

GUTS

Geeta University Test of Scholarship Syllabus

PHYSICS

Unit 1: Units and Measurement, Mechanics Units for measurement, a system of units-S.I., fundamental and derived units, measurements - errors in measurement - significant figures, dimensions - dimensional analysis - applications. Laws of Motion: Concept of force - Newton's laws of motion - projectile motion-uniform circular motion - friction - laws of friction - applications - centripetal force. Work, Energy and Power: Work - energy- potential energy and kinetic energy – power - collision-elastic and inelastic collisions.

Unit 2: Gravitation, Mechanics of Solids and Fluids Gravitation: The universal law of gravitation, acceleration due to gravity - a variation of 'g' with altitude, latitude and depth - gravitation potential - escape velocity and orbital velocity – geostationary satellites. Mechanics of solids and fluids: Hooke's law - Moduli of elasticity - surface tension capillarity - applications – viscosity - Poiseuille's formula - Stokes law applications - streamline and turbulent flow - Reynolds number - Bernoulli's theorem - applications.

Unit 3: Electrostatics Electric charge - Conservation laws - Coulomb's law principle of superposition - continuous charge distribution - electric field - electric field lines - electric dipole - electric field due to a dipole - torque on a dipole in a uniform electric field - Electric flux - Gauss's theorem - field due to infinitely long straight wire - uniformly charged infinite plane sheet. Electric potential - potential difference - equipotential surfaces - electrical potential energy - Dielectrics and electric polarization - capacitors and capacitance - Combination of capacitors in series and in parallel - capacitance of a parallel plate capacitor with and without dielectric medium - energy stored in a capacitor

Unit 4: Current Electricity Electric current - drift velocity - mobility - Ohm's law -V-I characteristics - electrical energy and power - electrical resistivity and conductivity - temperature dependence - Internal resistance of a cell - potential difference and emf of a cell - a combination of cells in series and in parallel - Kirchhoff's laws – applications - Wheatstone bridge - Metre bridge - Potentiometer - comparison of EMF of two cells - measurement of internal resistance of a cell.

Unit 5: Magnetism and Magnetic effects of current Earth's magnetic field and magnetic element - tangent law, tangent galvanometer deflection magnetometer - Magnetic effects of electric current – Biot Savart's law - moving coil galvanometer - conversion of a galvanometer into voltmeter and ammeter – Ampere's law.

Unit 6: Electromagnetic Induction, Alternating Currents and electromagnetic Waves Electromagnetic induction - Faraday's laws, induced EMF and current - Lenz's Law - Eddycurrents - Self and mutual induction - Alternating currents, peak and RMS value of alternating current/voltage - reactance and impedance - LC oscillations - LCR series circuit - resonance - AC generator and transformer - Electromagnetic waves – characteristics - Electromagnetic spectrum.

Unit 7: Optics Reflection of light - refraction of light - total internal reflection- optical fibres - refraction at spherical surfaces – lenses - thin lens formula - lensmaker's formula – magnification - the power of a lens - a combination of thin lenses in contact - refraction of light through a prism Wave front and Huygen's principle - reflection and refraction of plane wave at a plane surface- laws of reflection and refraction using Huygen's principle – Interference - Young's double-slit experiment and expression for fringe width - Diffraction due to a single slit -width of central maximum – Polarisation. Unit 8: Dual Nature of Radiation and Matter&Atomic Physics Dual nature of radiation - Photoelectric effect - Hertz and Lenard's observations - Einstein's photoelectric equation particle nature of light. Matter waves wave nature of particles - de-Broglie relation- Alpha-particle scattering experiment - Rutherford's model of the atom - Bohr model - hydrogen spectrum. Unit 9: Nuclear Physics Nuclear radius, mass, binding energy, density, isotopes, mass defect Bainbridge mass spectrometer-nuclear forces neutron discovery-artificial radio activity-radio isotopes-radio carbon dating-radiation hazards. Nuclear fission-nuclear reactor- the nuclear fusion hydrogen bomb - cosmic rays elementary particles. Unit 10: Electronic Devices Semiconductors-doping-types-PN junction diode – biasing-diode as a Rectifier – Special-purpose PN junction diodes – LED –photodiode - solar cell-transistors- transistor characteristics -logic gates-basic logic gates-NOT, OR, AND, NOR, NANDuniversal gates-De Morgan's theorem.

CHEMISTRY

Unit 1: Solutions Types of solutions, expression of concentration of solutions of solids in liquids, the solubility of gases in liquids, solid solutions, colligative properties - the relative lowering of vapour pressure, Raoult's law, the elevation of boiling point, depression of freezing point, osmotic pressure, determination of molecular masses using colligative properties.

Unit 2: Electrochemistry Redox reactions, conductance in electrolytic solutions, specific and molar conductivity, variations of conductivity with concentration, Kohlrausch's Law, electrolysis, 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.

Unit 3: Chemical Kinetics Rate of a reaction (Average and instantaneous), factors affecting rate of reaction: concentration, temperature, catalyst; order and molecularity of a reaction, rate law and specific rate constant, integrated rate equations and half-life (only for zero and first-order reactions), the concept of collision theory (elementary and mathematical treatment), Activation energy, Arrhenius equation.

Unit 4: Surface Chemistry Adsorption - physisorption and chemisorption, factors affecting adsorption of gases on solids, 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

Unit 5: p-Block Elements Group 16 Elements: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties, dioxygen: Preparation, Properties and uses, classification of Oxides, Ozone, Sulphur - allotropic forms; compounds of Sulphur: Preparation Properties and uses of Sulphur-dioxide, Sulphuric Acid: industrial process of manufacture, properties and uses; Oxoacids of Sulphur (Structures only). Group 17 Elements: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties; compounds of halogens, Preparation, properties and uses of Hydrochloric acid, interhalogen compounds (structures only). Group 18 Elements: General introduction, electronic configuration, occurrence, trends in physical and chemical properties, uses.

Unit 6: 'd and 'f Block 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

Unit 7: Coordination Compounds Coordination compounds - Introduction, ligands, coordination number, colour, magnetic properties and shapes, IUPAC nomenclature of mononuclear coordination compounds. Bonding, Werner's theory, VBT, and CFT, structure and stereoisomerism.

Unit 8: 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 (Directive influence of halogen in monosubstituted compounds only).

Unit 9: 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. Phenols: Nomenclature, methods of preparation, physical and chemical properties, acidic nature of phenol, electrophilic substitution reactions, uses of phenols. Ethers: Nomenclature, methods of preparation, physical and chemical properties, uses.

Unit 10: Aldehydes, Ketones and Carboxylic Acids Aldehydes and Ketones: Nomenclature, nature of carbonyl group, methods of preparation, physical and chemical properties, mechanism of nucleophilic addition, the reactivity of alpha hydrogen in aldehydes, uses. Carboxylic Acids: Nomenclature, acidic nature, methods of preparation, physical and chemical properties; uses.

Unit 11: Organic compounds containing Nitrogen Amines: Nomenclature, classification, structure, methods of preparation, physical and chemical properties, uses, identification of primary, secondary and tertiary amines.

Unit 12: Biomolecules Carbohydrates - Classification (aldoses and ketoses), monosaccharide (glucose and fructose), D-L configuration Proteins -Elementary idea of - amino acids, peptide bond, polypeptides, proteins, the structure of proteins - primary, secondary, tertiary structure and quaternary structures (qualitative idea only), denaturation of proteins Nucleic Acids: DNA and RNA.

MATHEMATICS

Unit 1: Sets, Relations and Functions Sets and their representations, union, intersection and their algebraic properties, relations, equivalence relations, mappings, one-one, into and onto mappings, the composition of mappings.

Unit 2: Complex Numbers and Quadratic Equations Complex numbers in the form $a+ib$ and their representation in a plane. Quadratic equations in real and complex number system and their solutions. Relation between roots and coefficients, nature of roots, formation of quadratic equations with given roots; symmetric functions of roots, equations reducible to quadratic equations.

Unit 3: Matrices, Determinants and their applications Determinants and matrices of order two and three, minors, cofactors and applications of determinants in finding the area of a triangle, equality, types zero and identity matrix, transpose, symmetric and skew-symmetric. Evaluation of determinants. Addition and multiplication of matrices, simple properties, adjoint and inverse of a matrix, solution of simultaneous linear equations using determinants and matrices using inverses.

Unit 4: Combinatorics Permutations and Combinations: Fundamental principle of counting: permutation as an arrangement without repetitions and constraint repetitions, no circular permutations. Combination as selection, problems in $P(n,r)$ and $C(n,r)$, factorial, simple applications.

Unit 5: Algebra Sequences and Series: Arithmetic, geometric and harmonic progressions. Insertion of arithmetic, geometric and harmonic means between two given numbers. Relation between A.M., G.M. and H.M. arithmetic, geometric series, exponential and logarithmic series.

Unit 6: Differential Calculus and its applications Polynomials, rational, trigonometric, logarithmic and exponential functions. Inverse functions. Graphs of simple functions. Limits, continuity, differentiation of the sum, difference, product and quotient of two functions, differentiation of trigonometric, inverse trigonometric, logarithmic, exponential, composite and implicit functions, up to second-order derivatives. Applications of Differential Calculus: Rate of change of quantities, monotonic-increasing and decreasing functions, maxima and minima of functions of one variable, tangents and normals, Rolle's and Lagrange's mean value theorems. Ordinary differential equations, order and degree. Formation of differential equations, solution of differential equations by the method of separation of variables. Solution of homogeneous and linear differential equations and those of the type $dy/dx + p(x)y=q(x)$.

Unit 7: Integral Calculus and its applications Fundamental integrals involve algebraic, trigonometric, exponential and logarithmic functions. Integration by substitution, integration using trigonometric identities, and properties of definite integrals. Evaluation of definite integrals excluding the application of definite integrals.

Unit 8: Analytical Geometry Straight Lines in Two Dimensions: Straight line - Normal form – Illustrations. Straight-line - Symmetric form. Straight-line - Reduction into various forms. The intersection of two Straight Lines. slope of a line, parallel and perpendicular lines, intercepts of a line on the coordinate axes. Family of straight lines - Concurrent lines. Condition for Concurrent lines. Cartesian system of rectangular coordinates in-plane, distance formula, area of a triangle and condition for the collinearity of three points and section formula, Concurrent lines - properties related to a triangle. centroid and incentre of a triangle, locus and its equation. Circles in Two Dimensions: Standard form of the equation of a circle, a general form of the equation of a circle, its radius and centre, equation of a circle in the parametric form, equation of a circle when the endpoints of a diameter are given, points of intersection of a line and a circle with the centre at the origin and condition for a line to be tangent to the circle. Conic Sections in Two Dimensions: Sections of cones, equations of conic sections (parabola, ellipse and hyperbola) standard form. Problems using their geometrical properties.

Unit 9: Vector Algebra Vectors and scalars, the addition of vectors, components of a vector in two dimensions and three-dimensional space, scalar and vector products, scalar and vector triple product. Application of vectors to plane geometry.

Unit 10: Statistics and Probability distribution Measures of Central Tendency and Dispersion: Calculation of mean, median and mode of grouped and ungrouped data. Calculation of standard deviation, variance and mean deviation for grouped and ungrouped data. Probability: Probability of an event, addition and multiplication theorems of probability and their applications; Conditional probability; Bayes' theorem, the probability distribution of a random variable; Binomial, Poisson and Normal distributions and their properties.

Unit 11: Trigonometry ratios, compound angles, solution of triangles, Trigonometric identities and equations-Inverse trigonometric functions definition range and domain Properties of triangles, including, in the centre, circumcenter and orthocentre, solution of triangles Problems related to Heights and distances.

BIOLOGY

Unit 1: Diversity in Living World Biodiversity, Importance of classifications, Taxonomy & Systematics, Concept of species and taxonomical hierarchy, Binomial nomenclature, Tools for study of Taxonomy. Five kingdom classification: Monera, Protista and Fungi into major groups; Lichens; Viruses and Viroids. Salient features of them. Classification of plants into major groups - Algae, Bryophytes, Pteridophytes, Gymnosperm and Angiosperm - salient and distinguishing features. Angiosperms - classification up to class, characteristic features and examples. Alternation of generation in plant life cycles. Classification of animals- non-chordate up to phyla level and chordate up to classes level - salient and distinguishing features with a few examples of each category.

Unit 2: Structural Organization in Animals and Plants Plant tissues: Morphology and modifications, Tissues, Anatomy and functions of different parts of flowering plants: Root, stem, leaf, inflorescence, flower, fruit and seed. Description of families: Fabaceae, Solanaceae and Liliaceous. Animal tissues: Morphology, anatomy and functions of different systems (digestive, circulatory, respiratory, nervous and reproductive) of an insect (cockroach)

Unit 3: Cell Structure and Function Cell theory, Structure of prokaryotic and eukaryotic cell, Plant cell and animal cell. Cell envelope, cell membrane, cell wall. Cell organelles - structure and function: Endomembrane system endoplasmic reticulum, Golgi bodies, lysosomes, vacuoles, mitochondria, ribosomes, plastids, microbodies: Cytoskeleton, cilia, flagella, centrioles. Nucleus – nuclear membrane, chromatin, nucleolus. Chemical constituents of living cells: Biomolecules – structure and function of proteins including Enzymes–types, properties, enzyme action, carbohydrates, lipid and nucleic acids. Cell division: Cell cycle, mitosis, meiosis and their significance.

Unit 4: Plant Physiology Transport in plants: Movement of water, gases and nutrients, Cell to cell transport – Diffusion, active transport; Plant – water relations – Imbibition, water potential, osmosis, plasmolysis; Long-distance transport of water – Absorption, apoplast, symplast, transpiration pull, root pressure and guttation; Transpiration – Opening and closing of stomata; Uptake and translocation of mineral nutrients – Transport of food, phloem transport, mass flow hypothesis. Mineral nutrition: Essential minerals, macro and micronutrients and their role, Deficiency symptoms, Mineral toxicity, Elementary idea of Hydroponics, Nitrogen – metabolism, cycle and fixation. Photosynthesis: Significance - site of photosynthesis, pigments - Photochemical and biosynthetic phases of photosynthesis, Cyclic and noncyclic photophosphorylation; Chemiosmosis hypothesis; Photorespiration; C₃ and C₄ pathways; Factors affecting photosynthesis. Respiration: Cellular respiration – glycolysis, fermentation (anaerobic), TCA cycle and electron transport system (aerobic); Energy relations – Number of ATP molecules generated; Amphibolic pathways; Respiratory quotient. Plant growth and development: Seed germination, Phases of plant growth and plant growth rate, Conditions of growth, Differentiation, dedifferentiation and dedifferentiation, Sequence of developmental process in a plant cell, Growth regulators: auxin, gibberellin, cytokine, ethylene, ABA. Seed dormancy, Photoperiodism, Verbalisation.

Unit 5: Human Physiology Digestion and absorption: Alimentary canal and digestive glands, Role of digestive enzymes and gastrointestinal hormones, Peristalsis, digestion, absorption and assimilation of proteins, carbohydrates and fats, Egestion; Nutritional and digestive disorders – indigestion, constipation, vomiting, jaundice, diarrhoea. Breathing and Respiration: Respiratory organs in animals, Respiratory system in humans, Mechanism of breathing and its regulation in humans– Exchange of gases, transport of gases and regulation of respiration, Respiratory volumes, Disorders related to respiration - Asthma, Emphysema, Occupational respiratory disorders. Body fluids and circulation: Composition of the blood, blood groups, coagulation of blood, Composition of lymph and its function, Human circulatory system – Structure of human heart

and blood vessels, Cardiac cycle, cardiac output, ECG, Double circulation, Regulation of cardiac activity, Disorders of the circulatory system - Hypertension, Coronary artery disease, Angina pectoris, Heart failure. Excretory Products and their elimination: Modes of excretion – Ammonotelism, ureotelic, uricotelism, Human excretory system – structure and function, Urine formation, Osmoregulation, Regulation of kidney function– Renin-angiotensin, Atrial Natriuretic Factor, ADH and Diabetes insipidus, Role of other organs in excretion, Disorders - Uraemia, Renal failure, renal calculi, Nephritis, Dialysis and artificial kidney, a kidney transplant. Locomotion and Movement: Types of movement – amoeboid, ciliary, flagella, muscular, skeletal muscle – contractile proteins and muscle contraction, Skeletal system and its functions, Joints, Disorders of the muscular and skeletal system – Myasthenia gravis, Tetany, Muscular dystrophy, Arthritis, Osteoporosis, Gout. Neural control and coordination: Neuron and nerves, Nervous system in humans– central nervous system, peripheral nervous system. Generation, conduction and transmission of nerve impulse, Reflex action, Sensory perception, Sense organs, Elementary structure and function of eye and ear. Chemical coordination and regulation: Endocrine glands and hormones, Human endocrine system - Hypothalamus, Pituitary, Pineal, Thyroid, Parathyroid, Thymus, Adrenal, Pancreas, Gonads. Hormones of heart, kidney, and gastrointestinal tract. Mechanism of hormone action, Role of hormones as messengers and regulators, Hypo- and hyperactivity and related disorders: Common disorders e.g. Dwarfism, Acromegaly, Cretinism, goitre, exophthalmic goitre, diabetes, Addison's disease.

Unit 6: Reproduction in Organisms: Reproduction, a characteristic feature of all organisms for continuation of species, modes of reproduction - asexual and sexual reproduction, asexual reproduction – binary fission, sporulation, budding, gemmule formation, fragmentation, vegetative propagation in plants. Events in sexual reproduction. Sexual Reproduction in Flowering Plants: Flower structure, development of male and female gametophytes, pollination - types, agencies and examples, outbreeding devices, pollen-pistil interaction, double fertilization, post-fertilization events - development of endosperm and embryo, development of seed and formation of fruit, special modes apomixes, parthenocarpy, polyembryony, Significance of seed dispersal and fruit formation. Human Reproduction: Male and female reproductive systems, microscopic anatomy of testis and ovary, gametogenesis - spermatogenesis and oogenesis, menstrual cycle, fertilization, embryo development up to blastocyst formation, implantation, pregnancy and placenta formation, parturition, lactation. Reproductive Health: Need for reproductive health and prevention of Sexually Transmitted Diseases (STDs), birth control - need and methods, contraception and medical termination of pregnancy (MTP), amniocentesis, infertility and assisted reproductive technologies - IVF, ZIFT, GIFT, AI.

Unit 7: Genetics and Evolution Principles of Inheritance and Variation: Heredity and variation, Mendelian inheritance, deviations from Mendelism – incomplete dominance, codominance, multiple alleles and inheritance of blood groups, pleiotropic, polygenic inheritance, chromosome theory of inheritance, chromosomes and genes, Sex determination in humans, birds, grasshopper and honey bee, linkage and crossing over. Mutation, Pedigree analysis, sex-linked inheritance - haemophilia, colour blindness, Mendelian disorders in humans – sickle cell anaemia, Phenylketonuria, thalassemia, chromosomal disorders in humans, Down's syndrome, Turner's and Klinefelter's syndromes. Molecular Basis of Inheritance: DNA as genetic material, Structure of DNA and RNA, DNA packaging and replication, Central dogma, transcription, genetic code, translation, gene expression and regulation - lac operon, genome and human genome projects, DNA fingerprinting. Evolution: Origin of life, biological evolution and evidence for biological evolution (palaeontology, comparative anatomy, embryology and molecular evidence), Lamarck's theory, Darwin's contribution, modern synthetic theory of evolution, mechanism of evolution - variation (mutation and recombination) and natural selection with examples, types of natural selection; Gene flow and genetic drift; Hardy - Weinberg's principle; adaptive radiation; human evolution.

Unit 8: Biology and Human Welfare Human Health and Diseases: Pathogens, parasites causing human diseases (malaria, dengue, chikungunya, filariasis, ascariasis, typhoid, pneumonia, common cold, amoebiasis, ringworm) and their control, Basic concepts of immunology – vaccines, cancer, HIV and AIDS, Adolescence - drug and alcohol abuse. Strategies for Enhancement in Food Production: Improvement in food production, Plant breeding, tissue culture, single-cell protein, Biofortification, Apiculture and Animal husbandry. Microbes in Human Welfare: In household food processing, industrial production, sewage treatment, energy generation and microbes as bio-control agents and bio-fertilizers. Antibiotics - production and judicious use.

Unit 9: Biotechnology and Its Applications Biotechnology - Principles and processes: Genetic Engineering (Recombinant DNA Technology). Biotechnology and its Application: Application of biotechnology in health and agriculture: genetically modified organisms -Bt crops; RNA interference. Human insulin, gene therapy, molecular diagnosis, transgenic animals, biosafety issues, biopiracy and patents. Unit 10: Ecology and Environment Organisms and Populations: Organisms and environment: Habitat and niche, abiotic factors, ecological adaptations, population interactions - mutualism, competition, predation, parasitism, commensalism, and population attributes - growth, birth rate and death rate, age distribution. Ecosystem: Structure and function, productivity and decomposition, energy flow, pyramids of number, biomass, energy, nutrient cycles (carbon and phosphorous), ecological succession, ecological services - carbon fixation, pollination, seed dispersal, oxygen release. Biodiversity and its Conservation: Biodiversity - Concept, patterns, importance, loss of biodiversity, biodiversity conservation, hotspots, endangered organisms, extinction, Red Data Book, Sacred Groves, biosphere reserves, national parks, wildlife, sanctuaries and Ramsar sites. Environmental Issues: Air pollution and its control, water pollution and its control, agrochemicals and their effects, solid waste management, radioactive waste management, greenhouse effect and climate change impact and mitigation, ozone layer depletion, deforestation, any one case study as success story addressing the environmental issue(s).

APTITUDE

1. Number System Properties of numbers, Divisibility rules, Unit digit, Euclid's algorithm, LCM and GCD
2. Statistics Arithmetic mean, weighted mean, Geometric mean
3. Percentage change [1] increase or decrease
4. Profit and Loss computing percentage of profit or loss and profit/loss value
5. Quadratic Equation Nature of roots, Relationship between roots and coefficients, Solutions of quadratic equations.
6. Geometry Similar triangles, Lines and angles, Circles and Quadrilaterals.
7. Arrangement Ordering, Grading and Ranking, coding and decoding
8. Direction Sense test Finding direction, distance or both
9. Linear Equation Solving simultaneous equations, Test of consistency, problems on ages
10. Trigonometry Values of trigonometric ratios, Identities, Heights and distance