DETAILEDSYLLABUS FOR THE POST OF SCIENTIFIC ASSISTANT IN AYURVEDA MEDICAL EDUCATION/ JUNIOR ASSAY MASTER IN LEGAL METROLOGY

(Cat.No. : 72/2022, 004/2023)

(Total Marks- 100)

MODULE – I: Analytical Principles (10 Marks)

Evaluation of analytical data: Accuracy and precision. Standard deviation, variance and coefficient of variation. Student 't' test, 'Q' test, and 'F' test. Confidence limits. Volumetric methods: Classification of reactions in volumetry. Theory of indicators. Complexometric titrations: Titration using EDTA-direct and back titration methods. Precipitation titrations. Redox titrations. Correlation analysis: Scatter diagram. Correlation coefficient, r. Calculation of r by the method of least squares. Applications of TG, DTA and DSC in the study of metal complexes.

MODULE – II: Separation Techniques (10 Marks)

Classification of chromatographic methods. Theory of chromatography. Applications of chromatographic methods. Adsorption and partition chromatography. Paper, thin layer and column chromatographic methods. Centrifugal TLC, LC, pressure column chromatography, HPLC and GC, column matrices. Detectors. Affinity and chiral separations using HPLC. GC MS and LC MS- Principle, instrumentation and applications. Normal and ultra-centrifugation. Gel and capillary electrophoresis and their applications.

MODULE – III: Analysis of selected materials (10 Marks)

Principles of estimation of biological fluids: Estimation and interpretation of data for blood sugar, haemoglobin, urea and cholesterol. Biological significance, analysis and assay of enzymes: pepsin, monoaminoxidase, and tyrosinase. Analysis of drugs and pharmaceuticals: quality control, official methods, classical and modern methods of drug analysis. Analysis of common drugs: analgesics, antipyretics, antimalarial, antiallergic (anti-histamines) and antibiotics.

MODULE – IV: Instrumental Methods of Chemical Analysis (10 Marks)

Flame spectrometry: introduction, elementary theory, instrumentation, type of burners, type of interferences, background correction method and applications. Atomic absorption spectroscopy (AAS) : principle and instrumentation of AAS. Atomic emission spectrometry: introduction, equipment, qualitative and quantitative analysis with AES, plasma emission spectrometry, ICP-AES, sample introduction and measurements. X-ray Photoelectron spectroscopy (XPS): introduction instrumentation, XPS imaging. Molecular fluorescence and X-ray fluorescence: instrumentation and applications.

MODULE – V: Material characterization (10 Marks)

Electron microscopies: Scanning electron microscopy (SEM), Transmission Electron Microscopy (TEM), High Resolution Transmission Electron Microscopy (HR-TEM). Probe microscopies: Atomic Force Microscopy (AFM), Scanning tunnelling microscopy (STM), Scanning tunnelling electron microscopy (STEM). X-ray methods: X-ray diffraction (XRD), Energy Dispersive X-ray Spectroscopy(EDAX), X-ray Fluorescence (XRF). Spectroscopic

techniques: IR spectroscopy for surface functionalization of nanoparticles, UV-visible – Diffused reflectance spectroscopy, photoluminescence, Raman spectroscopy. (Basic understanding of each technique with special emphasis on characterization at nano scale).
ESR spectroscopy: Electron spin. Interaction with magnetic field. Kramer's rule. The g factor. Fine structure and hyperfine structure. Analytical applications of ESR, Determination of reaction rates and mechanisms by ESR, Structural determination by ESR. Elementary idea of ENDOR and ELDOR.

MODULE – VI: Thermal and Radiochemical methods of Ana1ysis (10 Marks)

Principle, theory and instrumentation of thermo mechanical analysis (TMA) and Dynamic mechanical analysis (DMA). Thermometric titrimetry – theory, applications. Radiochemical methods of analysis: radioactive tracer techniques and its applications, principle and applications of isotope dilution analysis, neutron activation analysis and its applications. Applications of radio isotopes in industry, medicine, autoradiography, radio pharmacology, radiation safety precaution, nuclear waste disposal.

MODULE – VII: Forensic Analysis (10 Marks)

Analysis of biological substances – blood, saliva and urine. General discussion of poisons with special reference to mode of action of cyanide and organophosphates. Classification of poisons, Lethal dose, significance of LD50 and LC50. Diagnosis of poisons in the living and the dead– clinical symptoms – post mortem appearances. Antidotes for common poisons. Estimation of poisonous materials such as lead, mercury, chromium and arsenic in biological materials. DNA Finger printing, Steps involved, DNA Finger printing for tissue identification in dismembered bodies, Detecting steroid consumption in athletes.

MODULE – VIII: Spectroscopic identification of organic compounds (10 Marks)

UV & IR spectroscopy. ^{1}H NMR (proton NMR), ^{13}C NMR, Mass spectrometry, A brief account of the 2D NMR techniques like DEPT, COSY, HMQC, HETCOR, HMBC, TOCSY

MODULE – IX: Coordination chemistry (10 Marks)

Thermodynamic and kinetic stability, Stability of complex ions in aqueous solutions: Stability of chelates Crystal field theory: Splitting of d orbitals in octahedral, tetragonal, square planar, tetrahedral, trigonal bipyramidal and square pyramidal fields. Jahn-Teller theorem, evidence for JT effect, static and dynamic JT effect. Spectrochemical series. Evidence of covalency in Metal-Ligand bond, introduction to Ligand field theory. Experimental evidence of pi bond on the stability of sigma bond. Nephelauxetic effect. Interpretation of electronic spectra of complexes-Orgel diagrams, Tanabe-Sugano diagrams, calculation of Dq, B and β (Nephelauxetic ratio) values, charge transfer spectra.

MODULE – X: Surface Chemistry, Catalysis and Reaction Kinetics (10 Marks)

Different types of surfaces, properties of surface phase. Thermodynamics of surface. Surface tension of solutions. Surfactants and micelles. Examination of surfaces- Low Energy Electron Diffraction (LEED). Catalysis: Mechanism and theories of homogeneous and heterogeneous catalysis. Bimolecular surface reactions. Langmuir–Hinshelwood mechanism. Enzyme catalysis. Adsorption isotherms - Freundlich and Langmuir isotherms. Thermodynamic and statistical derivation of Langmuir adsorption isotherm. Multilayer adsorption-the BET theory
and Harkins-Jura theory. Adsorption from solutions: Gibb's adsorption equation and its verification. Adsorption with dissociation. Adsorption with interaction between adsorbate molecules. Theories of reaction rates: Collision theory and Transition state theory - Eyring equation. Thermodynamic formulation of the reaction rates. Potential energy surfaces. Reactions in solution: Factors affecting reaction rates in solutions, effect of dielectric constant and ionic strength, cage effect, Bronsted-Bjerrum equation. Kinetic effects: Primary and secondary kinetic

salt effect, influence of solvent on reaction rates, significance of volume of activation, linear free energy relationship. Hammet equation and Taft equation.

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