

SYLLABUS JET 2019

AGRICULTURE

Unit- A :

(15 questions)

Food production and its importance in the economy and nutritional security. History of Indian agriculture, branches, importance and scope. **Weather and Climate**- Definition, elements, effects on crops, general introduction to weather related equipments- Rain gauge, maximum minimum thermometer, dry and wet hygrometer, wind vane, and anemometer. **Irrigation**- Requirement, time and quantity, methods of irrigation. Concept of precision and pressure irrigation- drip and sprinkler irrigation. **Weed**- Definition, peculiarities, classification, harmful effect, extension, methods of multiplication, weed control (mechanical, chemical & biological), **Arid Agriculture**- Definition, importance & principle, **Crop rotation**- Definition, importance and principle.

Soil- Definition, composition, structure, texture, soil water, air, soil temperature, soil porosity and factors affect it. Saline, acidic and alkali soil and their management, soils of Rajasthan. Soil samplings and its methods. Introduction to soil pH and organic carbon. **Nutrient fertilizer**- Essential plant nutrients, importance and deficiency symptoms, importance of fertilizer, type (NPK) and methods of application. **Irrigation** - Importance of irrigation, sources of irrigation, water requirement of crops. **Water drainage**- Definition, need, importance, water logging, need of water conservation and methods (well, water recharge, water harvesting), **Introduction to agriculture machinery**- Definition and type of tillage, deshi plough, harrow, cultivator, combine harvester, seed cum fertilizer drill, planter, MB plough. **Seed**- Definition, type & quality of seed, seed production, seed dormancy. **Agronomy**- Definition, importance and scope, soil fertility and productivity- Factor affect soil erosion & conservation. **Crop production**- Study of following crops under Rajasthan climate condition in following points: botanical name, family, importance, climate, soil, preparation of field, improved varieties, seed rate, seed treatment, time of sowing, sowing method, manure & fertilizers, irrigation, intercropping plant protection & harvesting, threshing, yield and post-harvest management : **Cereal**- Rice, maize, sorghum, pearl millet, wheat & barley. **Pulses**- Black gram, green gram, mothbean, gram, pignonpea, and cowpea. **Oilseed**- Mustard & rapeseed, groundnut, soybean, linseed and sunflower. **Fodder**- Lucerne and berseem, **Cash crops**- Sugarcane, potato, and cluster bean, **Fiber crops**- Cotton and sunhemp.

Organic farming: Definition, importance, concept, history, present status and future scope of organic farming, contribution in national economy, important food products

grown organically. Organic manure and their utility, farm yard manure. Bio-fertilizer - Type & methods of application. Biological control of insect & diseases. Preparation of bio-pesticides (plant based). General introduction to sustainable agriculture.

Unit-B :

(15 questions)

Importance and scope of fruit and vegetable crops, present position and future.

Orchard management- Selection of site, planning, layout, pit filling, plantation, adverse weather condition- Frost, hot wind, hailstorm, drought, dust storm, heavy rainfall and their remedies. Unfruitfulness and their remedies. Alternate bearing in orchard and their solution. Application of plant growth regulators in orchards. **Study of following important fruit crops with special reference to-** Botanical name, family, importance, climate, soil, improved varieties, plant propagation, planting, manure & fertilizer, irrigation, weeding & hoeing, yield and plant protection of- Mango, citrus (orange and lime), banana, guava, pomegranate, papaya, grapes, aonla, ber, date palm, & bael. **Vegetable-** Classification of vegetable, on the basis of season and vegetable parts used, type of vegetable cultivation- Commercial & kitchen gardening. **Nursery-** Definition, importance, soil preparation and layout, sowing, transplanting, plant propagation sexual and asexual.

Vegetable cultivation- Botanical name, family, importance, climate, soil & field preparation, sowing, seed rate and treatment, improved varieties, manures & fertilizer, irrigation, weeding and hoeing, plant protection, yield- Tomato, brinjal, chilli, cauliflower, cabbage, pea, okra, carrot, radish, spinach, onion, garlic, round gourd, bitter guard, bottle guard, ridge guard, pumpkin. **Ornamental gardening-** Type of garden (formal and informal), private, public and school garden, **Study of ornamental plant-** trees, bush, climbers, and seasonal flower. **Flower cultivation-** Botanical name, importance, climate, soil, field preparation, plant propagation, improved varieties, planting, manure & fertilizer, care, picking & yield of rose, marigold, chrysanthemum and gladiolus. **Spices-** Cumin, coriander, fenugreek & fennel.

Introduction to and utility of medicinal plant- Safed musali, jatropa, sanay, isabgol, basil and giloy. **Mushroom-** Its nutritional status and methods of production. Beekeeping and its importance, uses and importance of honey, wax and royal jelly. **Post-harvest-** Importance, scope and future of post-harvest management of fruits, vegetables and flowers. Status of food processing in our country. Packaging, quality standards and their marketing including export. **Preservation of fruits and vegetable-** Present position of fruit and vegetable preservation, principle & methods of fruit preservation. Canning of fruit & vegetable, jam, jelly, marmalade, preserve, sauce, ketchup, pickle and squash. **Flowers and their harvesting-** Important processed flower products, packaging, storage and their marketing.

Unit-C :

(10 questions)

Importance of Livestock in Indian economy. Determination of age by teeth, horn, hoof and body condition of animals and weight- by using Shafer formula, **Animal Breeding-** Identification of heat, introduction to reproductive organs, natural & artificial insemination. General test of pregnancy. Care and management of pregnant & calving animals. **Animal nutrition-** General principle of animal feeding. **Determination of feed for-** Pregnant & milking cow and bullock. **Feed preservation-** Hay and silage7 Definition, importance, method for preparation. **Animal health-** Identification of healthy & suffering animals. Identification of general disease & treatment- Wounds, eczema, sprain, itching, inflammatory, indigestion, bloat, diarrhoea, dysentery & food poisoning. Parasite- Lice & kilni. **General medicine for animals and their utility-** Phenyl, potassium permanganate, magnesium sulphate, alcohol, copper sulphate, tincher iodine, carboxylic acid, laizol, castor oil, kapoor, phenovis, alum, turpentine oil. **Milking methods-** By hand and machine, **Poultry:** Importance and scope, breeds of poultry & their classification. Study of poultry breeds- White leghorn, rod island red, red carnish, ply mouth rock breeds. Structure of egg. Poultry feed and housing management. Important disease of poultry (cause, symptoms and treatment). Characteristics and utility of following animal breeds **Cow-** Gir, Tharparkar, Haryana, Nagori, Malvi, Mewati, Rathi, Jersey and Holstein Friesian. **Buffalo-** Murrah, Bhadawari, Surti, Neeli, Jafrabadi and Mehsana. **Sheep-** Marwari, Chokla, Malpuri, Marino, Karakul, Avivastra, Adikalin and Jaisalmeri. **Camel-** Bikaneri & Jaisalmeri, management of camel. **Animal diseases-** Rinderpest, foot & mouth disease, black quarter, anthrax, Hemorrhagic septicaemia, mastitis, tick fever, milk fever, enterotoxaemia, trypanosome & itching. **Dairy science-** Milk and milk products- Curd and ghee. Development and dairy industry in India- White revolution and operation flood.

BIOLOGY

Definition, branches, study area and importance in agriculture.

Section - I Botany

(25 questions)

Unit- A

Taxonomy and classification of plants: Genus, species, binomial nomenclature, brief history of classification. Salient features and classification of plants into major groups- Algae, Bryophyta, Pteridophyta, Gymnospermae and Angiospermae, Angiosperms- Classification upto class, characteristic features and examples.

Morphology and anatomy of angiosperm plant- Morphology and modifications, internal morphology of different parts of flowering plants: root, stem, leaf, inflorescence, flower, fruit and seed. **External morphology of angiosperm Plant-** Root, stem, leaf, inflorescence, flower, fruit, seed and modification.

Anatomy of flowering plants-Anatomy and functions of different tissues. **Plant tissue-** Definition, character & classification, meristematic tissue-Type and character. Tissue system- Epidermal, ground and vascular tissue system, internal structure of root, stem and leaf, secondary growth of root & stem. Permanent and special tissue.

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-Apomixis, parthenocarpy, polyembryony, significance of seed dispersal and fruit formation.

The Cell: The unit of life- Definition, cell theory and cell as the basic unit of life. Electron Microscopic structure of cell. Prokaryotic and eukaryotic cells. Plant and animal cells. Cell organelles and their functions-Nucleus (including DNA and RNA structure), mitochondria, chloroplast, endoplasmic reticulum, golgi complex, lysosomes, microbodies, microfilaments, ribosomes, centriole, cell wall, cilia and flagella, vacuoles, cell inclusions-starch grains, mineral crystals. **Cell division-** Amitosis, mitosis and meiosis. Comparison of mitosis and meiosis. Significance of meiosis, cell cycle.

Genetics- Mendel's experiments with pea and the reasons for his success. Mendel's laws of inheritance, mono and dihybrid crosses. Chromosome structure and morphology, chromosomes and genes, chromosome hypothesis. Linkages and crossing over. Mutations. Sex determination, genetic code, transcription and translation. Chromosomal disorder.

Plant Physiology: (i) **Transport in Plants-**Movement of water, gases and nutrients; cell to cell transport, diffusion, facilitated diffusion, active transport, plant water relation, semi permeable membranes, osmosis, diffusion, diffusion pressure deficit (DPD), water potential, plasmolysis. Transpiration-Types, factors affecting rate of transpiration. Guttation. Absorption of water, active and passive absorption of water and minerals. (ii) **Ascent of sap-** Path of ascent of sap, theories explaining ascent of sap. (iii) **Mineral nutrition-**Role of minerals in plant growth, macro and micro nutrient, trace elements and their importance. (iv) **Enzymes-** Introduction, enzymes as bio-catalysts, nature, classification and mode of enzyme action. (v) **Respiration-** Definition, comparison of respiration and fire. Types of respiration- Aerobic, anaerobic and fermentation processes. Respiratory substrate, respiratory quotient, respiration sites. Mechanism of aerobic and anaerobic respiration. Glycolysis, Krebs cycle and alcoholic fermentation, Electron transport chain and oxidative phosphorylation. Energy yield (kilo calories). Factors affecting respiration. (vi) **Photosynthesis-** Definition, role of water, chlorophyll and carbon-di-oxide, light and dark reactions, photophosphorylation, Hill reaction, red drop, two pigment

system, Calvin cycle, photorespiration, chemosynthesis (brief account). Factors affecting photosynthesis. (vii) **Growth**- Definition, phases of growth, plant hormones (auxins, gibberellins, cytokinin and ethylene) and growth regulation, action on various physiological processes. Factors affecting growth.

Unit – B

Ecology and Environment- Definition of ecology and environment. Environmental factors climatic, edaphic and biotic. Plant communities and their characteristics (density, frequency and abundance). Interaction between environment and organism, ecosystem concept, trophic levels producers, consumers, decomposers, food chain and food web. Ecological pyramids.

Environmental Issues: Type of pollution, air pollution and its control, sound pollution, soil pollution, 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 environmental issue(s). Global climatic change, global warming, stratospheric zone depletion, acid rain, albedo effect. Classification of natural resources, conservation & management of rain water, soil, soil moisture, energy minerals and sea resources. **Forest resources**- Importance, forest resources in India, deforestation, forest conservation and management (Chipko movement & social forestry) **Biodiversity**- Concept, patterns, importance, loss of biodiversity, biodiversity conservation in Rajasthan.

Unit – C

Economic Botany and Human Welfare- Domestication of plants-historical account, improvement of crop plants-plant breeding and plant introduction. Use of bio-fertilizers, economic and ecological aspects. Use of pesticides: advantages and hazards, economic botany (botanical name, family, plant parts used and uses) of the following: **Cereals**- Wheat, rice, maize and barley, **Millets**- Bajra and sorghum, **Pulses**- Gram, blackgram, pigeonpea, cowpea, mothbean and greengram, **Fibres** - Cotton and sunnhemp, **Oil seeds** - Groundnut, rapeseed, linseed, sunflower, mustard and castor, **Cash crop**- sugarcane, potato and clusterbean, **Fruits** - Mango and banana, **Medicinal plants**- Guggal, sarpagandha, belladonna, opium and isabgol. **Spices**: - Cumin, coriander, fennel and fenugreek

Unit-D

Biotechnology and Its Applications

Biotechnology: General introduction- Definition, history scope of biotechnology & importance for different fields. **Principles and processes**- Genetic engineering (recombinant DNA technology)- definition, discovery, general method & equipment, enzyme & cloning vector, plasmid, bacteriophage, cosmid, gene library, gene bank. **Biotechnology and its Application**-Application of biotechnology in health and agriculture, human insulin and vaccine production, stem cell technology,

gene therapy, genetically modified organisms - Bt crops, transgenic animals, biosafety issues, bio piracy and patents. **Plant tissue culture** - Definition, history, **Essential equipment**- Type of culture, step of tissue culture, achievement in plant tissue culture. Different method for gene transfer in plant. Transgenic plant, genetically modified crops and food.

Unit-E

Major disease of crop and their control: Classification of diseases- i) on the basis of pathogen, ii) on the basis of season, iii) on the basis of crops and iv) on the basis of nutrient deficiency. **Diseases of Kharif crops-** Downy mildew and green ear of pearl millet, cotton wilt, tikka disease of groundnut, peanut clump virus, bacterial blight of cotton, yellow vein mosaic of okra, early blight and leaf curl of tomato. **Diseases of Rabi crops-** Wheat rust disease, white rust of mustard, loose smut and covered smut, little leaf of brinjal, blight and powdery mildew of cumin. **Diseases of Fruit crops in Rajasthan-** Citrus canker, powdery mildew of ber, guava wilt. Disease management method- Chemical, biological and mechanical.

Section – II: Zoology

(15 questions)

Unit-A

Animal Kingdom- salient features and classification of non-chordates animals up to phyla level and chordates up to class level. **Taxonomy and classification of animals-** Different steps of classification, system of bio-scientific classification. Peculiar characteristic of kingdom animalia. **Body organization and animal tissue-** Epithelial tissue, connective tissue, blood lymph, supporting tissues, bone, cartilage, muscular tissues, nervous. **External and internal morphology and internal structure of animals-** Amoeba, earthworm cockroach in brief.

Unit-B

Invertebrates

(1) Animals and their economic importance with special reference to Agriculture;
(i) **Protozoa-** Amoeba, (ii) **Helminthes-** Soil Nematode and disease caused by nematode (molya, ear cockle, tundu of wheat, root knot, (iii) **Annelida-** Earthworm, (iv) **Mollusca-** Snail & slug, (v) **Arthropoda** (various classes)- (a) Arachnida- Mites (b) Crustacea- Prawns, lobsters, (c) Diplopoda- Millipede (d) Chilopoda- Centipedes, (e) Insecta- Cockroach
(2) Important insects of crops and storage (general introduction, importance, host plants, losses, life cycle and their control)- (i) Red hairy caterpillar, (ii) White grub, (iii) Termites, (iv) Grass hopper, (v) Pod borers, (vi) Khapra beetle

Honey bee: Bee Keeping and its importance in agriculture.

(3) **Methods of insect control** (insect control: general introduction): (i) Physical and mechanical control (ii) Cultural control, (iii) Chemical control (pesticides, insecticide formulation, classification of insecticides, miticides, nematocides,

rodenticides) and safe use of chemicals, (iv) Bio-control-predators and parasitoids, pheromone traps, *Trichoderma*, NPV, botanical insecticides. (v) Integrated pest management (vi) Sprayers and dusters.

Unit-C

Vertebrates

(i) **Nutrition in animals**– Nutritive elements of food, energy yielding chemicals, minerals and vitamins, balance diet.(ii) **Respiration in animals** – Gaseous exchange. (iii) **Circulation in animals**– Blood– Composition, blood groups, Rh-factor, blood coagulation. (iv) **Reproductive system** – Male and female reproductive system. (v) **Reproduction & development:** (a) Asexual & sexual reproduction in animals (b) Gametogenesis, spermatogenesis, structure of sperm, oogenesis and type of ovum, female reproductive cycle (c) Fertilization- external and internal fertilization. (d) Mechanism of fertilization.

CHEMISTRY

Unit– A

(10 questions)

Basic concept of chemistry- Importance and scope of chemistry in daily life and agriculture. Measurements in chemistry- Significant figures and international units of measurement. Laws of chemical combination. Dalton's atomic theory- initial concept of elements, atoms and molecules. Avogadro hypothesis and its uses. Mole concept and Avogadro number. Initial concept of atomic weight, equivalent weight and molecular weight. Percentage composition, empirical formula and molecular formula. Stoichiometry of chemical reaction and calculation, limiting reagent.

Structure of atom- Development of classical model of an atom- (i) Bohr's model of atom: Calculation of radius of Bohr's orbit and energy of an electron, (ii) Dual nature of matter and radiation- quantization of electronic energy levels, spectral evidence for quantization, (iii) Sommerfield's extension (no mathematical treatment), (iv) De-Broglie's relationship, (v) Uncertainty principle, (vi) Orbitals and quantum numbers- shapes of orbitals, spatial distribution of atomic orbitals, (vii) Distribution of extra nuclear electrons, Aufbau principle, Pauli's exclusion principle, Hund's rule, n+l Rule, variation in relative energies of orbitals with increase in atomic number, electronic configuration of elements (S, P, D, F, block elements). Stability of half-filled and completely filled orbitals.

Periodic table and periodicity in properties- (i) Electronic configuration and periodic table- the log form of periodic table and S, P, D, F, block elements and advantages over Mendeleev's periodic table, (ii) Electronic configuration and periodicity in properties, periodic perspectives, (iii) Detailed study of periodicity in physical and chemical properties with special reference to- density, melting and boiling points of elements. Atomic and ionic radii, ionization potential, electron

affinity. Electro negativity, variation of effective nuclear charge in a period, metallic character, diagonal relationship.

Chemical bonding and molecular structure- (i) Lewis structure- Octet rule and its limitations, (ii) ionic bond- characteristics of ionic compounds, solubility of ionic compounds, (iii) Covalent bond, introductory concept of over-lapping of orbitals and bonds, valence bond theory- Characteristics of covalent compounds. Coordinate bond, partial covalent character in ionic bond, partial ionic character in covalent bond. Fajan's rule, polarities of covalent molecules, (iv) Bond length, bond angle and bond-energy general consideration, (v) Hybridization of orbitals illustrated with example of compounds of first and second row elements in periodic table- shapes of common molecules- VSEPR Theory, (vi) Hydrogen bond, (vii) Vander Waals forces of attraction.

Redox reaction- (i) Concept of formal charge on ions, (ii) Oxidation number, (iii) Oxidation reduction electron transfer concept with examples, (iv) Redox reaction-examples, (v) Balancing of equations by ion-electron method.

Equilibrium Chemical equilibrium- (i) Concept of reversibility equilibrium constant, (ii) Law of mass action generalized expression, (iii) Experimental method for verification of law of mass action. factors affecting equilibrium (concentration, pressure, temperature), (iv) Application to systems such as $N_2 + 3H_2 \leftrightarrow 2NH_3$, $PCl_5 \leftrightarrow PCl_3 + Cl_2$, $N_2 + O_2 \leftrightarrow 2NO$ (v) Le Chatelier's principle-Application. **Ionic equilibrium-** (i) Electrolytes and non-electrolytes, (ii) Arrhenius theory- Evidence in favour of dissociation theory, (iii) Ionic product of water, (iv)Hydrolysis, degree of hydrolysis, hydrolysis constant, (v) Relation between hydrolysis constant, ionic product of water and dissociation constant, (vi) Common ion effect, (vii) Solubility product and its application to qualitative analysis.

Chemical kinetics- (i) Rate of a reaction, (ii) Instantaneous rate of a reaction and order of reaction (Zero and I order), (iii) Factors affecting the rate of reaction, concentration of reactant molecule, effect of temperature on the reaction rate, concept of activation energy, catalysis, (iv) Effect of light on rate of reaction, (v) How fast are chemical reactions?

Chemical thermodynamics Thermodynamics and chemical energy science- Basic concepts of thermodynamics, types process, first law of thermodynamics, complete heat, heat capacity, entropy heat of fusion, heat of vaporization, heat of sublimation. Exothermic and endothermic reactions. Adsorption- Definition, type (physical and chemical) and factors affecting adsorption.

Acids and bases- (i) Hydrogen and hydroxyl ion in aqueous solution, (ii) Bronsted-Lowey concept of acids and bases, (iii) Lewis concept (iv) Dissociation of acids, (v) pH value, (vi) Buffer solutions, (vii) Theory of indicators of acid-alkali titrations, (viii) Choice of indicators.

Unit– B

(10 questions)

Colloidal state of matter- (i) Crystalloid and colloids, (ii) Classification of colloids -Emulsion, preparation of colloids, lyophilic and lyophobic colloids, (iii) Properties- electrophoresis, dialysis, Tyndall phenomenon, Brownian movement, Coagulation- Hardy and Schulze's law, peptisation, absorption, applications.

Metals- (i) Nature of metallic state- structural packing of atom in metals. Metallic bond- valence bond concept, (ii) Occurrence of metals in nature, (iii) General principles of metallurgy- activity series of metals, standard electrode potential, metallurgical processes, (iv) Extraction of metals- copper, silver, aluminum and iron.

S-Block elements- (i) General characteristics, (ii) Trends in variation of properties in periodic table of alkali and alkaline earth metals, (iii) General principles of extraction of the elements, (iv) General chemistry of their compounds.

D-Block elements- (i) General characteristics, (ii) Elementary idea about paramagnetism and diamagnetism, (iii) Different oxidation states, (iv) Chemistry of transition elements as illustrated by different oxidation states of the following metals- Silver, gold, chromium, manganese and iron.

Unit– C

(10 questions)

Agricultural chemistry

Soil-Soil, minerals, rocks and its weathering, definition, functions of soil and characteristics soil is a natural body; soil is a medium for plant growth, soil composition, soil profile, earth, rocks and type of minerals, weathering of rocks and soil formation, factors of soil formation. **Soil organic matter and soil microorganism-** Definition, source, composition, decomposition, factors affecting the decomposition of organic matter, humus, definition, properties and formation, effect of organic matter on soil properties and fertility, soil microorganism, C:N ratio and nitrogen cycle, symbiotic and non-symbiotic nitrogen fixation. **Soil colloids-** Definition, types and importance, properties and classification, major clay minerals present in soil, importance of clay in soil. **Ion exchange-** Importance, mechanism of cation exchange, kinds of exchange exchangeable cations, cation exchange capacity- Definition, importance and factors affecting, percent base, saturation, cation and nutrition of plant. **Soil reaction-** (P_H , P_H^- scale, changes in P_H , relationship of soil P_H with availability of nutrient, effect of soil P_H soil microorganism, plant growth and disease, buffering capacity. **Acidic and saline soil-** Definition, characteristics, reason for formation of acidic soil, effect of acidic on plant and chemical amelioration, classification of salt affected soils, definition, reason for formation of saline and sodic soil and formation, effect of soil sodicity and salinity on plants, diagnosis of saline and sodic soil and its reclamation, properties of irrigation water and treatment of saline water and management. **Essential nutrients of plants-** Classification, sources of plant nutrients in soil, mechanism of absorption of

nutrients by plant, factors affecting the availability of nutrients, specific function of nutrients and deficiency symptoms. **Reaction of different fertilizers in soil & effects on crops-** Definition of fertilizer and classification properties, composition and effect on soil and crop of urea, calcium ammonium nitrate (CAN), ammonium sulphate, diammonium phosphate (DAP), single super phosphate, muriate of potash, potassium chloride and potassium sulphate. **Agrochemicals and environmental pollution-** Definition, types, importance, definition of environment and environmental pollution, types of environmental pollution its harmful effect and control measures, effect of uncontrol application of agrochemicals on environmental pollution (soil, water, air) and its control. **Biochemistry-** Preservatives- definition, types, uses and characteristics. **Edible colour-** Definition, types, characteristic and its effect on health, definition, importance and major sources for availability of carbohydrate, protein, fat, vitamin and enzymes. **Organic manures and bio fertilizers-** Definition, classification of organic manures, effect of organic manures on physical, chemical and biological properties, formation method, importance and effect on soil for farm yard manure, vermicompost, Nadep compost, green manure cakes and its importance in soil, bio fertilizer- Definition, classification, importance and benefits, method of application, deference between organic manure and fertilizer. **Dairy chemistry-** Milk and colostrum- Definition, chemical composition, nutritive value, factors effecting composition. Nutritive value and chemical composition of milk products (dahi, butter, ghee, cream, chhana) applied material for milk adulteration and its test. Milk processing method, clean and preservative, milk production, market milk and its types.

Unit-D.

(10 questions)

Organic Chemistry

Some basic principles and techniques- General introduction, methods of purification, qualitative and quantitative analysis, classification and IUPAC nomenclature of organic compounds. Electronic displacements in a covalent bond: inductive effect, electromeric effect, resonance and hyper conjugation. Homolytic and heterolytic fission of a covalent bond- Free radicals, carbocations, carbanions, electrophiles and nucleophiles, types of organic reactions. **Valency of carbon and hybridisation-** (i) Tetra-valency of carbon atom, Kekule, Vant-Hoff and Le-Bell theories, (ii) Orbital representation of covalent bond, multiple bonding (sigma bond: Pi bond), (iii) Hybridization (sp, sp², sp³ hybridization), (iv) Orbital structure of acetylene, ethylene and methane, (v) Concept of bond length, bond strength and bond angle, (vi) Electronegativity inductive effect, polarity of covalent bond, formal charge, polarity of carbon, Halogen bond.

Saturated hydrocarbons (upto 5 carbon atoms)- (i) Nomenclature and isomerism, (ii) General methods of preparation of alkanes, (iii) General properties and uses of

alkanes, (iv) Individual members propane, butane, pentane, (v) Inter conversions of alkanes.

Unsaturated hydrocarbons- (i) Nomenclature and isomerism, (ii) General methods of preparation of alkenes and alkynes, (iii) General properties and uses of alkenes and alkynes with reaction mechanism, (iv) Individual members, propene, butene, propyne and butyne.

Organic chemistry based on functional groups a- (i) Halides, nomenclature and isomerism, general methods of preparation of mono alkyl halides- general properties of mono alkyl halides with reaction mechanism. Preparations and properties of dihalogen derivatives, synthetic uses of alkyl halides, (ii) Hydroxy compounds- nomenclature and isomerism, classification of monohydric alcohols, general methods of preparation of monohydric alcohols, general properties and uses of monohydric alcohols, hydrogen bonding in alcohol and its effect on boiling point and solubility, test for alcoholic groups, Inter conversion of methanol and ethanol.

Organic chemistry based on functional groups b- (i) **Carbonyl groups-** nomenclature and isomerism of aldehydes and ketones, general preparations of aldehydes and ketones, general properties and uses of aldehydes and ketones with reaction mechanism, polarity of carbon-oxygen double bond; test for aldehydes and ketones, (ii) Carboxylic group- Nomenclature and isomerism. General preparations of monocarboxylic acids, general properties and uses of carboxylic acid, hydrogen bonding in carboxylic acids, resonance.

Synthetic and natural polymers- (i) Classification of polymers, (ii) Some important natural and synthetic polymers with their general methods of preparation.

Chemistry in action- (i) Dyes, (ii) Chemicals in medicines, (iii) Fertility contraceptives, material scheme- sterilints.

MATHEMATICS

Unit-A: Sets and functions

(5 questions)

Sets-Sets and their representations. Different type of set. Empty set. Finite and Infinite sets. Equal sets. Subsets. Subsets of a set of real numbers especially intervals (with notations). Power set. Universal set. Venn diagrams. Union and Intersection of sets. Difference of sets. Complement of a set. Properties of Complement. Operation of set. Primary operation of sets represented by Venn diagrams. **Relations & functions-** Open sentence, ordered pairs. Cartesian product of two sets. Relation as a set of ordered points, Invers relation, Identity relation, Kinds of relation. Number of elements in the Cartesian product of two finite sets. Cartesian product of the set of reals with itself (upto $R \times R \times R$). Definition of relation, pictorial diagrams, domain, co-domain and range of a relation. Junctions, Function as a set of ordered pairs, function as a special type of relation. Pictorial representation of a function, domain, co-domain and range of a function. Real valued functions, domain and

range of these functions, constant, identity, polynomial, rational, modulus, signum, exponential, logarithmic and greatest integer functions, with their graphs. Sum, difference, product and quotients of functions. Types of relations: reflexive, symmetric, transitive and equivalence relations. One to one and onto functions, composite functions, inverse of a function. Binary operations.

Unit-B: Algebra

(5 questions)

Principle of mathematical induction-Process of the proof by induction, motivating the application of the method by looking at natural numbers as the least inductive subset of real numbers. The principle of mathematical induction and simple applications. **Complex numbers and quadratic equations** -Set of complex numbers, theorems on complex numbers, basic operations of set of complex numbers, some properties of conjugate complex numbers, Need for complex numbers, especially $\sqrt{-1}$, to be motivated by inability to solve some of the quadratic equations. Algebraic properties of complex numbers. Argand plane and polar Representation of complex numbers. Statement of Fundamental Theorem of Algebra, solution of quadratic equations (with real coefficients) in the complex number system. Square root of a complex number, cube root of unit, quadratic equation. **Linear inequalities**- Linear inequalities. Algebraic solutions of linear inequalities in one variable and their representation on the number line. Graphical solution of linear inequalities in two variables. Graphical method of finding a solution of system of linear inequalities in two variables. **Permutations and combinations** -Fundamental principle of counting (multiplication & Addition). Factorial n . ($n!$) Permutations and combinations, Permutations of those objects in which not all distinct, Circular permutations, difference between clockwise and anticlockwise permutations. Derivation of formulae for and their connections, simple applications. **Binomial theorem**-History, statement and proof of the binomial theorem for positive integral indices. **Sequence progression and series** - Sequence and Series. Arithmetic Progression (A. P.), Properties of A.P., Arithmetic Mean (A.M.) Geometric Progression (G.P.), general term of a G.P. and A.P., sum of n terms of a G.P., infinite G.P. and its sum, geometric mean (G.M.), relation between A.M. and G.M. Sum of an infinite of G.P. Arithmetic Geometric series, sum to n terms of series of natural numbers, their squares and cubes, sum of series by difference method, Harmonic progression (H.P.) Harmonic mean (H.M.), relation between A.M., G.M. and H.M. **Logarithm**-Logarithm, fundamental laws and systems of logarithm, relation between Napierian & common logarithm, Characteristics and mantissa of the logarithm, Introduction and method to find antilogarithm.

Matrices-Concept, notation, order, equality, types of matrices, zero and identity matrix, transpose of a matrix, symmetric and skew symmetric matrices. Operation

on matrices: Addition and multiplication and multiplication with a scalar. Simple properties of addition, multiplication and scalar multiplication. Noncommutativity of multiplication of matrices and existence of non-zero matrices whose product is the zero matrix (restrict to square matrices of order 2). Concept of elementary row and column operations. Invertible matrices and proof of the uniqueness of inverse, if it exists; (Here all matrices will have real entries) **Determinants**-Determinant of a square matrix (up to 3 x 3 matrices), properties of determinants, minors, co-factors and applications of determinants in finding the area of a triangle. Adjoint and inverse of a square matrix. Consistency, inconsistency and number of solutions of system of linear equations by examples, solving system of linear equations in two or three variables (having unique solution) using inverse of a matrix.

Unit-C: Coordinate geometry

(5 questions)

Straight Lines- Shifting of origin. Slope of a line and angle between two lines. Various forms of equations of a line: parallel to axis, point -slope form, slope-intercept form, two-point form, intercept form and normal form. General equation of a line. Straight line and linear equation in x , y , reduction of general equation of straight line into standard forms, straight line passing through one point, two point. At last equation of line passing through a given point and making a certain angle with the given line. Equation of family of lines passing through the point of intersection of two lines angle between two lines. Distance of a point from a line. **Conic sections** -Sections of a cone: circles, ellipse, parabola, hyperbola, a point, a straight line and a pair of intersecting lines as a degenerated case of a conic section, different forms of conic section. Standard equations and simple properties of parabola, ellipse and hyperbola.

Introduction to three-dimensional geometry- Coordinate axes and coordinate planes in three dimensions. Coordinates of a point. Distance between two points and section formula.

Unit-D: Vectors and three-dimensional geometry

(5 questions)

Vectors and scalars, magnitude and direction of a vector. Direction cosines and direction ratios of a vector. Types of vectors (equal, unit, zero, parallel and collinear vectors), position vector of a point, negative of a vector, components of a vector, addition of vectors, multiplication of a vector by a scalar, position vector of a point dividing a line segment in a given ratio. Definition, Geometrical Interpretation, properties and application of scalar (dot) product of vectors, vector (cross) product of vectors, scalar triple product of vectors. **Three - dimensional geometry**- Direction cosines and direction ratios of a line joining two points. Cartesian equation and vector equation of a line, coplanar and skew lines, shortest distance between two

lines. Cartesian and vector equation of a plane. Angle between (i) two lines, (ii) two planes, (iii) a line and a plane. Distance of a point from a plane.

Unit-E: Calculus

(5 questions)

Limits and derivatives- Derivative introduced as rate of change both as that of distance function and geometrically. Intuitive idea of limit. Limits of polynomials and rational functions trigonometric, exponential and logarithmic functions. Theorems on limit, meaning of $x \rightarrow a$. Definition of derivative relate it to slope of tangent of the curve, derivative of sum, difference, product and quotient of functions. Derivatives of polynomial and trigonometric functions. Geometrical detail of derivative of functions.

Continuity and differentiability -Continuity and differentiability, derivative of composite functions, chain rule, derivatives of inverse trigonometric functions, derivative of implicit functions. Concept of exponential and logarithmic functions. Derivatives of logarithmic and exponential functions. Logarithmic differentiation, derivative of functions expressed in parametric forms. Second order derivatives. Rolle's and Lagrange's Mean Value Theorems (without proof) and their geometric interpretation. **Applications of derivatives** -Applications of derivatives: rate of change of bodies, increasing/decreasing functions, tangents and normal, use of derivatives in approximation, maxima and minima (first derivative test motivated geometrically and second derivative test given as a provable tool). Simple problems (that illustrate basic principles and understanding of the subject as well as real-life situations).

Integrals - Integration as inverse process of differentiation. Integration of a variety of functions by substitution, by partial fractions and by parts, Definite integrals as a limit of a sum, Fundamental Theorem of Calculus (without proof). Basic properties of definite integrals and evaluation of definite integrals. **Applications of the integrals**-Applications in finding the area under simple curves, especially lines, circles/ parabolas/ellipses (in standard form only), Area between any of the two above said curves (the region should be clearly identifiable). **Differential equations** -Definition, order and degree, general and particular solutions of a differential equation. Formation of differential equation whose general solution is given.

Unit-F: Mathematical reasoning

(5 questions)

Mathematically acceptable statements. Connecting words/ phrases - consolidating the understanding of "if and only if (necessary and sufficient) condition", "implies", "and/or", "implied by", "and", "or", "there exists" and their use through variety of examples related to real life and Mathematics. Validating the statements involving the connecting words, difference among contradiction, converse and contrapositive.

Linear programming- Introduction, related terminology such as constraints, objective function, optimization, different types of linear programming (L.P.) problems, mathematical formulation of L.P. problems, graphical method of solution for problems in two variables, feasible and infeasible regions (bounded or unbounded), feasible and infeasible solutions, optimal feasible solutions (up to three nontrivial constraints).

Unit-G: Statistics and probability (5 questions)

Statistics -Measures of dispersion: range, mean deviation (Quartile deviation and mean deviation-mean, median, mode) variance and standard deviation of ungrouped/grouped data. Analysis of frequency distributions with equal means but different variances. Probability - Random experiments; outcomes, sample spaces (set representation). Events- algebra of events. Occurrence of events, 'not', 'and' and 'or' events, exhaustive events, mutually exclusive events, Axiomatic (set theoretic) probability, connections with other theories addition and subtraction of probability of occurrence of at least one event. Probability of an event, probability of 'not', 'and' and 'or' events. Conditional probability, multiplication theorem on probability, independent events, total probability, Bayes' theorem, Random variable and its probability distribution, mean and variance of random variable. Repeated independent (Bernoulli) trials and Binomial distribution.

Unit-H: Trigonometric functions (5 questions)

Positive and negative angles. Measuring angles in radians and in degrees and conversion from one measure to another. Definition of trigonometric functions with the help of unit circle. Truth of the identity $\sin^2x + \cos^2x = 1$, for all x . Signs of trigonometric functions. Domain and range of trigonometric functions and their graphs. Expressing $\sin(x \pm y)$ and $\cos(x \pm y)$ in terms of $\sin x$, $\sin y$, $\cos x$ & $\cos y$ and their simple applications. Identities related to $\sin 2x$, $\cos 2x$, $\tan 2x$, $\sin 3x$, trigonometric equations of the type $\sin y = \sin a$, $\cos y = \cos a$ and $\tan y = \tan a$. **Inverse trigonometric functions** - Definition, range, domain, principal value branch. Graphs of inverse trigonometric functions. Elementary properties of inverse trigonometric functions.

PHYSICS

Unit-A (10 questions)

Physical world- Physics-scope and Expansion; nature of physical laws; Physics, technology and society.

Units and measurements: Need for measurement, Units of measurement, systems of units; SI units fundamental, merits of S-I unit, Rules to write name and symbol for units in S.I. system and derived units. Length, mass and time measurements, least

count of Vernier Calipers and screw gauge. accuracy and precision of measuring instruments; errors in measurement; systemic, random, gross error, combination of errors, significant figures. Dimensions of physical quantities, dimensional analysis and its applications. Use of dimensional equations and limitations of dimensional equation.

Kinematics- Motion in a straight line- Frame of reference, Motion in a straight line: Position-time graph, speed and velocity. Elementary concepts of differentiation and integration for describing motion, uniform and non- uniform motion, average speed and instantaneous velocity, uniformly accelerated motion, velocity - time and position-time graphs. Relations for uniformly accelerated motion.

Motion in plane-Scalar and vector quantities; position and displacement vectors, representation of vector, one dimensional, two dimensional and three-dimensional vectors in Cartesian coordinate system, combination of 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. Differential and integer calculus and their trigonometry means, logarithm and its uses. Motion in a plane, cases of uniform velocity and uniform acceleration- uniform circular motion. **Dynamics** – Frame reference Concept of rest and motion, type of motion, distance and displacement, speed and velocity (average and instantaneous), acceleration, (average and instantaneous), displacement and time, velocity and time graph study, equation for motion for uniform accelerated motion, relative motion. Two Dimensional and three-dimensional motion and its example, displacement, velocity and acceleration of particle in two-dimensional motion and their representation. Projectile motion, path of projectile motion, time of flight of a projectile, maximum height and horizontal projectile. Example of three-dimensional motion.

Laws of motion- Intuitive concept of force, Inertia, Inertia and Newton's first law of motion; momentum and Newton's second law of motion, impulse and impulse-momentum theorem, Newton's third law of motion. Law of conservation of linear momentum and its applications. System with variable mass, motion of a rocket, solution of problem in mechanics by concurrent force and force diagram. Friction, type of friction and its law. Equilibrium of concurrent forces, Static and kinetic friction, laws of friction, rolling friction, lubrication. **Dynamics of uniform circular motion:** Circular motion in horizontal and vertical plane. Centripetal force, examples of circular motion (vehicle on a level circular road, vehicle on a banked road). Motion on inclined planes, inertial and Non-inertial frames of references.

Work, energy and power- Work done by a constant force and a variable force; energy and its type: kinetic and potential energy, work-energy theorem, power. Notion of potential energy, potential energy of a spring, conservative forces:

conservation of mechanical energy (kinetic and potential energies); conservative and non-conservative forces: motion in a vertical circle; elastic and inelastic collisions in one and two dimensions. power.

System of particles and rotational motion- Centre of mass of a two-particle system, momentum conservation and centre of mass motion. Centre of mass of a rigid body; centre of mass of a uniform rod. Moment of a force, torque, angular momentum, law of conservation of angular momentum and its applications. Equilibrium of rigid bodies, rigid body rotation and equations of rotational motion, comparison of linear and rotational motions. Moment of inertia, theorem of moment of inertia, moment of inertia of circular ring, circular disc, solid cylinder, solid sphere, hollow sphere, Solid sphere, rod, force or torque, angular momentum, relation between torque and angular momentum, relation between torque, moment of inertia and angular acceleration. Radius of gyration, values of moments of inertia for simple geometrical objects (no derivation). Statement of parallel and perpendicular axes theorems and their applications. Angular velocity, angular acceleration, angular displacement relation between linear and angular acceleration, rolling motion inclined plane, law of conservation of angular momentum.

Unit-B

(10 questions)

Gravitation- Kepler's laws of planetary motion, universal law of gravitation. Gravitational field, Acceleration due to gravity and its variation with altitude and depth. Gravitational potential energy and gravitational potential, escape velocity, orbital velocity of a satellite, Geo-stationary satellites. Projection velocity, Gravitational field & its intensity, variation in acceleration due to gravity with shape of earth & its rotation polar satellite, Weightlessness, Orbital Energy. Orbital velocity of satellite, Revolution period, Achievement of India in space.

Properties of bulk matter: Mechanical properties of solids: Elastic behavior, Stress-strain relationship, Hooke's law, Young's modulus, bulk modulus, shear modulus of rigidity, Poisson's ratio; elastic energy. Determination of young's modulus of elasticity by Searl's method. **Mechanical properties of fluids-** Pressure due to a fluid column; Pascal's law and its applications (hydraulic lift and hydraulic brakes), effect of gravity on fluid pressure, Atmospheric pressure, **Viscosity-** Stokes' law, terminal velocity, viscosity coefficient, velocity gradient, Stocks Law, Terminal velocity, streamline and turbulent flow, critical velocity, Bernoulli's theorem and its applications, Reynold's number, equation of continuity, Different energy of flowing liquid, Surface energy and surface tension, angle of contact, excess of pressure across a curved surface, application of surface tension ideas to drops, bubbles and capillary rise, Angle of contact, Cohesive and adhesive forced. **Thermal properties of matter-** Heat, temperature, thermal expansion; thermal expansion of solids, liquids and gases, anomalous expansion of water; specific heat capacity; C_p , C_v -

calorimetry; change of state - latent heat capacity. Heat transfer conduction, convection and radiation, thermal conductivity, qualitative ideas of blackbody radiation: Absorption and emissive power, Newton's law of cooling, Wein's displacement Law, Stefan's law, Greenhouse effect. Calculation of specific heat of liquid by the help of colorimeter.

Thermodynamics- Thermal equilibrium and definition of temperature (zeroth law of thermodynamics), mechanical equivalent of heat, heat, work and internal energy. Different thermodynamic Processes and work. First law of thermodynamics, isothermal and adiabatic processes. Second law of thermodynamics: reversible and irreversible processes, Heat engine and Refrigerator. Carnot Engine and its efficiency,

Behavior of perfect gases and kinetic theory of gases- Kinetic theory of gases - assumptions, concept of pressure. Kinetic interpretation of temperature; rms speed of gas molecules; degrees of freedom, law of equi-partition of energy (statement only) and application to specific heat capacities of gases; concept of mean free path, Avogadro's number.

Mechanical Waves and ray optics: oscillations and waves- 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 loaded spring-restoring force and force constant; energy in S.H.M. Kinetic and potential energies; simple pendulum derivation of expression for its time period. Displacement velocity and acceleration for SHM and their graphical representation. Kinetic energy of SHO, graphical representation and energy conservation, example of simple SHM, loaded spring, Simple pendulum, calculation of values of gravitational by simple pendulum, combination of springs, Free, forced and damped oscillations (qualitative ideas only), resonance. **Wave motion-** Transverse and longitudinal waves, speed of wave motion, displacement relation for a progressive wave, principle of superposition of waves, reflection of waves, standing waves in strings and organ pipes, Wave velocity, Relation between amplitude and intensity of waves, progressive wave equation, Super position of waves, Velocity of transverse waves stretched string, formation of standing waves, Standing waves in stretched string and mode of vibration and laws of vibration, standing waves in air column and mode of vibration, resonance, sonometer, sound waves and velocity of sound in various mediums, Dependency of velocity on sound on temperature, Beats and its application, Doppler's effect in sound waves. **Ray optics-** Reflection of light, spherical mirrors, mirror formula, refraction of light, total internal reflection and its applications, optical fibers, refraction at spherical surfaces, lenses, thin lens formula, lens maker's formula, magnification, power of a lens, combination of thin lenses in contact, refraction and dispersion of light through a prism.

Scattering of light - blue color of sky and reddish appearance of the sun at sunrise and sunset. Optical instruments: Microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers.

Unit-C

(10 questions)

Electrostatics- Electric Charges; types of charge and properties Conservation of charge, Coulomb's law force between two-point charges, forces between multiple charges; superposition principle and continuous charge distribution. Electric field, electric field due to a point charge, electric field due to a system of charge, electric field lines and properties, electric dipole and dipole moment, electric field due to a dipole, torque on a dipole in uniform electric field. **Gauss's law and its applications-** Electric flux, continuous charge distribution, Gauss's theorem and its derivatives, calculation of intensity of electric field by Gauss's Law i) due to infinitely long straight wire, ii) infinite uniformly charged non conducting sheet iii) uniformly charged infinite conducting plate iv) uniformly charged non-conducting sphere v) uniformly charged thin spherical shell (field inside and outside). **Electrostatic potential and capacitance-** Electric potential, potential difference, electric potential due to a point charge, a dipole and system of charges; equipotential surfaces, relationship between electric field and potential, calculation of electric potential due to i) charged spherical shell ii) charge conducting sphere iii) charged non-conducting sphere, potential energy system of charge, work done and potential energy of electric dipole in electric field. Electrical potential energy of a system of two-point charges and of electric dipole in an electrostatic field. Conductors and insulators, free charges and bound charges inside a conductor. Dielectrics and electric polarization, capacitors and capacitance of conductor, capacitance of an isolated spherical conductor, combination of capacitors in series and in parallel, capacitance of a parallel plate capacitor with completely, partial and different thickness and without dielectric medium between the plates, energy stored in a capacitor.

Current electricity- Electric current, flow of electric charges in a metallic conductor, drift velocity, mobility and their relation with electric current; Ohm's law and its deduction, electrical resistance ohmic and non ohmic resistance, V-I characteristics (linear and non-linear), electrical energy and power, electrical resistivity and conductivity. Carbon resistors, colour code for carbon resistors; series and parallel combinations of resistors; temperature dependence of resistance. Internal resistance of a cell, potential difference and emf (Electro motive force) of a cell, terminal voltage, combination of cells in series and in parallel. Electric energy & Electric power, electrical unit, Kirchhoff's laws and simple applications. Wheatstone bridge, Meter Bridge.

Potentiometer – principle, standardization and sensitivity and its applications to measure potential difference and for comparing emf of two cells; measurement of internal resistance of a cell. Determination of internal resistance of primary cells, calibration of voltmeter and ammeter.

Electronics & Communication: classification of metals, conductors & semiconductors, intrinsic & extrinsic semiconductors, p-junction diode, forward & reverse bias, applications of junction diode as rectifier, junction transistor (CE, CB, biasing & characteristics) logic gates (OR, AND, NOT, NAND, NOR, XOR). Elements of communication system and demodulation (AM & FM).

Unit-D

(10 questions)

Magnetic effects of current: moving charges and magnetism- Concept of magnetic field, Oersted's experiment. Biot - Savart law, magnetic field due to a long and straight current carrying conductor and circular coil, comparison of small current loop with dipole Helmholtz coils, motion charge in a magnetic field force of speed in magnetic field. Force on speed charge in magnetic field, force on current carrying conductor in magnetic field, magnetic force between two parallel current carrying conducting wire and its application to current carrying circular loop. Definition of standard ampere, force and torque on current carrying rectangular loop in uniform magnetic field. Ampere's law and its applications to infinitely long straight wire. Straight and toroidal solenoids, Force on a moving charge in uniform magnetic and electric fields. Definition of ampere. Torque experienced by a current loop in uniform magnetic field; moving coil galvanometer-its current sensitivity and conversion to ammeter and voltmeter. **Magnetism and matter:** Magnetism and properties of magnetic substance natural and artificial magnet, properties of bar magnet, magnetic field line and magnetic line force, neutral point, magnetic moment of bar magnet, intensity of magnetic field, torque on bar magnet in uniform magnet field, earth magnetism, elements of earth's magnetism, magnetism and Gauss law, behaviour of substance in magnetic field, intensity of magnetization, magnetizing field, Magnetic permeability, Relationship between different magnetic quantities, classification of magnetic material, Magnetic Hysteresis curve B-H curve, selection of magnetic substance for special use. Curie law and Curie temperature, comparative studies of magnetic substance. current loop as a magnetic dipole and its magnetic dipole moment. Magnetic dipole moment of a revolving electron. Magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to its axis. Torque on a magnetic dipole (bar magnet) in a uniform magnetic field; bar magnet as an equivalent solenoid, magnetic field lines. Para-, dia- and ferro - magnetic substances, with examples. Electromagnets and factors affecting their strengths. Permanent magnets.

Electromagnetic induction and alternating currents: **Electromagnetic induction:** Magnetic flux, induction current & charge, Fleming's Right-Hand rule, induced emf in a conductor rod moving in uniform magnetic field, Induced emf and current in rectangular loop moving in non-uniform magnetic field. Energy conservation, induced emf in metal rod, metal disc, Rectangular coil rotating in uniform magnetic field. Faraday's laws, induced emf and current; Lenz's Law, Eddy currents. Self and mutual induction. **Alternating current:** Direct current: Alternating current, Instantaneous peak, Average and root mean square value of Alternating current & voltage, AC voltage in different type of ac circuits and phasor diagram. (I) Pure ohmic resistance, (II) Pure inductor circuit, (III) Pure capacitance circuit, L-R circuit, R-C circuit, LCR series circuit, series L-C-R Resonance circuit, Half power point frequencies, Band width and quality factor of a series Resonance circuit. Average power in AC circuit.

Electromagnetic waves- Basic idea of displacement current, electromagnetic waves, their characteristics, their transverse nature (qualitative ideas only). Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, X-rays, gamma rays) including elementary facts about their uses.

Dual nature of matter and radiation- Dual nature of radiation. Photoelectric effect and matter waves, Wave length of matter waves associated with different type of particles. Hertz and Lenard's observations; Einstein's photoelectric equation-particle nature of light. Matter waves-wave nature of particles, de Broglie relation. Experimental result of photo electric effect and their interpretation, concept of Photon, Davisson-Germier experiment, Heisenberg's uncertainty principle. **Atomic & Nuclear Physics:** Rutherford model of atoms, Bohr model of atom, atomic spectra, line spectra of hydrogen atom, De-Broglie explanation of Bohr's second postulate of quantization. Atomic masses & composition of nucleus, size of nucleolus, Mass energy and nuclear binding energy, radioactivity, half-life and mean life, nuclear fission and fusion. Nuclear reaction.