

**ODISHA STAFF SELECTION COMMISSION**

UNIT – II Bhubaneswar – 751001

Notice No.IIE-121/2023 - 4298 /OSSCDate: 25.10.2024

Subject: Notice regarding the schedule & syllabus of Main written examination for different posts of CGLRE for Group-B & Group-C Specialist Posts/services-2023 (Advt. No.5046/OSSC Dt.26.12.2023).

Pursuant to the Commission's Advertisement No.5046/OSSC dated 26.12.2023, Corrigendum No.763/OSSC dated 19.02.2024 and in continuation to Notification No.192(C)/OSSC dated 27.08.2024 & Notification No.194(C)/OSSC dated 28.08.2024 and Notice No.4288/OSSC dated 25.10.2024, it is for information of all concerned that the Main written examination for different post of **CGLRE Specialist Posts/services-2023** will be conducted at **Bhubaneswar** from **27.11.2024 onwards**. **The schedule with revised dates of examination for all posts is given below.**

Name of the post	Date of examination
Computer Programmer	27.11.2024 (1 st session)
Statistical Assistant	27.11.2024 (2 nd session)
Senior Laboratory Assistant	28.11.2024 (2 nd session)
Market Intelligence Inspector	
Inspector of Legal Metrology	03.12.2024 (2 nd session)
Junior Chemist	04.12.2024 (2 nd session)

Detail syllabus for Main written examination has already been uploaded on the website of the Commission vide Regulation 2 of 2024 & Regulation 3 of 2024. However, post wise **detail syllabus for all posts** is uploaded again and **enclosed below** for information of candidates.

The candidates are advised to visit the website of the Commission regularly to know further updates.

By order of the Commission

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25.10.2024
Secretary

SYLLABUS OF TECHNICAL PAPER FOR THE POST OF MARKET INTELLIGENCE INSPECTOR UNDER FS&CW DEPARTMENT.

- i. **Mathematics--** Questions on technical paper from Mathematics as expected from a candidate of 10th Standard or equivalent standard namely Number System, Polynomials, Logarithms, Percentage, Rate and Ratios, Average, Simple & Compound Interest, Time & Distance, Time & Work.
- ii. **Indian Economy--** Questions on technical paper from Indian Economic as expected from a candidate of +2 standard or equivalent namely sectorial composition of Indian economic, planning in India, fiscal federalism in India, Population, poverty and inequality.
- iii. **Statistics --** Questions on technical paper from Statistics as expected from a candidate of +2 standard or equivalent namely Collection, classification, tabulation, diagrammatic representation of Data, frequency distribution, measures of central tendency, dispersions, skewness, kurtosis, design of sample survey and probability.
- iv. **Accounting--** Questions on technical paper from Accounting namely procedure involving, cost accounting, marginal costing, cost volume, profit analysis, budget and control and standard costing etc.

SYLLABUS OF TECHNICAL PAPER FOR THE POST OF INSPECTOR OF LEGAL METROLOGY UNDER FS&CW DEPARTMENT

PHYSICS

DIGITAL AND ANALOG CIRCUITS, INSTRUMENTATION & SOLID-STATE PHYSICS

Difference between Analog and Digital Circuits, Binary Numbers, Decimal to Binary and Binary to Decimal Conversion, Semiconductor Devices and amplifiers. Crystal Structure: Solids-Amorphous and Crystalline Materials.

MECHANICS

Vectors: Vector algebra, Scalar and vector products. Derivatives of a vector with respect to a Parameter; Laws of Motion: Newton's Laws of motion; Momentum and Energy: Conservation of momentum; Work and energy; Conservation of energy. Rotational Motion: Angular velocity and angular momentum; Torque, Conservation of angular momentum; Gravitation: Newton's Law of Gravitation; Oscillations: Simple harmonic motion; Kinetic and Potential Energy. Total Energy and their time averages: Special Theory of Relativity.

WAVES AND OPTICS

Fluids: Surface Tension- Excess of pressure - Application to spherical and cylindrical drops and bubbles - variation of surface tension with temperature; Viscosity - Rate flow of liquid in a capillary tube – Poiseuille's formula - Determination of coefficient of viscosity of a liquid -Variations of viscosity of liquid with temperature- lubrication; Sound: Simple harmonic motion -forced vibrations and resonance: Wave Optics: Electromagnetic nature of light; Definition and Properties of wave front; Interference: Division of amplitude and division of wave front; Diffraction. Polarization.

THERMAL PHYSICS AND STATISTICAL MECHANICS

Laws of Thermodynamics & their applications, Reversible and irreversible processes, Entropy, Carnot's cycle: Kinetic Theory of Gases; Transport Phenomena: Viscosity. Conduction and Diffusion: Theory of Radiation.

ELECTRICITY AND MAGNETISM

Electrostatics: Electrostatic Field, electric flux. charged conductor: Electric potential as line integral of electric field. potential due to a point charge, electric dipole, Calculation of electric field from potential; Capacitance of an isolated spherical conductor; Resistances, AC and DC Voltages & Current: Checking electrical fuses: Magnetostatics: Biot-Savart's law and its applications; Electromagnetic Induction: Faraday's laws of electromagnetic induction.

SYLLABUS OF TECHNICAL PAPER FOR THE POST OF STATISTICAL ASSISTANT UNDER SCSTRTI & OFFICE OF LABOUR COMMISSION

1. APPLIED ECONOMICS

UNIT— I

Economic Growth and Development: Factors affecting economic growth, Concepts of GDP and National Income, Poverty and Inequality, Human Development indicators.

Economic Growth in India and Sectoral Composition - Impacts of liberalization and role of FDI.

Investment Criteria in Developing Countries, Alternative Investments Criteria, Cost - Benefit Analysis, Project Evaluation.

Budget- Kinds of Budget: Traditional Budgeting, Programme Budget, performance budget, Zero Base Budget, Outcome Budgeting and Gender Budget. Deficit Financing and Economic Development.

UNIT- II

Banking and Nonbanking Finance in India Role of RBI and SEBI.

Financial Inclusion: Concept, Need and trend in India, strategy to extend financial services, Institutional changes required for financial inclusion, Role of savings and rural credit structure, Micro Finance and role of SHGs. Importance of Rural Credit: Agencies for Rural Credit - Formal and Informal; Small Farmers Development Agency, National Bank for Agriculture and Rural Development, Rangarajan Committee on Financial system.

UNIT- III

Role of Education and Health in economic development, Demand and supply of education and their determinants, Cost and benefits of education, Manpower planning: programming and input-output models, Educational finance and need for privatization with special reference to India.

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Determinants of Health, Economic dimensions of health care- demand and supply of health care, financing of health care, Issues in health care delivery, Inequalities in health care: Income, class and gender dimensions, Public-Private partnership.

Economic Development and Environment, Poverty and Environment, Climate change - Problems, impacts and policy.

Pricing in social sector and issues of subsidies with special reference to India.

UNIT — IV

Role of fiscal and monetary policy in economic development and need for coordination, Indian Tax system: revenues of the centre, State and Local bodies, major taxes in India: Direct and Indirect, Recent Tax Reforms, need for GST, Non tax revenues of Centre, State and Local bodies.

Public expenditure in India- trends and composition, Globalization, WTO and their impacts on Indian Economy, Issues of privatization and safety nets in Indian economy.

Fiscal federalism in India, Center-state financial relations, Horizontal and vertical imbalances, Resource Transfer and role of Finance Commission and NITI Aayog. Criteria of Transfer and impacts, Problems of state finances and indebtedness, FRBM Act 2003 and fiscal reforms, Decentralized governance and local level finances.

UNIT - V

Agriculture in economic development, Production function approach and estimation methods, Land reforms in India, Technological changes and impacts, pricing of agricultural inputs and outputs, agricultural finance and subsidies, marketing and warehousing, Role of public investment and capital formation in agriculture. Issues of Food security and role of PDS, resource uses and policies for sustainable agriculture, Crop Insurance in India.

Growth and pattern of Industrialization in India, Evolution of Industrial policies, problems of sickness, privatization and disinvestment debate, role of MSME sector, employment generation and labour market reforms.

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UNIT- VI

Odisha Economy: Growth and Structure- Sectoral composition and trends, Poverty Issues, Social and Regional dimensions, Regional Imbalances in development, Rural development Issues in Odisha.

Social sector development in Odisha- health and education scenario - Problems and prospects.

Agriculture in Odisha, cropping pattern and diversity in agriculture, Institutional issues and role of technology. Problems and prospects. Industrialization in Odisha- trends and achievements, Issues, problems and prospects. Role of MSME sector.

State Finances: trends and issues. problems of resource mobilization and prospects. Decentralization and local level finances in Odisha.

2. MATHEMATICS

PROBABILITY & STATISTICS

Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function, discrete distributions: uniform, binomial, Poisson, continuous distributions: uniform, normal, exponential. Joint cumulative distribution function and its properties, joint probability density functions. marginal and conditional distributions, expectation of function of two random variables, conditional expectations, independent random variables.

LOGIC & SETS

Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators. Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction. Quantifiers. Binding variables and Negations. Sets, subsets, Set operations, the laws of set theory and Venn diagrams. Examples of finite and, infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standard set



operations. Classes of sets. Power set of a set. Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections. Relation: Product set, Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation.

DIFFERENTIAL EQUATIONS

First order exact differential equations. Integrating factors, rules to find an integrating factor. First order higher degree equations solvable for x , y , p . Methods for solving higher-order differential equations. Basic theory of linear differential equations, Solving a differential equation by reducing its order.

3. STATISTICS

- Probability, Probability distribution (binomial, poisson & normal distribution)
- Compilation, classification, tabulation of statistical data, graphical presentation of data.
- Measure of central tendency, measure of dispersion, measure of association and contingency, scatter diagram, correlation, rank correlation coefficient and linear regression analysis for two variables.
- Concept of population, sample, parameter, statistic, sampling distribution and principle of sampling, simple random sampling, stratified sampling, sampling and non-sampling error.
- Concept of hypothesis: null and alternative hypothesis, type-1 & type- 2 error, testing of hypothesis for large sample and as well as small sample including chi-square, t, f test.
- Time series analysis, component of variation, index number, demographic method
- Official statistics, CSO, NSSO.

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SYLLABUS OF TECHNICAL PAPER FOR THE POST OF COMPUTER PROGRAMMER UNDER BOARD OF REVENUE

1. Computer Fundamentals & Information Technology
2. Office Automation (Word, Excel, Power-Point)
3. DMBS (MS-Access, MS-SQL)
4. Web Designing using HTML, DHTML, XHTML, JavaScript, CSS, Photoshop
5. Operating System (DOS, Windows, Linux)
6. OOPs & Programming with C/C++
7. Computer Networks, Internet, E-commerce & Email

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SYLLABUS FOR WRITTEN EXAMINATION FOR RECRUITMENT TO THE POST
OF SENIOR LABORATORY ASSISTANT

PAPER-I

1) PHARMACEUTICAL CHEMISTRY AND MEDICINAL CHEMISTRY:-

Unit-I:- Pharmaceutical inorganic Chemistry:-

- Sources and types of impurities, principle involved in the limit test for Chloride, Sulphate, Iron, Arsenic, Lead and Heavy metals, modified limit test for Chloride and Sulphate.
- Acid, Bases and Buffers, Electrolytes used in the replacement therapy: Sodium chloride, Potassium chloride, Calcium gluconate and Oral Rehydration Salt (ORS), Dental products.
- Gastrointestinal agents: - Acidifiers, Antacid, Cathartics, Antimicrobials.
- Expectorants, Emetics, Haematinics, Poison and Antidote, Astringents and Radiopharmaceuticals.

Unit-II:- Pharmaceutical Organic Chemistry:-

- Classification of organic compounds, Common and IUPAC systems of nomenclature of organic compounds.
- Preparation, reactions and uses of Alkanes, Alkenes, Alkynes, Alkyl halides, Alcohols, Aldehydes, Ketones, Carboxylic acids, cycloalkanes, Aliphatic amines, Aromatic Hydrocarbons (Benzene, Phenol), Aryl halides.
- Stereo isomerism and Geometrical isomerism.
- Nomenclature and classification Synthesis, reactions and medicinal uses of following compounds/derivatives Pyrrole, Furan, and Thiophene.

Unit-III:- Medicinal Chemistry:-

- Physicochemical properties in relation to biological action
Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism.
- Drug metabolism: Drug metabolism principles- Phase I and Phase II. Factors affecting drug metabolism including stereo chemical aspects.
- Classification, synthesis, MOA, SAR and uses of following classes of drugs:-
 - Drugs acting on Autonomic Nervous System: Adrenergic Neurotransmitters, Sympathomimetic agents, Adrenergic Antagonists.
 - Cholinergic neurotransmitters: Para sympathomimetic agents.
 - Cholinesterase reactivator, Cholinergic Blocking agents.
 - Drugs acting on Central Nervous System: Sedatives and Hypnotics, Antipsychotics, Anticonvulsants, General anesthetics,

Narcotic and non-narcotic analgesics (Morphine and related drugs), Narcotic antagonists and Anti-inflammatory agents.

- Antihistaminic agents (H1 & H2 Antagonists), Gastric Proton pump inhibitors, Anti-neoplastic agents, cardiovascular drugs, drugs acting on endocrine system anti diabetic drugs & Local anaesthetics.
- Antibiotics, Anti-tubercular Agents, Urinary tract anti-infective agents, Antiviral agents, Antifungal agents, Anti-protozoal Agents, Anthelmintics.

2. PHARMACEUTICS:

Unit-I: General

- Pharmacopoeias: Introduction to IP, BP, USP and Extra Pharmacopoeia,
- Pharmaceutical calculations, Prescription, Posology and Pharmaceutical Incompatibilities.

Unit-II:-Industrial Pharmacy:-

- Preformulation Studies.
- Dosage forms :-
- Liquid dosage forms (monophasic and biphasic), Suppositories, Solid dosage forms (Tablets, Capsules, Powders etc.), Semisolid dosage forms (ointments, pastes, creams and gels), sterile dosage forms.
- Tablets: (classification, excipients, formulation, granulation methods, compression and processing problem, tablet coating& its defects, quality control tests.)
- Liquid orals: (formulation and manufacturing considerations, filling and packaging and evaluation tests.)
- Capsules: Hard gelatin capsules(formulation, manufacturing defects, quality control tests) Soft gelatin capsules (formulation, manufacturing defects, quality control tests , stability tests)
- Pellets(formulation, pelletization process, equipment for manufacture of pellets)
- Parenteral Products: Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives, importance of isotonicity, aseptic Processing, Formulation of injections, sterile powders, large volume parenterals and lyophilized products, Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products.

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- Ophthalmic Preparations: formulation considerations; formulation of eye drops, eye ointments and eye lotions; methods of preparation; labeling, containers; evaluation of ophthalmic preparations.
- Cosmetics: Formulation and preparation of the following cosmetic preparations: lipsticks, shampoos, cold cream and vanishing cream, tooth pastes, hair dyes and sunscreens.
- Pharmaceutical Aerosols: Definition, propellants, containers, valves, types of aerosol systems; formulation and manufacture of aerosols; Evaluation of aerosols; Quality control and stability studies.
- Regulatory affairs and Regulatory requirements for drug approval (IND, NDA, IB, ANDA).
- Quality Management Systems: QbD, Six Sigma Concept, (Out of Specifications) OOS, ISO14000, NABL, GLP.

Unit-III:Physical Pharmaceutics:

- Solubility of Drugs, states of matter and properties of matter, physiochemical properties of drug molecules, surface and interfacial Phenomenon, complexation and protein binding, pH, Buffers and isotonic solutions.
- Colloidal dispersions, rheology, deformation of solids, coarse dispersion, micrometrics and drug stability.

Unit-IV:-BioPharmaceutics and Pharmacokinetics:-

- Absorption, distribution, metabolism and elimination(ADME)
- Bioavailability and Bioequivalence: absolute and relative bioavailability, measurement of bioavailability, in-vitro drug dissolution models, in-vitro-in-vivo correlations, bioequivalence studies, methods to enhance the dissolution rates and bioavailability of poorly soluble drugs.

Unit-V:- Novel Drug Delivery Systems:-

- Controlled drug delivery systems: Rationale, advantages and disadvantages, selection of drug candidates. Approaches to design controlled release formulations based on diffusion, dissolution and ion exchange principles. Physicochemical and biological properties of drugs relevant to controlled release formulations, application of polymers in formulation of controlled release drug delivery systems.
- Definition, Formulation and Evaluation of the following NDDS: Microencapsulation, mucosal drug delivery system, implantable drug delivery systems, TDDS, GRDDS, nasopulmonary drug delivery

systems, targeted drug delivery, ocular drug delivery system, intrauterine drug delivery systems.

3. HOSPITAL AND CLINICAL PHARMACY(PHARMACY PRACTICE)AND FORENSIC PHARMACY

Unit-I Hospital and clinical Pharmacy:

- Adverse drug reaction and drug interaction
- Hospital formulary, Therapeutic Drug Monitoring
- Clinical pharmacy: function and responsibility of clinical Pharmacist, Dosing Pattern and drug therapy based on pharmacokinetics and disease pattern.
- Inventory control
- Interpretation of clinical laboratory tests (blood chemistry, hematology and urine analysis.)

Unit-II Pharmaceutical Jurisprudence(Forensic Pharmacy)

- Drugs and Cosmetics Act, 1940 and its rules 1945: Objectives, Definitions, Legal definitions of schedules to the Act and Rules.
- Detailed study of Schedule C,C(1),G, H,H1,L1, M,M-1,M-II, N, P,P1,Q,R1,S, T, U, V, Sale of Drugs - Wholesale, Retail sale and restricted license. Offences and penalties Labeling & Packing of drugs- General labeling requirements and specimen labels for drugs and cosmetics, List of permitted colors. Offences and penalties. Administration of the Act and Rules - Drugs Technical Advisory Board, Central drugs Laboratory, Drugs Consultative Committee, Government analysts, licensing authorities, controlling authorities, Drugs Inspectors.
- Pharmacy Act -1948, Medicinal and Toilet Preparation Act -1955, Narcotic Drugs and Psychotropic substances Act-1985 and Rules, Study of Salient Features of Drugs and Magic Remedies Act and its rules and National Pharmaceutical Pricing Authority, Medical Termination of Pregnancy Act .
- Right to Information Act, Introduction to Intellectual Property Rights (IPR).

4. HUMAN ANATOMY AND PHYSIOLOGY

- Introduction to human body, Cellular level of organization and Tissue level of organization.
- Basic structure and function of following systems:-

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Skeletal system, joints, body fluids and blood, cardiovascular system, nervous system, Digestive system, Respiratory System, endocrine system, reproductive system.

- Diseases: Hypertension, CHF, IHD (Angina, Myocardial Infarction, atherosclerosis and arteriosclerosis), asthma, COPD, renal failure, anaemia, hemophilia, diabetes, epilepsy, Parkinson's disease, depression, schizophrenia, Alzheimer's Disease, peptic ulcer, IBD, Jaundice, Hepatitis, Rheumatoid Arthritis, gout, osteoporosis, cancer, STDS, meningitis, leprosy, Tuberculosis.

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PAPER-II

1. PHARMACOLOGY

Unit-I:- General Pharmacology:- Essential drugs concept and routes of drug administration, Agonists, antagonists (competitive and non competitive), spare receptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy, Principles and mechanisms of drug action. Receptor theories and classification of receptors, regulation of receptors. drug receptors interactions signal transduction mechanisms, G-protein-coupled receptors, ion channel receptor, trans-membrane enzyme linked receptors, trans-membrane JAK-STAT binding receptor and receptors that regulate transcription factors, therapeutic index, combined effects of drugs and factors modifying drug action. Drug interactions (pharmacokinetic and pharmacodynamic), Drug discovery and clinical evaluation of new drugs -Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance, Drug addiction, drug abuse, tolerance and dependence, Bioassay (Principle and Applications), principles of toxicology, genotoxicity, carcinogenicity, teratogenicity and mutagenicity, General principles of treatment of poisoning, Clinical symptoms and management of barbiturates, morphine, organophosphorus compound and lead, mercury and arsenic poisoning.

Unit-II:- Pharmacology of drugs acting on:-

- PNS (Parasympathomimetics, Parasympatholytics, Sympathomimetic, sympatholytic, Local anesthetic agents),
- CNS (General anesthetics and pre-anesthetics, Sedatives, hypnotics, centrally acting muscle relaxants, Anti-epileptics, Alcohols and disulfiram, Antipsychotics, antidepressants, anti-anxiety agents, anti-manics and hallucinogens, Opioid analgesics and antagonists)
- Cardiovascular System (congestive heart failure, Anti-hypertensive drugs., Anti-anginal drugs, Anti-arrhythmic drugs. Anti-hyperlipidemic drugs, Hematinics, coagulants and anticoagulants, Fibrinolytics and anti-platelet drugs, Plasma volume expanders)

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- Respiratory system(Anti -asthmatic drugs, Drugs used in the management of COPD, Expectorants and antitussives, Nasal decongestants, Respiratory stimulants)
- G.I Tract (Antiulcer agents, Drugs for constipation and diarrhoea. Appetite stimulants and suppressants, Digestants and carminatives, Emetics and anti-emetics.)
- Urinary System (Diuretics, Anti-diuretics).
- Anti-gout drugs, anti- rheumatic drugs, NSAIDS.
- Insulin, Hypoglycemic Agents.
- Chemotherapy(Antitubercular agents, Antileprotic agents, Antifungal Agents, Antiviral Drugs, Anthelmintics, Antimalarial Drugs and Antiamoebic Drugs)
- Immunostimulant and immunosuppressants.

2. PHARMACOGNOSY AND PHYTOCHEMISTRY:

- Sources of Drugs – Plants, Animals, Marine & Tissue culture .
- Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo- gum -resins).
- Classification of drugs: Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero taxonomical classification of drugs.
- Quality control of Drugs of Natural Origin: Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical, chemical and biological methods and properties. Quantitative microscopy of crude drugs including lycopodium spore method, leaf constants, camera lucida and diagrams of microscopic objects to scale with camera lucida.
- Plant tissue culture: Historical development of plant tissue culture, types of cultures, Nutritional requirements, growth and their maintenance. Applications of plant tissue culture in pharmacognosy.
- Introduction to secondary metabolites: Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins.
- General introduction, composition, chemistry & chemical classes, biosources, therapeutic uses and commercial applications of following secondary metabolites:
 - Alkaloids: Vinca, Rauwolfia, Belladonna, Opium,
 - Phenylpropanoids and Flavonoids: Lignans, Tea, Ruta
 - Steroids, Cardiac Glycosides & Triterpenoids: Liquorice, Dioscorea, Digitalis

- Volatile oils: Mentha, Clove, Cinnamon, Fennel, Coriander,
- Tannins: Catechu, Pterocarpus
- Resins: Benzoin, Guggul, Ginger, Asafoetida, Myrrh, Colophony
- Glycosides: Senna, Aloes, Bitter Almond.
- Isolation, Identification and Analysis of Phytoconstituents
 - a) Terpenoids: Menthol, Citral, Artemisin
 - b) Glycosides: Glycyrrhetic acid & Rutin
 - c) Alkaloids: Atropine, Quinine, Reserpine, Caffeine
 - d) Resins: Podophyllotoxin, Curcumin.
- Basics of Phytochemistry:- Modern methods of extraction, application of latest techniques like Spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs.

3. PHARMACEUTICAL ANALYSIS:-

- Acid base titrations, Nonaqueous titrations, precipitation titrations, complexometric titrations, gravimetry, diazotization titrations and redox titrations.
- Electrochemical methods of Analysis (conductometry, Potentiometry and Polarography)
- Principle, Instrumentation and applications of following instrumentation Technology: UV Visible spectroscopy, Fluorimetry, IR Spectroscopy, Flame Photometry, AAS, Nepheloturbidometry.
- Chromatography: Methodology, advantages, disadvantages, applications and types (TLC, GC, HPLC, Ion Exchange, Paper, gel and affinity chromatography).

4. PHARMACEUTICAL BIOCHEMISTRY AND MICROBIOLOGY

Unit-I Pharmaceutical Biochemistry:-

- Biomolecules (Introduction, classification, chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins.)
- Enthalpy and Entropy; Redox potential
- Energy rich compounds: classification; biological significances of ATP and cyclic AMP.
- Carbohydrate Metabolism:
 - Glycolysis - Pathway, energetics and significance
 - Citric acid cycle- Pathway, energetics and significance
 - HMP shunt and its significance; Glucose-6-Phosphate dehydrogenase (G6PD) deficiency Glycogen metabolism Pathways and glycogen storage diseases (GSD)

- Gluconeogenesis- Pathway and its significance H
- Hormonal regulation of blood glucose level and Diabetes mellitus
- Biological oxidation Electron transport chain (ETC) and its mechanism.
 - Oxidative phosphorylation & its mechanism and substrate phosphorylation
 - Inhibitors ETC and oxidative phosphorylation/Uncouplers.
- Lipid metabolism: β -Oxidation of saturated fatty acid (Palmitic Acid), Formation and utilization of ketone bodies; ketoacidosis De novo synthesis of fatty acids (Palmitic acid) Biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamin D Disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity.
- Amino acid metabolism:-General reactions of amino acid metabolism: Transamination, deamination & decarboxylation, urea cycle and its disorders Catabolism of phenylalanine and tyrosine and their metabolic disorders (Phenylketonuria, Albinism, alpeptonuria, tyrosinemia) Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline Catabolism of heme; hyperbilirubinemia and jaundice.
- Nucleic acid metabolism and genetic information transfer: Biosynthesis of purine and pyrimidine nucleotides Catabolism of purine nucleotides and Hyperuricemia and Gout disease Organization of mammalian genome Structure of DNA and RNA and their functions DNA replication (semi conservative model) Transcription or RNA synthesis Genetic code, Translation or Protein synthesis and inhibitors.

Unit-II Pharmaceutical Microbiology:-

- Study of ultra-structure and morphological classification of bacteria, nutritional requirements, raw materials used for culture media and physical parameters for growth, growth curve, isolation and preservation methods for pure cultures, cultivation of anaerobes, quantitative measurement of bacterial growth (total & viable count). Study of different types of phase contrast microscopy, dark field microscopy and electron microscopy.
- Identification of bacteria using staining techniques (simple, Gram's & Acid fast staining) and biochemical tests (IMViC). Study of principle, procedure, merits, demerits and applications of physical, chemical gaseous, radiation and mechanical method of sterilization. Evaluation of the efficiency of sterilization methods, Equipments employed in large scale sterilization. Sterility indicators.

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- Study of morphology, classification, reproduction/replication and cultivation of Fungi and Viruses. Classification and mode of action of disinfectants Factors influencing disinfection, antiseptics and their evaluation. For bacteriostatic and bactericidal actions Evaluation of bactericidal & Bacteriostatic.
- Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP.
- Bacterial Endotoxin Test (BET) of different parenteral products according to IP, BP and USP.
- Designing of aseptic area, laminar flow equipments; study of different sources of contamination in an aseptic area and methods of prevention, clean area classification.
- Principles and methods of different microbiological assay. Methods for standardization of antibiotics, vitamins and amino acids. Assessment of a new antibiotic.
- Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage.
- Preservation of pharmaceutical products using antimicrobial agents, evaluation of microbial stability of formulations.
- Growth of animal cells in culture, general procedure for cell culture, Primary, established and transformed cell cultures. Application of cell cultures in pharmaceutical industry and research.

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SYLLABUS FOR JUNIOR CHEMIST UNDER DIRECTORATE OF MINES & GEOLOGY

Atomic Structure

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Somerfield's modification. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle, Schrodinger's wave equation (time independent) and its significance, Derivation of Schrodinger's wave equation (for hydrogen atom) in Cartesian coordinate, significance of ψ and ψ^2 Normalized and orthogonal wave functions. Sign of wave functions; Setting of Schrodinger's equation in popular coordinates (derivation not required), radial and angular wave functions for hydrogen atom. Radial and angular distribution curves; Shapes of s,p,d and f orbitals; Quantum numbers and their significance. Pauli's Exclusion principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations.

Periodicity of elements

Periodicity of elements: s,p,d,f block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to s & p-blocks. (a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table. (b) Atomic radii (van der Waals) (c) Ionic and crystal radii (d) covalent radii (octahedral and tetrahedral) (e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy (f) electron gain enthalpy, trends of electron gain enthalpy

Chemical bonding-I

- (i) Ionic bond: general characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation. Madelung constant, Born-Haber cycle and its application, Solvation energy.
- (ii) Covalent bond: Valence Bond theory (Heitler-London approach). Hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements, equivalent and non-equivalent hybrid orbitals, Resonance and resonance energy.
- (iii) Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules.

Chemical bonding-II

- (i) **Metallic Bond:** Qualitative idea of valence bond and band theories. Semiconductors and insulators.
- (ii) **Weak Chemical Forces:** Van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment) Effects of chemical force, melting and boiling points, solubility energetics of dissolution process.

List of experiments

(A) Acid-Base titrations

- i. Estimation of carbonate and hydroxide present together in mixture.
- ii. Estimation of carbonate and bicarbonate present together in a mixture.

(B) Oxidation-Reduction Titrimetry

- i. Standardization of KMnO_4 with standard sodium oxalate and estimate of Fe (II) using standardized KMnO_4 solution.
- ii. Estimation of percentage of oxalic acid and sodium oxalate in given mixture.
- iii. Estimation of Fe (II) and Fe (III) in a mixture by standard $\text{K}_2\text{Cr}_2\text{O}_7$ solution.

Ionic equilibria-I

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect.

Solid state

Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method.

Ionic equilibria-II

Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry. Solubility and solubility product of sparingly soluble salts-applications of solubility product. Qualitative treatment of acid-base titration curves (calculation of pH

at various stages). Theory of acid-base indicators; selection of indicators and their limitations.

Multistage equilibria in poly electrolyte systems; hydrolysis and hydrolysis constants.

pH-metry

- a. Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures.
- b. Preparation of buffer solutions of different pH (i) Sodium acetate-acetic acid (ii) Ammonium chloride-ammonium hydroxide.
- c. pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base.
- d. Determination of dissociation constant of a weak acid.

Basics of organic chemistry

Electronic Displacements: Inductive, electrometric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength.

Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reaction.

Carbon-carbon sigma bonds

Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fitting Reactions, Free radical substitutions: Halogenation-relative reactivity and selectivity.

List of experiments

1. Functional group tests for alcohols, phenols, carbonyl and carboxylic acid groups and identification of unknown organic compounds of CHO system (without element detection).
2. Separation and purification of any one component of following binary solid mixture based on the solubility in common laboratory reagents like water (cold, hot), dil. HCl, dil. NaOH, dil. NaHCO₃, etc. and determination of melting point.
3. **Chromatography**
 - Separation of mixture of two amino acids by ascending and horizontal paper chromatography
 - Separation of a mixture of two sugars by ascending paper chromatography
 - Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC)



PHYSICAL CHEMISTRY

Chemical thermodynamics

Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics.

First law: Concept of heat (q), work(w), internal energy(U) and statement of first law; enthalpy(H), relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.

Thermochemistry: Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculations of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions.

Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes.

Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules.

Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G, A with T, V, P ; Free energy change and spontaneity.

Systems of variable composition

Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.

Chemical equilibrium

Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient (Vant Hoff's reaction). Equilibrium constant and their quantitative dependence on temperature, pressure and concentration. Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants K_p, K_c and K_x . Le Chatelier principle (quantitative treatment) and its applications.

Dr.

INORGANIC CHEMISTRY

Acids and Bases

Bronsted-Lowry concept of acid-base reaction, solvated proton, relative strength of acids, types of acid-base reactions, Lewis acid-base concept, classification of Lewis acids, Hard and Soft Acids and bases (HSAB) application of HSAB principle.

Chemistry of S and P Block elements - I

Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behavior of first member of each group. Allotropy and catenation. Complex formation tendency of s and p block elements.

Hydrides and their classification ionic, covalent and interstitial.

Basic beryllium acetate and nitrate.

Iodometric/Iodimetric titrations

- i. Standardization of sodium thiosulphate solution by standard of $K_2Cr_2O_7$ solution.
- ii. Estimation of Cu (II) using standard sodium thiosulphate solution (Iodimetrically)
- iii. Estimation of available chlorine in bleaching powder iodometrically.

Alcohols, Phenols, Ethers and Epoxides

Alcohols: preparation, properties and relative reactivity of 1^o, 2^o, 3^o alcohols, Bouvaelt-Blanc Reduction; Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement;

Phenols: Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, Reimer-Tiemann and Kolbe's-Schmidt Reactions, Fries and Claisen rearrangements with mechanism;

Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxides with alcohols, Ammonia derivatives and $LiAlH_4$.

Chemical Kinetics

Order and molecularity of reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of orders.

Kinetics of complex reactions (integrated rate expressions up to first order only): (i) Opposing reactions (ii) Parallel reactions (iii) Consecutive reactions and their



differential rate equations (steady-state approximation in reaction mechanisms) (iv)
Chain reactions.

Temperature dependence of reaction rates.

Coordination Chemistry

Werner's theory, valence bond theory (inner and outer orbital complexes), electro neutrality principle and back bonding.

IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination's numbers. Chelate effect, Labile and inert complexes.

Transitions Elements II

Chemistry of Ti, V, Cr, Mn, Fe and Co in various oxidation states (excluding their metallurgy).

Bioinorganic Chemistry

Metal ions present in biological systems, classification of elements according to their action in biological system. Na/K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, use of chelating agents in medicine.

Iron and its application in bio-systems, Haemoglobin and myoglobin.

Complexometric titration

- i. Estimation of Ca by EDTA
- ii. Estimation of Mg by EDTA

Gravimetric Analysis:

- i. Estimation of nickel (II) using dimethylglyoxime (DMG)
- ii. Estimation of copper as CuSCN
- iii. Estimation of iron as Fe_2O_3 by precipitating iron as $\text{Fe}(\text{OH})_3$
- iv. Estimation of Al (III) by precipitating with oxine and weighing as $\text{Al}(\text{oxine})_3$ (Aluminium Oxinate).

Electrochemistry-I

Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry.



Electrochemistry

Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation).

Conductometry

- i. Determination of cell constant.
- ii. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
- iii. Perform the following conductometric titrations:
 - i. Strong acid vs. Strong base.
 - ii. Weak acid vs. Strong base.
 - iii. Strong acid vs. Weak base.

Potentiometric

- i. Perform the following potentiometric titrations:
- ii. Strong acid vs. Strong base
- iii. Weak acid vs. Strong base
- iv. Dibasic acid vs. Strong base

ORGANIC CHEMISTRY

Organic Spectroscopy

UV Spectroscopy: Types of electronic transitions, ϵ_{\max} Lambert-Beer's law and its limitations, chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward rules for calculation of ϵ_{\max} for the following systems: α, β the unsaturated aldehydes; ketones, carboxylic acids and esters; Conjugated dienes: alicyclic homoannular and heteroannular; Extended conjugated systems distinction.

Organic Spectroscopy

NMR Spectroscopy: Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it; Spin-spin coupling and coupling constant; Anisotropic effects in alkene, alkyne, aldehydes and aromatic; Interpretation of NMR spectra of simple compounds.

Mass Spectroscopy- Basic principle, Fragmentation pattern, instrumentation, determination of m/e ratio. Application of mass spectroscopy on CH_4 , C_2H_6 n-butane.

Applications of IR, UV & NMR for identification of simple organic molecules.



Chemical Bonding

Chemical Bonding: Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of H_2^+ . Bonding and antibonding orbitals. Qualitative extension to H_2 . Comparison of LCAO-MO and VB treatments of H_2 (only wave functions, detailed solution not required) and their limitations.

Molecular Spectroscopy

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration.

Photochemistry

Characteristics of electromagnetic radiation, physical significance of absorption coefficients. Laws of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reaction, quenching, chemiluminescence.

Spectroscopy/Colorimetry

- i. Study of absorption spectra (visible range) of $KMnO_4$ and determination the max value. Calculate the energies of the transitions in kJ, mol^{-1}, cm^{-1} and eV .
- ii. Verify Lambert-Beer's law and determine the concentration of $CuSO_4/KMnO_4/K_2Cr_2O_7$ in a solution of unknown concentration.
- iii. Determination the dissociation constant of an indicator (phenolphthalein).

Spectrophotometric titration

1. Determination the concentration of HCl against $0.1 N NaOH$ spectrophotometrically.
2. To find the strength of given ferric ammonium sulphate solution of $(0.05M)$ by using $EDTA$ spectrophotometrically.
3. To find out the strength of $CuSO_4$ solution by titrating with $EDTA$ sepctrophotometrically.
4. To determine the concentration of $Cu (II)$ and $Fe (III)$ solution photometrically by titrating with $EDTA$.

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Catalysis by Organometallic Compounds.

Study of the following industrial process and their mechanism:

1. Alkene hydrogenation (Wilkinson's Catalyst)
2. Hydroformylation (Co salts)
3. Wacker Process

Thermodynamic & kinetic aspects and reaction mechanism of meta complexes

Thermodynamic and kinetic stability, Stepwise and overall formation constants and their relationship, factors affecting stability. Introduction to inorganic reaction mechanisms-types of reaction and classification of substitution reaction. Substitution reaction of square planar complexes, Trans effect and its applications, theories of trans-effect (electrostatic polarization and Static π -Bonding Theory). Kinetics of octahedral substitution (classification of metal ions based on water exchange rate), General mechanism of ligand substitution reactions in octahedral complexes (D, I, I_d, I_a).

Introduction to Green Chemistry

What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations Obstacles in the pursuit of the goals of Green Chemistry.

Examples of Green Synthesis/Reactions and some real world cases

Green Synthesis of the following compounds: adipic acid, catechol, methyl methacrylate, urethane, disodium iminodiacetate (alternative to Strecker synthesis), paracetamol, furfural.

Microwave assisted reactions: Application to reactions (i) in water: Hofmann Elimination, hydrolysis (of benzyl chloride, methyl benzoate to benzoic acid), Oxidation (of toluene, alcohols); (ii) reactions in organic solvents; Diels-Alder reaction and Decarboxylation reaction.

Ultrasound assisted reactions: Application to esterification, saponification, Simmons-Smith Reaction (Ultrasonic alternative to Iodine).

INDUSTRIAL CHEMICALS AND ENVIRONMENT

Industrial Gases and Inorganic Chemicals

Industrial Gases: Large scale production uses storage and hazards in handling of the following gases: oxygen, nitrogen argon, hydrogen, acetylene, carbon monoxide, chlorine, sulphur dioxide.

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Inorganic Chemicals: Manufacture, application and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, potassium dichromate and potassium permanganate.

Environment Chemistry

Basics of Pollution Chemistry affecting the Environment mainly Water & Environment pollution.

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