial system and International Code of Botanical Nomenclature (ICBN)
6. Post Mendelian approaches: An introduction to Genecology, Experimental taxonomy, Cytotaxonomy, Biosystematics, Palynotaxonomy, Chemotaxonomy, Numerical Taxonomy/Taximetrics & Molecular Systematics
7. Meristems: Types, Organization of Shoot Apical Meristem (SAM)
8. Organization of Root Apical Meristem (RAM)
9. Differentiation of epidermis with special reference to stomata.
10. Anomalous secondary growth.
11. Nodal, Floral and Seed Anatomy – A phylogenetic consideration
12. Anatomy in relation to taxonomy
13. Development of ovule, megasporogenesis and organization of female gametophytes (embryo sacs)
14. Pollen-Pistil interaction

15. Double fertilization and post fertilization changes leading to formation of seed, development of embryo, endosperm and seed coat
16. Polyembryony and Apomixis
17. Role of embryology in Taxonomy

UNIT-V: Physiology & Biochemistry

1. Osmotic relations
2. Transport of water and organic solutes, mechanism of xylem transport, mechanism of phloem transport, phloem loading and unloading
3. Photosynthesis: Difference between two pigment systems, Light reaction and dark reaction
4. Carbon fixation in C3 and C4 plants
5. Plant growth and development
6. Growth hormones and growth regulators: Auxin Gibberellin, Cytokinin
7. Structure, classification, properties and mode of action of enzymes.
8. Cofactors, coenzymes, prosthetic groups, isoenzymes, allosteric enzymes, multienzymes.
9. Differences between enzymes, catalysts and hormones.
10. Biochemical Energetics: Glycolysis, TCA cycle, ETS, oxidative phosphorylation, photorespiration.
11. Difference between oxidative phosphorylation and photophosphorylation.

UNIT-VI: Conservation of Biodiversity (Phytodiversity):

1. Distinctions between preservation and conservation.
2. Protocols for conservation.
3. Traditional conservation practices, In situ and ex situ conservation.
4. People's movements for biodiversity conservation
5. Patenting, Intellectual property right.
6. Biosafety protocols

UNIT-VII: Biometry

1. Distribution and measurement of variation.
2. Mean, Median, Mode
3. Standard deviation, standard error, coefficient of variability, test of significance- t test, F- test (analysis of variants)
4. Measurement of correlation coefficient,
5. Application of chi-square test for testing hypothesis

UNIT-VIII: Cell Biology and Cell Division:

1. Cmposition of the following:
   Cell wall, Plasma membrane, Cytoplasm and cytoplasmic organelles: Plastids, Mitochondria, Endoplasmic reticulum, Ribosomes, Golgi complex, Lysosomes, Peroxisomes and Centrosomes Nucleus, Nuclear membrane, nuclear pore, nucleolus and Nucleoplasm.
2. Cell division, Cell cycle and apoptosis.
3. Chromosome: Organization and special types of chromosome.

UNIT-IX: Genetics

1. Gene interaction
2. Sex determination
3. Extranuclear inheritance
4. Chromosomal aberration,
5. Polyploidy-types and role in speciation
6. Mutations- Molecular mechanism, induction by physical and chemical mutagens
7. Population Genetics

UNIT-X: Microscopy

1. Trinocular Research microscope
2. Phase contrast microscopy,
3. Fluorescence microscopy
4. Electron microscopy-SEM and TEM
5. Microdensitometry

UNIT-XI: Organization of DNA

1. Nucleic acids as hereditary material
2. Structure and different forms of DNA and RNA,
3. DNA double helix,
4. Supercoiling of DNA, Packaging of DNA in Prokaryotes and eukaryotes
5. DNA replication, Mechanism of DNA replication.
6. Different methods for DNA repair
7. Transcriptions, Post-transcriptional processing and transport of RNA, Transcription factors
8. Translation machinery and mechanism in prokaryotes and eukaryotes
9. Genetic code, Cracking of code characteristics of genetic code

UNIT-XII: Biotechnology and Recombinant DNA Technology

1. Scope and different branches of biotechnology

2. Techniques used in biotechnology: Agarose gel electrophoresis, PAGE, Southern, Northern and Western blotting, Polymerase chain reaction, DNA sequencing, Various methods of DNA sequencing
3. Recombinant DNA technology: History and scope, Different tools and techniques involved in RDT,
4. Restriction enzymes-types and cleavage pattern, DNA ligase-types and ligation of DNA molecule in vitro
5. Cloning vectors: Plasmids, pBR322, pUC19, Ti plasmid, phagemids, cosmids, BAC, YAC.
6. Passenger DNA: Different strategies used for isolation/synthesis of gene, Organochemical synthesis of gene,
7. Construction of genomic and cDNA libraries
8. Different strategies for construction of rDNA
9. Use of restriction enzymes, Linkers, Adaptors, Homopolymer tailing
10. Transformation, electroporation, microinjection, particle gun method
11. Different methods for selection of clones (antibiotic resistant markers, colony hybridization, plaque hybridization, immuno screening.
12. Application of rDNA technology: In medicine, agriculture and forensic science.

UNIT-XIII: Ecology, Environment and population concept:

1. Natality, Mortality, Density, Rate of population increase,
2. Age and sex ratio aggregation.
3. Interactions among populations, Commensalism, Amensalism, Mutualism, and Symbiosis, Predation and Parasitism, competition among intraspecific and interspecific organism, Plant adaptations
4. Methods of studying plant community: Quadrates, Transects, Bisect, Plotless method
5. Classification of communities: Physiognomic classification, Floristic classification, Dynamic system, Continuum concept
6. Community dynamics: Concept of Succession, Nudation, Invasion, Competition and reaction, Stabilization and Climax Community.
7. Xerosere and Hydrosere and their seral stage
8. Abiotic and biotic components, Ecological pyramids, Structural organization of grassland, forest and aquatic ecosystem
9. Ecosystem energetic: Laws of thermodynamics, Productivity, energy food chain and ecosystem budget.
10. Biogeochemical cycles
11. Air, Water, Soil, waste radioactive and noise pollution.
12. Global warming, green house effect; O3 depletion; Climate change, Blackhole
13. Environmental Awareness: Man and Biosphere (MAB); International Union for Conservation of Nature and Natural Resources (IUCN), United Nations Environment Programme (UNEP), World Environmental Day, Wildlife Preservation Act (1972), Indian Forest Conservation Act (1989)

UNIT-XIV: Cytogenetics and Crop improvement

1. Contributions of M.S. Swaminathan, Har Govind Khurana, Barbara Mc Clintock, V. Ramakrishnan
2. Chromatin organization (DNA packaging) and replication,
3. Structural changes in chromosomes
4. Sex linked, sex influenced and sex limited traits
5. Haploidy- Origin, production, cytological behaviour and genetic uses
6. Aneuploidy-Origin, classification, production, cytological behaviour and genetic uses
7. Polyploidy- Types, cytological, genetical and evolutionary significance
8. Brief account of classical methods of plant breeding
9. Modern techniques of plant breeding: Hybrids vs cybrids,
10. Protoplast fusion and somatic hybridization (parasexual hybridization techniques)
11. Brief idea of Terminator gene technology
12. Inbreeding depression; heterosis and heterosis breeding
13. Evolution of karyotypes
14. Modern concept of gene
15. Molecular genetic maps & their uses
16. Transposons and controlling elements
17. Gene regulation in prokaryotes and eukaryotes
18. Mutations-Molecular mechanism, induction by physical and chemical mutagens, site directed mutagenesis and role of mutation in speciation and evolution, Incompatibility
19. Population genetics and Human cytogenetics

UNIT-XV: Applied Microbiology and Plant Pathology

1. Fermentation technology: Scope and prospects
2. Isolation, screening and strain improvement of industrial microorganisms
3. Batch, continuous, fed-batch, solid state, submerged
4. Primary and secondary metabolites
5. Production of organic acids

(citric acid, acetic acid), amino acid (Glutamic acid) and Vitamin (Vitamin B12)

6. Production of antibiotics (specially Streptomycin)
7. Enzymes production and their commercial applications: Amylases, Proteases Renin
8. Fermented beverages, Production of wine and beer, Fermented foods, Soya sauce Fermented dairy products, yogurt and cheeses
9. Single cell proteins.
10. Microbial technology in agriculture and Biofertilizers.

11. Nitrogen fixers- Rhizobium, Azospirillum, Azotobacter and Cyanobacteria; Azolla-Anabaena association, Phosphate solubilizers.
12. Bacterial, viral and fungal biopesticides and their and applications
13. Treatment of solid wastes Composting & Land filling
14. Wastewater treatment methods: Oxidation pond, Trickling filter, Activated sludge methods.
15. Anaerobic treatment of wastewater and waste water treatments by plants
16. Phytoremediation and biogas production
17. History, classification and importance of plant pathology.

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