

**DETAILED SYLLABUS FOR THE POST OF LABORATORY
TECHNICIAN (DRUGS STANDARDIZATION UNIT)**

(AYURVEDA MEDICAL EDUCATION) - Direct Recruitment

(Cat.No:97/2022)

Part I

PHARMACY

I. PHARMACEUTICS (12 Marks)

1. Pharmacopoeia: Introduction to Pharmacopoeias with special reference to the Indian Pharmacopoeia.

2. Packaging materials: Types, selection criteria, advantages and disadvantages of glass, plastic, metal, rubber as packaging materials.

3. Pharmaceutical aids: Organoleptic (Colouring, flavouring and sweetening) agents Preservatives: Definition, types with examples and uses.

4. Unit operations (a) **Size reduction:** Hammer mill and ball mill (b) **Size separation:** official standards for powders, Sedimentation methods of size separation, Cyclone separator (c) **Mixing:** Double cone blender, Turbine mixer, Triple roller mill and Silverson mixer homogenizer (d) **Filtration:** Theory of filtration, membrane filter and sintered glass filter (e) **Drying:** Tray dryers, fluidized bed dryer, Vacuum Dryer and freeze dryer (f) **Extraction:** Definition, Classification, method and applications.

5. Heat process:

(a) Evaporation: Definition, Factors affecting evaporation, study of evaporating still and Evaporating pan.

(b) Distillation: Simple distillation and fractional distillation, steam distillation and vacuum distillation, study of vacuum still, preparation of purified water I.P. and water for injection I.P.

6. Sterilization: Concept of sterilization and its differences from disinfection. Sterilization with moist heat, Dry heat sterilization, Sterilization by radiation, Sterilization by filtration and Gaseous sterilization.

Aseptic techniques: Applications of sterilization process in hospitals particularly with reference to surgical dressings and intravenous fluids. Precautions for safe and effective handling of sterilization equipment.

7. Dosage Forms:

(a) Tablets: Definition; different type of compressed tablets and their properties. Processes involved in the production of tablets; Tablets excipients; Defects in tablets; Evaluation of Tablets; Physical standards including Disintegration and Dissolution. Tablet coating-sugar coating, film coating, enteric coating and micro-encapsulation.

(b) Capsules: Hard and soft gelatin capsules, different sizes of capsules, filling of capsules, handling and storage of capsules, special applications of capsules.

(c) Liquid dosage forms

(i) Monophasic Liquid Dosage Forms: Mixtures, Syrup, Elixir, Linctuses, Liniment, Lotion, Gargles, Mouth Wash, Throat Paints, Douches, Ear drops, Nasal drop and Sprays.

(ii) Biphasic Liquid Dosage Forms: Suspensions and Emulsions.

(d) Semisolid Dosage Forms: Ointments, Pastes, Jellies, Suppositories and Pessaries.

(e) Dental and cosmetic preparations: Introduction to Dentifrices, facial cosmetics, Deodorants. Antiperspirants, shampoo and Hair removers.

(f) Parenteral dosage forms: Definition, General requirements for parenteral dosage forms. Types of parenteral formulations, vehicles, adjuvants, processing and personnel, Facilities and quality control. Preparation of Intravenous fluids and admixtures-Total parenteral nutrition, Dialysis fluids.

(g) Ophthalmic products: Study of essential characteristics of different ophthalmic preparations. Formulation additives, special precautions in handling and storage of ophthalmic products.

(h) Galenicals: (a) Preparation of tinctures and extracts (b) Introduction to Ayurvedic dosage forms.

II. PHARMACEUTICAL CHEMISTRY

(8 Marks)

1. Quality Control of Drugs and Pharmaceuticals: Importance of quality control, significant errors, methods used for quality control, Source and effect of impurities in Pharmaceuticals, importance of limit test, Principle and procedures of limit tests for chlorides, sulfates, iron, heavy metals and arsenic.

2. Volumetric analysis: Fundamentals of volumetric analysis, Acid-base titration, non-aqueous titration, precipitation titration, complexometric titration and redox titration.

Gravimetric analysis: Principle and method.

3. Important physical and chemical properties, medicinal and pharmaceutical uses, storage conditions and chemical incompatibility of the following:

(i) Acids, bases and buffers: Boric acid, Hydrochloric acid, Strong Ammonium hydroxide, Sodium hydroxide and official buffers.

(ii) Antioxidants: Hypophosphorous acid, Sulphur dioxide, Sodium bisulphite, Sodium meta-bisulphite, Sodium thiosulphate, Nitrogen and Sodium nitrite.

(iii) Topical Agents: Protective-Talc, Zinc Oxide, Calamine, Zinc stearate, Titanium dioxide and silicone polymers.

(iv) Antimicrobials and Astringents: Hydrogen peroxide (including chemical formula), Potassium permanganate, Chlorinated lime, Iodine, Solutions of Iodine, Povidone-iodine, Boric acid, Borax, Silver nitrate, Mild silver protein, Mercury, Yellow mercuric oxide and Ammoniated mercury.

(v) Expectorants and Emetics: Ammonium chloride (including chemical formula), Potassium iodide and Antimony potassium tartrate.

(vi) Antidotes: Inorganic official compounds of Iron, Iodine and Calcium, Ferrous Sulphate and Calcium Gluconate.

(vii) Antiseptics and Disinfectants: Proflavine (including chemical formula), Benzalkonium chloride, Cetrимide, Phenol, chloroxylenol, Formaldehyde solution, Hexachlorophene, Nitrofurantoin.

4. Classification, chemical name, uses, stability, storage conditions and different types of formulations of the following:

(i) Analgesic, Antipyretic and Anti-Inflammatory Agents: Morphine, Pethedine, Codeine, Aspirin (including chemical structure), Paracetamol and Pentazocin; Nonsteroidal Anti-Inflammatory Agents (NSAIDs): Indomethacin (including chemical structure), Phenylbutazone (including chemical structure), Oxyphenbutazone and Ibuprofen (including chemical structure).

(ii) Anti-Infective Agents:

Antifungal agents: Undecylenic acid, Tolnaftate, Nystatin, Amphotericin, Hamycin.

Anti-tubercular drugs: Isoniazid (including chemical structure), PAS (including chemical structure), Streptomycin, Rifampicin, Ethambutol (including chemical structure), Thiacetazone, Ethionamide, cycloserine and pyrazinamide (including chemical structure).

Sulphonamides: Sulphadiazine, Sulphaguanidine, Phthalylsulphathiazole, Succinylsulphathiazole, Sulphadimethoxine, Sulphamethoxypyridazine, Co-trimoxazole and sulfacetamide (including chemical structure)

Antimalarial Drugs: Chloroquine (including chemical structure), Amodiaquine, Primaquine, Proguanil, Pyrimethamine (including chemical structure), Quinine and Trimethoprim.

Antileprotic Drugs: Clofazimine, Thiambutosine, Dapsone (including chemical structure) and Solapsone,

(iii) Antibiotics: Benzyl penicillin (including chemical structure), Phenoxy methyl penicillin (including chemical structure), Benzathine penicillin, Ampicillin (including chemical structure), Cloxacillin, Carbenicillin, Gentamicin, Neomycin, Erythromycin, Tetracycline, Cephalexin, Cephaloridine, Cephalothin, Griseofulvin and Chloramphenicol.

(iv) Drugs Acting on Central Nervous System

Tranquilizers: Chlorpromazine (including chemical structure), Prochlorperazine, Trifluoperazine, Thiothixene, Haloperidol (including chemical structure), Triperiodol, Oxypertine, Chlordiazepoxide, Diazepam (including chemical structure), Lorazepam and Meprobamate.

Hypnotics: Phenobarbitone (including chemical structure), Butobarbitone, Cylobarbitone, Nitrazepam, Glutethamide (including chemical structure) and Paraldehyde.

General Anesthetics: Halothane (including chemical structure), Cyclopropane (including chemical structure), Diethyl ether (including chemical structure) and Methohexital sodium

Antidepressant Drugs: Amitriptyline, Nortriptyline, Imipramine (including chemical structure), Phenelzine and Tranylcypromine.

(v) Drugs Acting on Autonomic Nervous System

Adrenergic drugs: Adrenaline (including chemical structure), Noradrenaline, Isoprenaline (including chemical structure), Phenylephrine, Salbutamol, Terbutaline, Ephedrine (including chemical structure) and Pseudoephedrine.

Adrenergic antagonists: Tolazoline, Propranolol (including chemical structure) and Practolol.

Cholinergic Drugs: Neostigmine (including chemical structure), Pyridostigmine, Pralidoxime, Pilocarpine and Physostigmine (including chemical structure).

Cholinergic Antagonists: Atropine (including chemical structure), Hyoscine, Homatropine, Propantheline (including chemical structure), Benztropine, Tropicamide and Biperiden.

(vi) Diuretic Drugs: Furosemide (including chemical structure), Chlorothiazide, Hydrochlorothiazide (including chemical structure), Benzthiazide, Urea (including chemical structure), Mannitol (including chemical structure) and Ethacrynic Acid.

(vii) Anti-Neoplastic Drugs: Actinomycin, Azathioprine, Busulphan, Chloramubucil, Cisplatin, Cyclophosphamide, Daunorubicin Hydrochloride, Fluorouracil, Mercaptopurine, Methotrexate and Mytomyacin.

(viii) **Hypoglycemic Agents:** Insulin, Chlorpropamide (including chemical structure), Tolbutamide, Glibenclamide, Phenformin (including chemical structure) and Metformin.

(ix) **Diagnostic Agents:** Lopanoic Acid, Propylidone, Sulfobromophthalein-sodium, Indigotindisulfonate, Indigo Carmine, Evans blue, Congo Red and Fluorescein sodium.

III. PHARMACOGNOSY (12 Marks)

1. Quality Control of Crude Drugs: Different methods of adulteration of crude drugs and evaluation of crude drugs.

2. Occurrence, distribution, isolation, identification tests, therapeutic activities and pharmacological applications of: Alkaloids, Terpenoids, Glycosides, Volatile oils, Tannins and Resins.

3. Biological source, chemical constituents and therapeutic efficacy of the following categories of crude drugs:

Laxatives: Aloe, Rhubarb, Castor oil, Ispaghula and Senna.

Cardiotonics: Digitalis and Arjuna

Carminatives and G.I. regulators: Umbelliferous fruits, Coriander, Fennel, Ajowan, Cardamom, Ginger, Clove, Black Pepper, Asafoetida, Nutmeg and Cinnamon.

Astringents: Myrobalan, Black Catechu and Pale Catechu.

Drugs acting on nervous system: Hyoscyamus, Belladonna, Aconite, Ashwagandha, Ephedra, Opium, Cannabis and Nux-Vomica.

Anti-hypertensive: Rauwolfia

Anti-tussive: Vasaka, Tolu Balsam and Tulsi.

Anti-rheumatics: Colchicum and Guggul.

Anti-tumour agent: Vinca.

Anti-leprotics: Chaulmoorga oil.

Antidiabetics: Pterocarpus and Gymnema.

Diuretics: Gokhru and Punarnava.

Anti-dysenteric agent: Ipecacuanha.

Antiseptics and disinfectants: Benzoin, Myrrh, Neem and Turmeric.

Antimalarial: Cinchona

Oxytocic: Ergot.

Vitamins: Cod liver oil, Shark liver oil and Amla.

Enzymes: Papaya, Diastase and Yeast.

Perfumes and flavouring agents: Peppermint oil, Lemon oil, Orange oil, Lemon grass oil and sandal wood.

Pharmaceutical Aids: Honey, Arachis oil, Starch, Pectin, Kaolin, Lanolin, Beeswax, Acacia, Tragacanth, Sodium alginate, Agar, Guar gum and Gelatin.

Miscellaneous: Liquorice, Picorhiza, Dioscorea, Linseed, Shatavari, Shannkhupushpi, Pyrethrum, Tobacco, Squill and Ashwagandha.

4. Study of source, preparation and identification of the following:

(a) **Plant fibers used as surgical dressings:** Cotton, silk, wool and regenerated fibers.

(b) **Sutures:** Surgical Catgut and Ligatures

5. (a) **Basic principles involved in the traditional systems of medicine like:** Ayurveda, Siddha, Unani and Homeopathy.

(b) **Method of preparation of Ayurvedic formulations like:** Arista, Asava, Gutika, Taila, Churna, Lehya and Bhasma.

6. **Gross anatomical studies of:** Senna, Datura, Cinnamon, Cinchona, Fennel, Clove, Ginger, Nuxvomica & Ipecacuanha.

IV. PHARMACOLOGY & TOXICOLOGY (3 Marks)

1. **General Pharmacology:** Various routes of administration, advantages and disadvantages, Drug absorption, Bioavailability, Drug distribution, Biotransformation of drugs, Excretion of drugs, General mechanisms of drug action and factors modifying drug action.

2. **Drugs acting on the Peripheral Nervous System:** Definition, classification, pharmacological actions, dose, indications and contraindications of: Cholinergic drugs, Anti-Cholinergic drugs, Adrenergic drugs, Anti-adrenergic drugs and Neuromuscular blocking agents. Drugs used in Myasthenia gravis.

3. Drugs acting on eye: Mydriatics, drugs used in glaucoma.

4. Drugs acting on the Central Nervous System: General anaesthetics, Hypnotics and Sedatives, Anti-Convulsant drugs, Anti-anxiety drugs, Anti-depressant drugs, Anti-psychotics, Centrally acting muscle relaxants and Opioid analgesics.

5. Drugs acting on the Cardiovascular System: Cardiotonics, Anti-hypertensive drugs, Anti-anginal drugs and Anti-arrhythmic drugs. Drugs used in Atherosclerosis and Peripheral vasodilators.

6. Drugs Acting on the Kidney: Diuretics and Anti-Diuretics.

7. Autocoids: Physiological role of Histamine, Serotonin, Antihistamines and Prostaglandins.

8. Hormones and hormone antagonists: Hypoglycemic agents, Anti-thyroid drugs, Sex hormones, Oral contraceptives and Corticosteroids.

9. Drugs acting on digestive system: Carminatives, Digestants, Bitters, Antacids and drugs used in Peptic ulcer, Purgatives and Laxatives, Emetics, Anti-emetics and Antispasmodics.

10. Drugs acting on respiratory system: Respiratory stimulants, Bronchodilators, Nasal decongestants, Expectorants and Antitussive agents.

V. BIOCHEMISTRY & CLINICAL PATHOLOGY (7 Marks)

1. Proteins: Polypeptides and amino acids, classification, qualitative tests, biological value and diseases related to malnutrition of proteins.

2. Carbohydrates: Brief chemistry and role of carbohydrates, classification, qualitative tests and diseases related to carbohydrate metabolism.

3. Lipids: Brief chemistry and role of lipids, classification, qualitative tests and diseases related to lipids metabolism.

4. Vitamins: Brief chemistry and role of vitamins and coenzymes, classification and deficiency diseases of fat and water soluble vitamins.

5. Enzymes: Brief concept of enzymatic action and factors affecting it.

6. Therapeutics: Introduction to pathology of blood and urine. Lymphocytes and platelets, their role in health and disease. Erythrocytes-Abnormal cells and their significance. Abnormal constituents of urine and their significance in diseases.

VI. PHARMACEUTICAL JURISPRUDENCE (2 Marks)

1. Pharmacy Act, 1948: The General study of the pharmacy Act with special reference to Education Regulations, Working of state and central councils, constitution of these councils and functions and Registration procedures under the Act.

2. The Drugs and Cosmetics Act, 1940: General study of the Drugs and cosmetics Act and the Rules there under. Definitions and salient features related to retail and whole sale distribution of drugs. The powers of inspectors, the sampling procedures and the procedure and formalities in obtaining licenses under the rule. Facilities to be provided for running a pharmacy effectively. General study of the schedules with special reference to schedules C, C1, F, G, J, H, P and X and salient features of labeling and storage conditions of drugs.

3. The Drugs and Magic Remedies (Objectionable Advertisement) Act, 1954: General study of the Act, objectives, special reference to be laid on Advertisements, magic remedies and objectionable and permitted advertisements -diseases which cannot be claimed to be cured.

4. Narcotic Drugs and psychotropic substances Act, 1985: A brief study of the act with special reference to its objectives, offences and punishment.

5. Drugs (Prices Control) order, 2013: Brief introduction to the study of the order.

VII. DRUG STORE AND BUSINESS MANAGEMENT (2 Marks)

1. Drug House Management: selection of site, space lay-out and legal requirements. Importance and objectives of purchasing, selection of suppliers, credit information, tenders, contracts and price determination and legal requirements. Codification, handling of drug stores and other hospital supplies.

2. Inventory Control: Objects and importance, modern techniques like ABC,VED analysis, the lead time, inventory carrying cost, safety stock, minimum and maximum stock levels, economic order quantity, scrap and surplus disposal.

3. Sales promotion, Market Research, Salesmanship, qualities of a salesman, Advertising and Window Display.

4. Banking and Finance: Service and functions of bank, Finance planning and sources of finance.

VIII. HOSPITAL AND CLINICAL PHARMACY (2 Marks)

1. Drug Distribution system in Hospitals. Out-patient service and In-patient services: types of services detailed discussion of unit dose system, Floor ward stock system, satellite pharmacy services, central sterile services and bed side pharmacy.

2. Different Committees in the Hospital:

- (i) Pharmacy and Therapeutic Committee (PTC)
- (ii) Hospital Formulary System: Organization, Functioning and Composition.

3. Drug Information service and Drug Information Bulletin.

4. Surgical dressing: Cotton, Gauze, Bandages and Adhesive tapes including their pharmacopoeial tests for quality. Other hospital supply eg. I.V. sets, B.G. sets, Ryles tubes, Catheters, Syringes etc.

5. Application of computers in maintenance of records, inventory control, medication monitoring, drug information and data storage and retrieval in hospital retail pharmacy establishment.

6. Drug Interactions: Definition and introduction. Mechanism of Drug Interaction. Drug-drug interaction with reference to analgesics, diuretics, cardiovascular drugs, Gastro-intestinal agents. Vitamins and Hypoglycemic agents. Drug-food interaction.

7. Adverse Drug Reaction: Definition and significance. Drug-Induced diseases and Teratogenicity.

8. Drugs in Clinical Toxicity: Introduction, general treatment of poisoning, systemic antidotes, Treatment of insecticide poisoning, Heavy metal poison, Narcotic drugs, Barbiturate and Organo-phosphorus poisons.

9. Drug dependences, drug abuse, addictive drugs and their treatment and complications.

10. Bio-availability of drugs including factors affecting it.

IX. HEALTH EDUCATION AND COMMUNITY PHARMACY (2 Marks)

1. Nutrition and health: Classification of foods, requirements, diseases induced due to deficiency of vitamins and minerals-treatment and prevention.

2. Demography and family planning: Demography cycle, fertility, family planning and contraceptive methods.

3. Fundamental principles of microbiology: Classification of microbes, isolation, staining techniques of organisms of common diseases.

4. Communicable diseases: Causative agents, mode of transmission and prevention.
Respiratory infections: Chicken pox, Measles, Influenza, Diphtheria, Whooping cough and Tuberculosis.

5. Intestinal infection: Poliomyelitis, Hepatitis, Cholera, Typhoid, Food poisoning and Hookworm infection.

6. Arthropod borne infections: Plague, Malaria and Filariasis.

7. Surface infection: Rabies, Trachoma, Tetanus and Leprosy.

8. Sexually transmitted diseases: Syphilis, Gonorrhoea and AIDS.

Module No	PART II Chemistry	Marks
1	<p>Inorganic Chemistry: Bonding and Molecular Structure</p> <p>Octet rule, exceptions to octet rule; Different types of chemical bonds - Strong (Ionic, covalent, coordinate and metallic) and Weak (hydrogen bond and van der Waals bond).</p> <p>Theories of covalent bonding (valence bond theory and molecular orbital theory). Hybridization (sp, sp^2, sp^3, sp^3d, sp^3d^2, sp^3d^3 and dsp^2). Shape of molecules and VSEPR theory.</p> <p>Co-ordination compounds - Werner's theory, different terms (central metal ion, ligands - types of ligands, coordination number, oxidation number, coordination polyhedron, counter ions, homolytic and heterolytic complexes. Nomenclature, isomerism (structural and stereoisomerisms), and theory of bonding (valence bond theory and crystal field theory) in complexes. Spectrochemical series, stability of complexes. Application of complexes. Structure of metal carbonyls.</p>	6
2	<p>Organic Chemistry-I: Basic Organic Chemistry</p> <p>Nomenclature, isomerism (structural: chain, position, functional group, metamerism and tautomerism and stereo: conformational - in the case of ethane, butane and cyclohexane, geometric and optical).</p> <p>Homolytic and heterolytic modes of bond cleavage, reaction intermediates (carbocation, carbanion, carbon free radicals and carbenes), types of reagents (electrophiles & nucleophiles) and electron displacement effects (inductive, hyperconjugative, resonance and electromeric effects)</p> <p>Purification of organic compounds: sublimation, fractional crystallization, simple distillation, fractional distillation, distillation under reduced pressure and steam distillation).</p> <p>Qualitative and quantitative analyses of Carbon, Hydrogen,</p>	5

	Nitrogen, Sulphur, Halogens and Phosphorous. Aromaticity: Hückel's rule, aromaticity in homocyclic and heterocyclic compounds.	
3	<p>Organic Chemistry-II: Organic Reaction Mechanisms</p> <p>Addition (nucleophilic and electrophilic) reactions: Addition of hydrogen halides to alkenes (Markovnikov and anti Markovnikov additions). Nucleophilic additions of HCN, NaHSO₃, Grignard reagents, alcohols, ammonia and its derivatives to carbonyl compounds.</p> <p>Substitution reactions: SN₁ and SN₂ with reference to alkyl halides, electrophilic substitution (Halogenation, Nitration, Sulphonation & Friedel-Crafts Reaction) in haloarenes. Benzyne mechanism. Relative reactivity of alkyl, vinyl, allyl, benzyl and aryl halides towards nucleophilic substitution reactions.</p> <p>Pericyclic reactions: electrocyclic, cycloaddition (Diels-Alder reaction) and sigmatropic reactions. Cope rearrangement and Claisen rearrangement.</p>	4
4	<p>Organic Chemistry-III: Organic compounds containing different functional groups and Polymer Chemistry</p> <p>Alkyl and aryl halides: Preparation, reactions of alkyl and aryl halides with metals (Wurtz reaction, Fittig reaction, Wurtz-Fittig reaction, Grignard reaction and Ullmann reaction).</p> <p>Alcohols: Preparation, physical and chemical properties of 1^o, 2^o, and 3^o alcohols. Distinguishing tests (Lucas, Victor-Mayer, oxidation and catalytic dehydrogenation tests) for 1^o, 2^o, and 3^o alcohols.</p> <p>Phenols: Preparation, physical and chemical properties. Acidity of phenols. Reimer-Tiemann reaction and Kolbe's reaction.</p> <p>Ethers: Preparation, physical and chemical properties. Reaction with hydroiodic acid.</p> <p>Heterocyclic compounds: Classification. Structure of furan, pyrrole, thiophene, pyridine and pyrimidine. Comparison of their basicity.</p> <p>Polymers: Monomers, polymerization, homopolymers and copolymers. Classification of polymers - based on structure, based on intermolecular forces (elastomers, fibres, thermoplastics, thermosetting plastics), based on mode of polymerization (addition and condensation).</p>	4

5	<p>Bio-Chemistry: Biomolecules and Chemical Biology</p> <p>Amino acids - classifications, isoelectric point. Structural aspects of peptides and proteins. Protein denaturation. Carbohydrates (mono, di and polysaccharides); nucleic acids (structure and composition of RNA & DNA) and their biological functions. Enzyme Catalysis (mechanisms - lock and key & induced fit model). Enzyme chemistry including the role of co-enzymes and co-factors.</p> <p>Bio-degradable polymers: definition, applications of dextran, nylon-2-nylon-6 and PHBV polymers.</p> <p>Drugs and medicines: Antacids, antipyretics, analgesics (narcotic and antinarcotic), antiallergic, antihistamines, tranquilizers, antiseptics and disinfectants. Antibiotics - narrow spectrum and broad spectrum, bacteriostatic and bactericidal.</p>	4
6	<p>Physical Chemistry-I: States of Matter</p> <p>Gases: Kinetic theory of gases, different types of molecular velocities (average, root mean square and most probable velocities - relations between these velocities). Ideal and non-ideal gases, ideal gas equation, deviation of gases from ideal behaviour, compressibility factor (Z), van der Waal's equation of state and its application to explain deviation of gases. Critical constant of gas in terms of van der Waal's constant, Boyle's temperature, inversion temperature and critical constants (P_c, T_c and V_c). Reduced equation of state, law of corresponding state.</p> <p>Liquids: Physical properties of liquids (vapour pressure, boiling point, surface tension and viscosity) and their determination. Explanation of cleansing action of soaps.</p> <p>Solids: Classification (crystalline, amorphous, molecular, ionic, covalent and metallic). Space lattices and unit cells. Seven crystal systems and fourteen Bravais lattices. X-ray diffraction. Bragg's law. Close packing (ccp and hcp), packing efficiency, types of voids. Radius ratio rule. Structure of ionic solids (rock-salt, zinc blende, fluorite and antiferite). Defects in crystals - Stoichiometric (Schottky and Frenkel defect), non-stoichiometric (metal excess and metal deficient) and impurity defects.</p> <p>Liquid crystals - classification, examples and uses.</p>	6
7	<p>Physical Chemistry-II: Chemical and Ionic Equilibria</p> <p>Chemical Equilibria: Law of mass action and law of chemical equilibrium. Relationships between K_p, K_c and K_x. Relationship between equilibrium constant and reaction free energy. Dependence of equilibrium constant on temperature - Van't Hoff relation. Le Chatelier's principle - application to physical and chemical equilibria.</p> <p>Ionic Equilibria: Strong and weak electrolytes, degree of</p>	4

	ionization, factors affecting degree of ionization, ionic product of water. Acid-base equilibrium, concepts of acids and bases (Arrhenius, Lowry-Bronsted and Lewis). Comparison of strengths of weak acids and weak bases. pH scale, pOH scale. Buffer solutions, types of buffers; pH of buffers (Henderson equation). Salt hydrolysis - calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Solubility and solubility product of sparingly soluble salts - applications of solubility product principle, common ion effect.	
8	<p>Physical Chemistry-III: Thermodynamics, Kinetics and Surface Chemistry</p> <p>Chemical Thermodynamics: System and surroundings. Types of systems (open, closed and isolated). State variables and path variables. Internal energy and first law of thermodynamics. Different types of processes (isothermal, adiabatic, isobaric, isochoric, reversible and irreversible). Extensive and intensive properties. Concept of enthalpy, entropy and free energy. Conditions of spontaneity of a reaction. Second and third law of thermodynamics.</p> <p>Chemical kinetics: Order and molecularity of a reaction. Examples of different orders and molecularities. Pseudo first order reaction. Differential and integrated rate law for zeroth and first order reactions. Expressions for half-life (for zeroth and first order reactions). Elementary and complex reactions (opposing, parallel and consecutive reactions). Temperature dependence of reaction, rate constant, Arrhenius equation and activation energy. Collision theory of reaction rate.</p> <p>Surface Chemistry: Physical and chemical adsorption. Freundlich and Langmuir adsorption isotherms. Colloids - different classification schemes (based on physical states of dispersed phase and dispersion media, based on interaction between the dispersed phase and dispersion medium (lyophilic & lyophobic), based on the types of particles of the dispersed phase (multimolecular, macromolecular and associated colloids)) with examples. Purification of colloids - dialysis. Kinetic, optical, mechanical and electrical properties of colloids. Coagulation, Hardy Schulze rule, protection of colloids and gold number. Types of emulsions with examples.</p>	6
9	<p>Physical Chemistry-IV: Electrochemistry</p> <p>Types of cells (electrochemical and electrolytic cells). Electrochemical cells - representation, electrode reaction (of Daniel cell), electrode potential, EMF of the cell. Nernst equation. Relations connecting EMF and reaction free</p>	5

	<p>energy. Standard EMF and standard Gibb's free energy, Standard EMF and equilibrium constant. Electrolytic cells – electrolysis (electrolysis of molten NaCl, aqueous NaCl, aqueous Na₂SO₄, aqueous CuSO₄, dilute and concentrated sulfuric acid using Platinum electrodes). Quantitative aspects of electrolysis – Faraday's laws. Comparison of electrochemical and electrolytic cells. Classification of electrochemical cells – primary (Dry cell and mercury cell), secondary (lead-acid battery) and fuel cells (H₂-O₂). Conductivity: Molar and equivalent conductivity – relation between them. Variation of conductivity and molar conductivity of weak and strong electrolytes with dilution. Kohlrausch's law of independent migration of ions. Arrhenius theory of electrolytic dissociation and its applications.</p>	
10	<p>Analytical Chemistry: Principles of Spectroscopy and Chromatography</p> <p>Spectroscopy: Electromagnetic radiations, types of spectra (absorption and emission). Atomic emission spectra of hydrogen atom.</p> <p>Microwave Spectroscopy: Rigid rotors, selection rules, rotational spectra of rigid diatomic molecules.</p> <p>Vibrational Spectroscopy: harmonic oscillator, zero-point energy, selection rules, different modes of vibrations, vibrational spectra of polyatomic molecules (H₂O and NH₃).</p> <p>Raman Spectroscopy: Raman and Rayleigh scattering, selection rule for rotational-vibrational Raman spectra.</p> <p>Electronic Spectroscopy: Beer-Lambert law, electronic transitions in organic molecules.</p> <p>Fluorescence spectroscopy: Jablonski diagram, fluorescence and phosphorescence, quantum yield.</p> <p>Introduction to nuclear magnetic resonance spectroscopy: nuclear spin, chemical shift, shielding and deshielding effect. Spin-spin splitting and coupling constant. Equivalent and non-equivalent protons.</p> <p>Chromatography: Principles of chromatographic techniques (instrumentation not required) - Column Chromatography, Paper Chromatography, Thin Layer Chromatography, Gas Chromatography, High Performance Liquid Chromatography.</p>	6

NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper.

**There is no undertaking that all the topics above may be covered
in the question paper**