Detailed Syllabus for the post of Media Maker in Kerala Drugs Control Department
Category No.100/2025

(Total 100 Marks)

B.Sc. Chemistry – 40 Marks

Inorganic Chemistry (10 Marks)

Dual nature of electron, de Broglie equation, matter waves. Heisenberg's uncertainty principle, Schrodinger equation and its significance. Quantum numbers, Pauli's Exclusion principle, Aufbau Principle, Hund's rule, Electronic configuration of atoms, classification of elements into s, p, d and f blocks, Effective nuclear charge, Slaters rule and its applications, Periodic properties, Ionisation energy, Electronegativity and Electron affinity. Diagonal relationship and anomalous behaviour of first element in a group with other elements.

Ionic, Covalent and metallic bonding, Born-Haber cycle and its application, Solvation energy. Valence Bond theory, concept of hybridization, Molecular orbital theory. Molecular orbital electronic configuration of N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions, Bond order. Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, Fajan's rules. Intermolecular and intramolecular Hydrogen bondings and its consequences on boiling point, volatility and solubility.

Important characteristics of representative elements: valency, oxidation states, ionic and covalent bond formation. Boranes and carboranes. Important characteristics of transition elements: variable valency and oxidation states, formation of Complex compounds.

General principles of occurrence and extraction of metals, Concentration of ores- roasting, calcinations and smelting, Refining of metals: electrolytic and zone refining

Organo metallic compounds in medicines – organomercury, organoboron, organosilicon and organo arsenic compounds

Werner's coordination theory, Isomerism in complexes, Valence bond theory of bonding in complexes, Crystal field theory of octahedral and tetrahedral complexes, high and low spin complexes, Jahn-Teller Effect and tetragonal distortion.

Nuclear Chemistry, stability of nucleus, n/p ratio. Artificial transmutation and radioactivity, mass defect, binding energy, applications of radio activity in medicine and agriculture.

Organic Chemistry (10 Marks)

Electron displacement effects: Inductive effect, electromeric effect, mesomeric effect, resonance, hyperconjugative and steric effects. Reaction intermediates: Carbocations, carbanions, carbenes and nitrenes.

Preparation and properties of alkane, alkene and alkynes. Isomerism, Conformations of cyclohexane, E-Z nomenclature, Relative and absolute configuration: D/L and R/S designations. Preparation and properties of alcohols, aldehydes, ketones, carboxylic acids and amines.

Concept of aromaticity, Huckel's rule-Types of aromaticity- aromatic, anti-aromatic, non-aromatic, Aromaticity in benzenoid and non-benzenoid compounds and charged rings, annulenes.

Carbohydrates-classification, glucose and fructose, epimers and anomers, mutarotation. Amino acids: Classification, Zwitter ion, isoelectric point, Peptide bond. Proteins: Classification of proteins-Primary, secondary and tertiary structure of proteins, Denaturation of proteins, Tests for proteins.

Nucleic acids: nitrogenous base, nucleoside and nucleotide – Double-helical structure of DNA – Differences between DNA and RNA.

Analysis of oils and fats-saponification value, iodine value and acid value. Terpenes: Classification-Isoprene and special isoprene rule.

Enzymes: classification and characteristics, mechanism of enzyme action, Cofactors and coenzymes, enzyme inhibitors. Vitamins: Classification, biological functions and deficiency diseases of vitamins. Classification and therapeutic uses of antipyretics, Analgesics, Antimalarials and Antibiotics.

Physical Chemistry (10 Marks)

Amorphous and crystalline solids, isotropy and anisotropy, types of crystals: molecular crystals, ionic crystals, covalent crystals and metallic crystals- examples and properties. Space lattice and unit cell, Bravais lattices, close packing, Miller indices, Bragg's equation, Structure of NaCl and

CsCl, Imperfections in crystals: Stoichiometric and Nonstoichiometric defects, point defects – Schottky and Frenkel defects, F-centre.

Physical properties of liquids – vapour pressure, surface tension, viscosity, and refractive Index, factors affecting surface tension and viscosity, Interfacial tension, Surface active agent, cleansing action of detergents. Liquid crystals Types –smectic, nematic and cholesteric liquid crystals- examples, Disc shaped liquid crystals, Polymer liquid crystals, uses of liquid crystals.

Ideal gas, Ideal gas equation, gas constant: Dalton' Law of Partial pressure. Postulates of Kinetic theory of gases, collision frequency, collision diameter, mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, variation of viscosity with temperature and pressure. Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartitions of energy and degrees of freedom. Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, Z, and its variation with pressure for different gases, Causes of deviation from ideal behaviour. van der Waal's equation of state inversion temperature critical state, relation between critical constants and van der Waal's constants, Correction factors, Boyle temperature, Boyle temperature in terms of van der waal's constant. Virial equation of state and virial coefficients.

Raoult's Law for solutions of non-volatile solutes, vapour pressure of ideal solutions and relative lowering of vapour pressure. Colligative properties- lowering of vapour pressure, elevation of boiling point and depression in freezing point, molal elevation constant, molal depression constant, Osmosis and Osmotic pressure, van't Hoff equation, Isotonic, hypertonic and hypotonic solutions, Abnormal molecular mass and van't Hoff factor, determination of degree of dissociation and association, Reverse osmosis. Classification of colloids, kinetic, optical and electrical properties of colloids – Tyndall effect & applications, coagulation of colloids, Hardy-Schulz rule, Gold number.

K_P, K_C, and K_X and inter relationships, Le Chatelier's principle. pH, Buffer solutions, Henderson equation, Acidic and basic buffers-examples. Hydrolysis of salts – degree of hydrolysis and hydrolytic constant.

Rate of reactions, various factors influencing rate, order, molecularity, zero, first, second, third order reactions, fractional life time, units of rate constants, Influence of temperature on reaction rates, Arrhenius equation.

Basic concepts of thermodynamics, system, surroundings, open, closed and isolated systems Isothermal, isochoric and isobaric process, first and second law of thermodynamics, Enthalpy, Entropy and Free energy.

Analytical Chemistry (10 Marks)

Principles of volumetric analysis, primary standard, secondary standard, standard solution, calculation of normality, molality and molarity of solutions. Accuracy and precision.

Theory of Acid- Base titration: Acidimetry, Alkalimetry: Basic concepts, theory of acid-base indicators, definition of redox Reactions, Balancing of redox equations, Theory of Redox titration: Titration of Fe^{2+} with $KMnO_4$ and $K_2Cr_2O_7$ and theory of redox indicators, Theory of complexometric titration: metal ion-EDTA titration. Theory of metallochromic indicators Precipitation titration: NaCl- $AgNO_3$ titration and use of potassium chromate as adsorption indicator.

Inorganic qualitative analysis, common ion effect, solubility product, precipitation and inter group separation of cations. Salting out process.

Chromatography- principle and applications of paper and thin layer chromatography, Beer- Lambert law, colorimetric estimation of Iron and phosphate. Separation Techniques: General principles of distillation and solvent extraction.

Introduction to gravimetric analysis, factors influencing precipitation, Precipitating agents, Co-precipitation & post-precipitation.

MLT (60 Marks)

Module 1. General Microbiology (2 marks)
History and scope of Microbiology, Rules for laboratory safety and personal care, Microscopy- different types of microscopes, use, care and maintenance, principles and micrometry.

Module 2. Sterilisation and disinfection (5 marks)
Sterilisation methods employing dry heat, moist heat, filtration, radiation, and newer methods. Important disinfectants and antiseptics, their modes of action and applications, newer disinfectants and antiseptics, testing of disinfectants.

Module 3. Bacteriology (10 marks)
Structure of a bacterial cell, morphological classification of bacteria, growth requirements, multiplication of bacteria, growth curve, physical and chemical factors affecting bacterial growth. Culture media- types, ingredients, composition, preparation, pH adjustment, distribution,

sterilization, storage and uses of commonly used and special media for cultivation of aerobic and anaerobic bacteria, Quality control.
Staining of bacteria-Simple staining, differential-Gram's and Acid fast staining, special staining, negative staining, fluorescent staining-principles, methods and application.
Culture methods-Aerobic and anaerobic culture techniques.
Biochemical tests for the identification of bacteria and rapid methods of identification.
Study of medically important bacteria- scheme of identification of medically important bacteria, common infections caused and laboratory diagnosis. Microbial flora in health and disease.
Antimicrobial susceptibility testing-introduction to antimicrobial agents, preparation and storage of antimicrobial agents for testing, different methods of susceptibility testing, and use of antimicrobial agents in the identification of bacteria.
Clinical bacteriology-Collection, transport and processing of clinical specimens, serological tests, molecular techniques and Preservation of bacteria.

Module 4. Parasitology (5 marks)

Morphology and classification of Protozoa, Helminths. Common and important parasitic diseases due to protozoa, nematodes, cestodes and trematodes, and sporozoans. Morphology, life cycle and laboratory diagnosis of medically important parasites and the role of vectors in parasitic diseases.
Clinical parasitology-collection, transportation, storage, and use of preservatives/fixatives in transportation or storage of specimens.
Processing of specimens-microscopy-thin and thick blood smear preparation, staining-different staining techniques, examination and reporting, other specimens, stool examination for parasites-unstained and stained mounts, concentration methods, permanent staining techniques, rapid diagnostic tests, serodiagnosis, cultivation of parasites.

Module 5. Mycology (3 marks)

Morphological classification of fungi- Yeast, Yeast-like, Mould and Dimorphic fungi. A study of the morphology, cultural characteristics and methods of identification of medically important fungi.
Common diseases of fungal origin-cutaneous, sub-cutaneous/sub-mucous, systemic and opportunistic fungal infections.
Clinical Mycology-collection of specimens and processing, microscopy-Potassium hydroxide preparation, Lactophenol Cotton Blue preparation, Gram's staining, Negative staining, Special staining.
Cultivation of fungi-Sabouraud's Dextrose Agar, other media, slide culture.
Biochemical and other identification tests, serological tests and preservation of fungi.

Module 6. Virology, Immunology and Serology (5 marks)

Introduction to virology, structure of viruses, classification-DNA and RNA viruses-morphology, cultivation of viruses and identification of viral growth in culture, inclusion bodies and their demonstration, a brief study of important viruses.
Clinical virology-collection and transportation of viral samples, special care in handling specimens, processing of specimens, serological techniques and molecular tests in the diagnosis of viral infections.
Immunology-Introduction to the immune system, immunity, antigen, antibody, antigen-antibody reactions.
Serology-application of antigen-antibody reactions in the diagnosis of infections, Standardisation of tests, ELISA, Latex agglutination tests and other serological tests.

Module 7. Clinical Biochemistry (15 marks)

Cleaning and care of laboratory glassware, preparation of glassware for laboratory use and calibration of glassware, preparation of normal, molar and percentage solutions.
Units of measurement, purification and testing of water, biological sample collection, preservation and transportation, blood anticoagulants and urine preservatives.
Analyses of biochemical parameters from biological specimens- Glucose, RFT, LFT, Pancreatic function tests, Lipid profile, Enzyme analyses, Electrolytes, Electrophoresis, Chromatography, Quality control and Automation Laboratory instruments.

Module 8. Haematology (5 marks)

Composition of blood, blood collection technique, smear preparation, complete blood cell count, ESR, Coagulation studies, Anaemia, Leukaemia, haemoglobinopathies.

Module 9. Clinical Pathology and Blood Banking (5 marks)

Analyses of Urine, cerebrospinal fluid, seminal fluid and other body fluids.
Blood grouping and Cross matching, Selection of donors, Screening of blood, Storage and Component separation, Transfusion reactions.

Module 10. Histotechnology, Cytology and Cytogenetics (5 marks)

Basic knowledge of different types of tissues, Fixation-purpose, common fixatives, ideal fixative, methods of removing formalin pigment from tissues, Decalcification, Microtome-principle, different types, maintenance, microtome knives-sharpening, care.
Preparation of paraffin sections-Steps of tissue processing, embedding, Automatic tissue processors, trouble shooting, storage of blocks.
Staining and mounting-principle, procedure and reagent preparation of Haematoxylin & Eosin stain and other staining techniques used in histotechnology, Immunohistochemistry, mounting agents, storage of sections, Frozen sections.
Cytology-important applications, collection of specimens, preparation of smears, fixation, Papanicolaou’s staining, Shorr’s stain, Barr body demonstration.
Cytogenetics-Karyotyping, sample preparation, staining, general aspects of chromosomes and abnormal chromosomes.

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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.