

PHARMACEUTICS

Paper-11

Surface and Interfacial Phenomenon:

Liquid interface, surface and interfacial tensions, surface free energy, measurement of surface and interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB classification, solubilization, detergency, adsorption at solid interfaces, solid-gas and solid-liquid interfaces, complex films, electrical properties of interface.

Viscosity and Rheology:

Newtonian systems, Law of flow, kinematic viscosity, effect of temperature; non-Newtonian systems: pseudoplastic, dilatant, plastic; thixotropy, thixotropy in formulation, negative thixotropy, determination of viscosity, capillary, falling ball, rotational viscometers.

Dispersion Systems:

Colloidal dispersions: Definition, types, properties of colloids, protective colloids, applications of colloids in pharmacy; Suspensions and Emulsions: Interfacial properties of suspended particles, settling in suspensions, theory of sedimentation, effect of Brownian motion, sedimentation of flocculated particles, sedimentation parameters, wetting of particles, controlled flocculation, flocculation in structured vehicles, rheological considerations; Emulsions-types, theories, physical stability.

Complexation:

Classification of complexes, methods of preparation and analysis, applications.

Sterilization:

different methods, validation of sterilization methods & equipments; Sterility testing of all pharmaceutical products. Microbial assays of antibiotics, vitamins & amino acids.

Immunology and Immunological Preparations:

Principles, antigens and heptans, immune system, cellular/humoral immunity, immunological tolerance, antigen-antibody reactions and their applications. Hypersensitivity, active and passive immunization. Vaccines and sera: their preparation, standardization and storage.

Introduction to pharmaceutical jurisprudence & ethics:

Pharmaceutical Ethics; Pharmacy Act 1948; Drugs and Cosmetics Act 1940 and Rules 1945; Medicinal & Toilet Preparations (Excise Duties) Act 1955; Narcotic Drugs & Psychotropic Substances Act 1985 & Rules; Drugs Price Control Order.

Incompatibilities:

Physical and chemical incompatibilities, inorganic incompatibilities including incompatibilities of metals and their salts, non-metals, acids, alkalis, organic incompatibilities. Purine bases, alkaloids, pyrazolone derivatives, amino acids, quaternary ammonium compounds, carbohydrates, glycosides, anesthetics, dyes, surface active agents, correction of incompatibilities. Therapeutic incompatibilities.

Heat transfer:

Concept of heat flow, applications of Fourier's law, forced and natural convection, surface coefficients, boiling liquids, condensing vapors, heat exchangers, heat interchangers, radiation, black body, Stefan Boltzmann equation, Kirchoff's law.

Evaporation:

Basic concept of phase equilibria, factor affecting evaporation, evaporators, film evaporators, single effect and multiple effect evaporators, Mathematical problems on evaporation.

Distillation:

Roult's law, phase diagrams, volatility; simple steam and flash distillations, principles of rectification, Mc- Cabe Thiele method for calculations of number of theoretical plates, Azeotropic and extractive distillation.

Drying:

Moisture content and mechanism of drying, rate of drying and time of drying calculations; classification and types of dryers, dryers used in pharmaceutical industries and special drying methods.

Size Reduction:

Definition, objectives of size reduction, mechanisms of size reduction, factors affecting size reduction, laws governing energy and power requirements of a mills including ball mill, hammer mill, fluid energy mill. Size separation: Different techniques of size separation, sieves, sieve shakers, sedimentation tank, cyclone separators, bag fillers etc.

Mixing:

Theory of mixing, solid-solid, solid-liquid and liquid-liquid mixing equipments.

Filtration and Centrifugation:

Theory of filtration, continuous and batch filters, filter aids, filter media, industrial filters including filter press, rotary filter, edge filter, etc. Factors affecting filtration, optimum cleaning cycle in batch filters. Principles of centrifugation, industrial centrifugal filters, and centrifugal sedimenters.

Crystallization:

Characteristics of crystals like-purity, size, shape, geometry, habit, forms size and factors affecting them, Solubility curves and calculation of yields. Material and heat balances around Swenson Walker Crystallizer. Supersaturation, theory and its limitations, Nucleation mechanisms, crystal growth. Study of various types of Crystallizers, tanks, agitated batch, Swenson Walker, Single vacuum, circulating magma and Krystal Crystallizer, Caking of crystals and its prevention. Numerical problems on yields.

Liquid Dosages Forms:

Introduction, types of additives used in formulations, vehicles, stabilizers, preservatives, suspending agents, emulsifying agents, solubilizers, colors, flavors and others, manufacturing packaging, labeling, evaluation of clear liquids, suspensions and emulsions official in pharmacopoeia.

Semisolid Dosage Forms:

Definitions, types, mechanisms of drug penetration, factors influencing penetration, semisolid bases and their selection. General formulation of semisolids, clear gels manufacturing procedure, evaluation and packaging.

Suppositories:

Ideal requirements, bases, displacement value, manufacturing procedure, packaging and evaluation.

Extraction and Galenical Products:

Principle and method of extraction, preparation of infusion, tinctures, dry and soft liquid extracts.

Blood Products and Plasma Substitutes:

Collection, processing and storage of whole human blood, concentrated human RBCs, dried human plasma, human fibrinogen, human thrombin, human normal immunoglobulin, human fibrin, foam plasma substitutes, -ideal requirements, PVP, dextran etc. for control of blood pressure as per I.P.

Pharmaceutical Aerosols:

Definition, propellants, general formulation, manufacturing' and packaging methods, pharmaceutical applications.

Ophthalmic Preparations:

Requirements, formulation, methods of preparation, labeling, containers, evaluation;

Cosmeticology and Cosmetic Preparations: Fundamentals of cosmetic science, structure and functions of skin and hair. Formulation, preparation and packaging of cosmetics for skin, hair, dentifrice and manicure preparations like nail polish, nail polish remover, Lipsticks, eye lashes, baby care products etc.

Capsules:

Advantages and disadvantages of capsule dosage form, material for production of hard gelatin capsules, size of capsules, formulation, method of capsule filling, soft gelatin, capsule shell and capsule content, importance of base absorption and minimum/gm factors in soft capsules, quality control, stability testing and storage of capsule dosage forms.

Micro-encapsulation:

Types of microcapsules, importance of microencapsulation in pharmacy, microencapsulation by phase separation, coacervation, multi-orifice, spray drying, spray congealing, polymerization complex emulsion, air suspension technique, coating pan and other techniques, evaluation of micro capsules.

Tablets:

Advantages and disadvantages of tablets, Application of different types of tablets, Formulation of different types of tablets, granulation, technology on large-scale by various techniques, different types of tablet compression machinery and the equipments employed, evaluation of tablets. Coating of Tablets:Types of coating, film forming materials, formulation of coating

solution, equipments for coating, coating process, evaluation of coated tablets. Stability kinetics and quality assurance.

Parenteral Products:

Pre-formulation factors, routes of administration, water for injection, and sterile water for injection, pyrogenicity, non aqueous vehicles, isotonicity and methods of its adjustment, Formulation details, Containers and closures and selection, labeling; Pre-filling treatment, washing of containers and closures, preparation of solution and suspensions, filling and closing of ampoules, vials, infusion fluids, lyophilization & preparation of sterile powders, equipment for large scale manufacture and evaluation of parenteral products; Aseptic Techniques-source of contamination and methods of prevention, Design of aseptic area, Laminar flow bench services and maintenance. Sterility testing of pharmaceuticals.

Designing of dosage forms; Pre-formulation studies:

Study of physical properties of drug like physical form, particle size, shape, density, wetting, dielectric constant. Solubility, dissolution and organoleptic properties and their effect on formulation, stability and bioavailability.

Study of chemical properties of drugs like hydrolysis, oxidation, reduction, racemization, polymerization etc., and their influence on formulation and stability of products. Study of pro-drugs in solving problems related to stability, bioavailability and elegance of formulations. Design, development and process validation methods for pharmaceutical operations involved in the production of pharmaceutical products with special reference to tablets, suspensions. Stabilization and stability testing protocol for various pharmaceutical products. ICH Guidelines for stability testing of formulations.

Biopharmaceutics:

Passage of drugs across biological barrier (passive diffusion, active transport, facilitated diffusion, ion-pair formation and pinocytosis); Factors influencing absorption- biological, physico-chemical, physiological and pharmaceutical; Drug distribution in the body, plasma protein binding.

Pharmacokinetics:

Significance of plasma drug concentration measurement. Compartment model- Definition and Scope. Pharmacokinetics of drug absorption - Zero order and first order absorption rate constant

using Wagner- Nelson and residual methods. Volume of distribution and distribution coefficient. Compartment kinetics- One compartment and two compartment models. Determination of pharmacokinetic parameters from plasma and urine data after drug administration by intravascular and oral route. Clearance concept, mechanism of renal clearance, clearance ratio, determination of renal clearance. Extraction ratio, hepatic clearance, biliary excretion, extra-hepatic circulation. Non-linear pharmacokinetics with special reference to one compartment model after I.V. drug administration.

Bioavailability and bioequivalence:

Measures of bioavailability, C_{max}, t_{max}, K_{el} and Area Under the Curve (AUC); Design of single dose bioequivalence study and relevant statistics; Review of regulatory requirements for conducting bioequivalent studies. Biopharmaceutical Classification System (BCS) of drugs.

PHARMACEUTICAL CHEMISTRY

Stereochemistry:

Nomenclature, isomerism, stereoisomerism, conformational and configurational isomerism, optical activity, specification of configuration, Reactions involving stereoisomers, chirality, conformations.

Stereoselective and stereospecific reactions; Structure, Nomenclature, Preparation and

Reactions of:

Alkanes, Alkenes, Alkynes, Cyclic analogs, Dienes, Benzene, Polynuclear aromatic compounds, Arenes, Alkyl halides, Alcohols, Ethers, Epoxides, Amines, Phenols, Aldehydes and ketones, Carboxylic acids, Functional derivatives of carboxylic acids, α,β -Unsaturated carbonyl compounds, Reactive intermediates- carbocations, carbanions, carbenes and nitrenes.

Nucleophilic and Electrophilic Aromatic Substitution Reactions:

Reactivity and orientation.

Electrophilic and Nucleophilic Addition Reactions; Rearrangements

(Beckman, Hoffman, Benzilic acid, pinacole-pinacolone and Beyer-Villiger).

Elimination reactions; Conservation of Orbital Symmetry and Rules:

Electrocyclic, Cycloaddition and Sigmatropic reactions.

Neighboring group effects; Catalysis by transition metal complexes; Heterocyclic

Compounds:

Nomenclature, preparation, properties and reactions of 3, 4, 5, 6 & 7-membered heterocycles with one or two heteroatoms like O, N, S. Chemistry of lipids, Carbohydrates and Proteins.

Enzymes:

Nomenclature, enzyme kinetics and their mechanism of action, mechanism of inhibition, enzymes and iso-enzymes in clinical diagnosis.

Carbohydrates and Lipids Metabolism :**Biosynthesis of Nucleic Acids:**

Brief introduction of genetic organization of the mammalian genome, alteration and rearrangements of genetic material, Biosynthesis of DNA and its replications.

Basic Principles of Medicinal Chemistry:

Physico-chemical and stereoisomeric (Optical, geometrical) aspects of drug molecules and biological action, Bioisosterism, Drug-receptor interactions including transduction mechanisms.

Drug metabolism and Concept of Prodrugs; Principles of Drug Design (Theoretical Aspects):

Traditional analog and mechanism based approaches, QSAR approaches, Applications of quantum mechanics, Computer Aided Drug Designing (CADD) and molecular modeling.

Synthetic Procedures, Mode of Action, Uses, Structure Activity Relationships including Classification and MOA of the Following Classes of Drugs:

Drugs acting at synaptic and neuro-effector junction sites: Cholinergics, anti-cholinergics and cholinesterase inhibitors, Adrenergic drugs, Antispasmodic and anti-ulcer drugs, Local Anesthetics, Neuromuscular blocking agents.

Autacoids:

Antihistamines, Eicosanoids, Analgesic-antipyretics, Anti-inflammatory (non-steroidal) agents.

Steroid Drugs:

Steroid nomenclature (IUPAC) and stereochemistry, Androgens and anabolic agents, Estrogens and Progestational agents, Oral contraceptives, Adrenocorticoids.

Drugs acting on the central nervous system:

General Anesthetics, Hypnotics and Sedatives, Anticonvulsants, Anti-Parkinsonian drugs, Psychopharmacological agents (Neuroleptics, Anti-depressants, Anxiolytics), Opioid analgesics, Anti-tussives, CNS stimulants;

Diuretics; Cardiovascular drugs:

Anti-hypertensives, Anti-arrhythmic agents, anti-anginal agents, Cardiotonics, Antihyperlipidemic agents, Anticoagulants and Anti-platelet drugs;

Insulin and oral hypoglycemic agents:

Anti-neoplastic agents; Anti-viral agents (including anti-HIV);
Immunosuppressives and immunostimulants; Diagnostic agents; Pharmaceutical Aids.

Pharmaceutical Analysis**Fundamentals of volumetric analysis:**

methods of expressing concentration, primary and secondary standards:

Acid Base Titrations:

Acid base concepts, Role of solvents, Relative strengths of acids and bases, Ionization, Law of mass action, Common ion effect, Ionic product of water, pH, Hydrolysis of salts, Henderson-Hasselbach equation, Buffer solutions, Neutralization curves, Acid-base indicators, Theory of indicators, Choice of indicators, Mixed indicators, Polyprotic systems, Polyamine and amino acid systems, Amino acid titrations;

Oxidation Reduction Titrations:

Concepts of oxidation and reduction, Redox reactions, Strengths and equivalent weights of oxidizing and reducing agents, Theory of redox titrations, Redox indicators, Cell representations, Measurement of electrode potential, Oxidation-reduction curves, Iodimetry and Iodometry, Titrations involving ceric ammonium sulphate, potassium iodate, potassium bromate, potassium permanganate; titanous chloride, stannous chloride and Sodium 2,6-dichlorophenolindophenol;

Precipitation Titrations:

Precipitation reactions, Solubility product, Effect of acids, temperature and solvent upon the solubility of a precipitate, Argentometric titrations and titrations involving ammonium or

potassium thiocyanate, mercuric nitrate, and barium sulphate, indicators, Methods of end point determination (GayLussac method, Mohr's method, Volhard's method and Fajan's method).

Gravimetric Analysis:

Precipitation techniques, The colloidal state, Supersaturation, Co-precipitation, Postprecipitation, Digestion, washing of the precipitate, Filtration, Filter papers and crucibles, Ignition, Thermogravimetric curves, Specific examples like barium sulphate, aluminium as aluminium oxide, calcium as calcium oxalate and magnesium as magnesium pyrophosphate, Organic precipitants;

Non-aqueous titrations:

Acidic and basic drugs, Solvents used, Indicators;

Complexometric titrations;

Complexing agents used as titrants, Indicators, Masking and demasking;

Miscellaneous Methods of Analysis:

Diazotization titrations, Kjeldahl method of nitrogen estimation, Karl-Fischer aquametry, Oxygen flask combustion method, Gasometry; Extraction procedures including separation of drugs from excipients;

Potentiometry:

Standard redox potential, Nernst equation, Half-cell potential, Standard and indicating electrodes, potentiometric titrations;

Conductometry:

Specific and equivalent conductance, conductometric titrations;

Coulometry:

Coulomb's law, Coulometric titrations at fixed potential/current;

Chromatography:

Theory of chromatography, plate theory, Factors affecting resolution, van Deemter equation, The following chromatographic techniques (including instrumentation) with relevant examples of Pharmacopoeial products: TLC, HPLC, GLC, HPTLC, Paper Chromatography and Column Chromatography;

The Theoretical Aspects, Basic Instrumentation, Elements of Interpretation of Spectra,

and Applications (quantitative and qualitative) of the Following Analytical Techniques:

Ultraviolet and visible spectrophotometry, Fluorimetry, Infrared spectrophotometry, Nuclear Magnetic Resonance spectroscopy, Mass Spectrometry (EI & CI only), Flame Photometry, Atomic Absorption Spectroscopy, X-ray Diffraction Analysis, Radioimmunoassay.

Pharmacology

Fundamentals of general pharmacology:

Dosage forms and routes of administration, mechanism of action, combined effect of drugs, factors modifying drug action, tolerance and dependence; Pharmacogenetics; Principles of Basic and Clinical pharmacokinetics, absorption, Distribution, Metabolism and Excretion of drugs, Adverse Drug Reactions; Bioassay of Drugs and Biological Standardization; Discovery and development of new drugs, Bioavailability and bioequivalence studies;

Pharmacology of Autonomous Nervous System:

Neurohumoral transmission (autonomic and somatic), Parasympathomimetics, Parasympatholytics, Sympathomimetics, Adrenergic receptor and neuron blocking agents, Ganglion stimulants and blocking agents, Neuromuscular blocking Agents, Local anesthetic Agents.

Pharmacology of Central Nervous System:

Neurohumoral transmission in the C.N.S., General Anesthetics, Alcohols and disulfiram, Sedatives, Hypnotics, Anti-anxiety agents and Centrally acting muscle relaxants, Psychopharmacological agents (anti-psychotics), anti-maniacs and hallucinogens, Antidepressants, Anti-epileptics drugs, Anti-Parkinsonian drugs, Analgesics, Antipyretics, Narcotic analgesics and antagonists, C.N.S. stimulants, Drug Addiction and Drug Abuse.

Pharmacology of Cardiovascular System:

Drugs used in the management of congestive cardiac failure, Antihypertensive drugs, Antianginal and Vasodilator drugs, including calcium channel blockers and beta adrenergic antagonists, Anti-arrhythmic drugs, Anti-hyperlipidemic drugs, Drugs used in the therapy of shock.

Drugs Acting on the Hemopoietic System:

Hematinics, Anticoagulants, Vitamin K and hemostatic agents, Fibrinolytic and anti-platelet drugs, Blood and plasma volume expanders.

Drugs acting on urinary system:

Fluid and electrolyte balance, Diuretics.

Autacoids:

Histamine, Antihistaminic drugs, 5-HT- its agonists and antagonists, Prostaglandins, thromboxanes and leukotrienes, Angiotensin, Bradykinin and Substance P and other vasoactive peptides, non-steroidal anti-inflammatory and anti-gout agents.

Drugs acting on the Gastrointestinal Tract:

Antacids, Anti-secretory and Anti-ulcer drugs, Laxatives and anti-diarrhoeal drugs, Appetite Stimulants and Suppressants, Emetics and anti-emetics, Miscellaneous: Carminatives, demulcents, protectives, adsorbents, astringents, digestants, enzymes and mucolytics.

Pharmacology of Endocrine System:

Hypothalamic and pituitary hormones, Thyroid hormones and anti thyroid drugs, parathormone, calcitonin and Vitamin D, Insulin, glucagons, incretins, oral hypoglycemic agents and insulin analogs, ACTH and corticosteroids, Androgens and anabolic steroids, Estrogens, progesterone and oral contraceptives, Drugs acting on the uterus.

Chemotherapy:

General Principles of Chemotherapy, Bacterial resistance; Sulfonamides and cotrimoxazole, Antibiotics- Penicillins, Cephalosporins, Aminoglycosides, Chloramphenicol, Macrolides, Tetracyclines, Quinolones, fluoroquinolones and Miscellaneous antibiotics; Chemotherapy of tuberculosis, leprosy, fungal diseases, viral diseases, HIV and AIDS, urinary tract infections and sexually transmitted diseases, malaria, amoebiasis and other protozoal infections and Anthelmintics. Chemotherapy of malignancy and immunosuppressive agents.

Important Disorders of Organs, Systems and their Management:

Cardio-vascular disorders- Hypertension, Congestive heart failure, Angina, Acute myocardial infarction, Cardiac arrhythmias.

Principles of Toxicology:

Definition of poison, general principles of treatment of poisoning with particular reference to barbiturates, opioids, organophosphorous and atropine poisoning, Heavy metals and heavy metal antagonists.

Pharmacognosy

Sources of Drugs:

Biological, marine, mineral and plant tissue cultures as sources of drugs.

Classification of Drugs:

Morphological, taxonomical, chemical and pharmacological classification of drugs.

Quality Control of Crude Drugs:

Adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical and biological methods and properties.

Introduction to Active Constituents of Drugs:

Their isolation, classification and Systematic pharmacognostic study of the followings:

Carbohydrates, Alkaloids, Glycosides, Terpenoids, Resins, Tannins, Fibers and Volatile oils, derived products.

Studies of Traditional Drugs:

Common vernacular names, botanical sources, morphology, chemical nature of chief constituents, pharmacology, categories and common uses and marketed formulations of following indigenous drugs: Amla, Kantkari, Satavari, Tylophora, Bhilawa, Kalijiri, Bach, Rasna, Punamava, Chitrack, Apamarg, Gokhru, Shankhapushpi, Brahmi, Adusa, Atjuna.

Lignans, quassanoids and flavonoids. Role of plant-based drugs on National economy:

A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India. Utilization and production of phyto-constituents such as quinine, calcium sennosides, podophyllotoxin, diosgenin, solasodine, and tropane alkaloids.

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.

Marine pharmacognosy:

Novel medicinal agents from marine sources. Natural allergens and photosensitizing agents and fungal toxins. Herbs as health foods. Herbal cosmetics. Standardization and quality control of herbal drugs, WHO guidelines for the standardization of herbal drugs.