

P.A.H. Solapur University
Syllabus for Ph. D. Entrance Test-Pharmacy
(w.e.f. March 2024)

Pharmaceutics

1. Introduction to dosage forms

Drug and dosage forms. The desirable properties of a dosage form, the need of dosage form. Idea about the available types of dosage forms and new drug delivery systems.

2. Dosage Form Necessities and Additives

Antioxidants, preservatives, coloring agents, flavoring agents and diluting agents, emulsifying agents, suspending agents, ointment bases, solvents, and others.

3. Capsules

Hard gelatin capsules, shell formulation and manufacturing, capsule sizes, storage, filling, general formulation and evaluation. Soft gelatin capsules, formulation. Microencapsulation, advantages, encapsulation materials, methods of microencapsulation,

4. Tablets

Types, ideal requirement, classification, granulation methods, general formulation, compression machines, different types of toolings, troubleshooting aspects, evaluation, sugar coating, compression coating, film coating, problems in tablet coatings.

5. Parenterals - product requiring sterile packaging

Definition, types, advantages and limitations, general formulation, vehicles, production procedure, production facilities, controls, tests, sterile powders, implants, emulsions, suspensions.

6. Suspensions

Formulation of deflocculated and flocculated suspension, manufacturing procedure, evaluation methods.

7. Emulsions

Types, emulsifying agents, general formulation, manufacturing procedure, evaluation methods.

8. Pharmaceutical Aerosols

Definition, propellants, general formulation, manufacturing and packaging methods, pharmaceutical applications. Impacts of propellants on the environment.

9. Preformulation

Consideration of Importance, physical properties, physical forms, particle size, crystal forms, bulk control, solubility, wetting, flow cohesiveness, compressibility, organoleptic properties and its effect on final product, consideration of chemical properties.

10. Stability of formulated products

Requirements, drug regulatory aspects, pharmaceutical products stability, shelf life, overages, containers, closures. Accelerated stability testing.

11. Novel Drug delivery system

Critical fluid technology, transdermal drug delivery system, controlled drug delivery system, multiple emulsion, nanoparticles, targeted drug delivery system.

12. GMP and Validation

Introduction to GMP, QC and QA. Concept and need of good manufacturing practice guidelines. Introduction of the validation process.

13. Pilot plant scale-up techniques

Need, organization and layout, scale-up techniques for solid and liquid dosage forms. Technology transfer.

14. Bio-pharmaceutics

a. The fate of drug after drug absorption, various mechanisms for drug absorption, drug concentration in blood, biological factors in drug absorption, physicochemical factors, dosage form consideration for gastrointestinal absorption.

b. Drug Absorption:

Gastrointestinal absorption-biological considerations, physicochemical considerations, role of the dosage form. Concepts of dissolution and diffusion

Pharmacokinetics, Compartmental and non-compartmental pharmacokinetics. Biotransformation, drug disposition, distribution, elimination. Variability-Body weight, age, sex and genetic factors. Pharmacokinetic variability- diseases, drug interactions. Individualization and optimization of drug dosing regimens.

15. Bio-availability & Bio-equivalence

Quality parameters of dosage forms. Assay methods & its validation.

Physicochemical properties of drugs & added substances and its effect on preparations and biological availability of dosage forms. Pharmaceutical properties of dosage forms, disintegration, dissolution rate. biological, pharmacological effects of dosage forms. Factors affecting Bioavailability, Determination of bioavailability.

Significance of bio-equivalence studies. Statistical analysis of bioequivalence studies. Development, scale up & post approval changes [SUPAC] & *in vitro* [dissolution] *in vivo* [plasma concentration profile] correlation or IV/IV correlation (IVIVC). Multi stage - Bioequivalence studies. Therapeutic equivalence.

16. Aseptic Technique

The omnipresence of microorganisms, the importance of asepsis, sources of contamination and methods of prevention. Principle, construction & working of laminar airflow bench.

17. Microbial Assay

Importance, general methods of assay of antibiotics (Cup & plate method, paper disc method, turbidometry, dilution method), methods for fungicidal & antiviral compounds assay, microbial limit tests.

18. Fluid flow

Type of flow, Reynold's number, viscosity, the concept of the boundary layer, basic equation of fluid flow, the study of valves, flow meters, manometers and measurement of flow.

19. Evaporation

The basic concept of phase equilibrium, factors affecting evaporation, evaporators, film evaporators, single effect and multiple effect evaporators, mathematical problems on evaporation.

20. Distillation

Raoult's law, phase diagram, volatility, simple steam and flash distillation, principles of rectification, Mc-Cabe Thiele method for calculations of a number of theoretical plates, azeotropic and extractive distillation.

21. Drying

Moisture content and mechanism of drying, the rate of drying and time of drying calculations, classifications and types of dryers, dryers used in pharmaceutical industries and special drying methods like freeze drying and lyophilization.

22. Size reduction

Definition, objectives of size reduction, factors affecting size reduction, laws governing in energy and power requirement of a mill.

23. Mixing

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

24. Crystallization

Characteristics of crystals like purity, size, shape, geometry, habit, forms, size and factors affecting them. Solubility curves and calculation curves and calculations of heat balance around S Swanson's Walker crystallizer, supersaturation theory and its limitations, Nucleation mechanism, crystal growth, study of various types of crystallizers, tanks, agitated batch, Swanson's Walker, single vacuums, circulating magma and crystal crystallizers, cracking of crystals and its prevention.

25. Filtration and Centrifugation

Theory of filtrations, filter aids, filter media, industrial filters, including filter press, rotary filter, edge filters, filter leaf and laboratory filtration equipment etc., Factors affecting filtration. Principles of centrifugation, industrial centrifugal filters and centrifugal sedimentars.

26. Surface and interfacial phenomenon

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

27. Viscosity and rheology

Newtonian systems, law of flow, kinematics viscosity, effect of temperature, non-Newtonian systems, pseudoplastics, dilatant, plastic, thixotropy in formulations, determination of viscosity and thixotropy by capillary, falling ball, rotational viscometer.

Pharmaceutical Chemistry

1. Kinetics

Order of reactions, derivation & internal form of rate laws, molarities of reaction, derivation of rate constants.

2. Solutions

Solubility, factors affecting solubility, solubility curves. Types of solutions, effect of co-solvency, pH & other factors on solubility. Solubility of gases in liquids, liquids in liquids, & solids in liquids, critical solution temperature, law of partitioning & its applications. Solute-solvent interactions. Expression of the concentration of pharmaceutical solutions & calculations. Molarity, molality, mole fraction & percentage expressions.

3. Buffer

Buffer equations and buffer capacity in general. Buffers in pharmaceutical systems, preparations and stability, buffered isotonic solutions. Measurements of tonicity calculations and methods of adjusting isotonicity.

4. Heterocyclic Chemistry

IUPAC Nomenclature of heterocyclic rings [3-10 membered] containing O, S, & N atoms. Nomenclature of above rings containing mono-, di-, & multiple [same or different] heteroatoms should also be covered. Nomenclature of 2 & 3 fused rings containing mono-, di-, & multiple heteroatoms [same or different].

5. Therapeutic classes of drugs

A detailed study of the following classes with respect to drug nomenclature, classification, physicochemical properties, mode of action [MOA], structure-activity relationships [SAR],

- a. Autonomic nervous system.
- b. Central nervous system
- c. Cardiovascular system
- d. Non Steroidal Anti-inflammatory Drugs
- e. Antibiotics: Penicillins, cephalosporins & other beta-lactam antibiotics like imipenem & aztreonam. Beta-lactamase inhibitors such as clavulanic acid & sulbactam. Chloramphenicol. Tetracyclines. Aminoglycoside antibiotics. Macrolide antibiotics. Lincomycins. Polypeptide antibiotics.

Pharmacology

1. General Pharmacology

Introduction to Pharmacology- Definition, scope and source of drugs, dosage forms and routes of drug administration. Pharmacodynamics-Mechanism of drug action, Receptors, classification and drug-receptor interactions, combined effects of drugs, factors modifying drug actions.

Pharmacokinetics-Mechanism and principle of absorption, distribution, metabolism and excretion of drugs. Principles of basic and clinical pharmacokinetics. Pharmacogenetics. Adverse drug reactions. Discovery of new drugs-Preclinical and clinical studies.

Detailed pharmacology including classification, mechanism of action and therapeutic uses of following classes:

2. Neurohumoral transmission in autonomic and central nervous system:

Neurohumoral transmission (Autonomic and somatic). Neurohumoral transmission in the CNS with special emphasis on Pharmacology of various neurotransmitters.

3. Pharmacology of peripheral nervous system

Parasympathomimetics, Parasympatholytics, Sympathomimetics, Sympatholytics, Ganglionic stimulants and blockers. Neuromuscular blocking agents and skeletal muscle relaxants (peripheral). Local anesthetic agents.

4. Pharmacology of central nervous System

General anesthetics. Alcohols and disulfiram. Sedatives, hypnotics and centrally acting muscle relaxants, Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents. Anti-epileptic drugs. Anti-parkinsonism drugs. Narcotic analgesics, drug addiction, drug abuse, tolerance and dependence.

5. Pharmacology of cardiovascular system

Introduction of hemodynamics and Electrophysiology of heart.

Anti-hypertensive drugs, Anti-anginal agents, Anti-arrhythmic drugs, drugs used in congestive heart failure. Anti-hyperlipidemic drugs, Haematinics, anticoagulants and haemostatic agents. Fibrinolytics and antiplatelet drugs, Blood and plasma volume expanders.

6. Chemotherapy

General principles of chemotherapy. Sulphonamides and co-trimoxazole.

Antibiotics- Penicillins, cephalosporins, chloramphenicol, Macrolides, quinolones and fluoroquinolones, Tetracyclines. Aminoglycosides and miscellaneous antibiotics.

7. Autacoids and their Antagonists

Histamine, 5-HT and their agonists and antagonists. Prostaglandins, thromboxanes and leukotrienes. pentagastrin, cholecystokinin, angiotensin, bradykinin and substance P., Analgesic, anti-pyretic, anti-inflammatory and anti-gout drugs.

8. Principles of toxicology

Definition of poison. General principles of treatment of Poisoning. Treatment of poisoning due to Heavy metals, insecticides, opioids. Study of acute, sub acute and chronic toxicity as per OECD guidelines (guidelines 420,423,425,407,408,451/452; only names and significance).

Pharmacognosy

1. Introduction to phytoconstituents

Definition, classification, chemical tests and pharmaceutical importance of: carbohydrates and their derivatives, fats and proteins, alkaloids, glycosides, flavonoids, steroids, saponins, tannins, resins, lipids and volatile oils.

2. Pharmaceutical aids

Biological sources, chemical constituents, and uses of starches, acacia gum, tragacanth, guar gum, pectin, arachis oil, castor oil, olive oil, cotton, silk, wool, asbestos, kaolin, prepared chalk, kieselguhr.

3. Plant products

Introduction to plant bitters, sweeteners, nutraceuticals, cosmeceuticals.

4. Enzymes

Biological sources, preparation, characters, and uses of diastase, papain bromelain, ficin, yeast, pancreatin, urokinase, pepsin, trypsin, penicillinase, hyaluronidase and streptokinase.

5. Quantitative microscopy

Definition and determination of stomatal index, stomatal number, palisade ratio, vein islet number, vein termination number, lycopodium spore method. Micrometers and measurement of microscopic characters.

6. Extraction and Isolation Techniques

General methods used for the extraction, isolation and identification of alkaloids, lipids, glycosides, flavonoids, saponins, volatile oils and resins. Application of column, paper and thin layer chromatographic techniques for the isolation of phytopharmaceuticals.

7. Quality control and Standardization of herbal drugs

Quality control of herbal drugs as per WHO, AYUSH and Pharmacopoeial guidelines. Extractive values, ash values, chromatographic techniques (TLC, HPTLC and HPLC) for determination of chromatographic markers. Determination of heavy metals, insecticides, pesticides and microbial load in herbal preparations.

8. Herbal formulations

Principals involved in Ayurveda, Sidha, Unani, Chinese and Homeopathic systems of medicines. Preparation of Ayurvedic formulations like aristas, asava, ghutika, tailia, churna, avaleha, ghrita and bhasmas: Unani formulations like majooms, Safoofs. Determination of alcohol contents in arishtas & asavas.

Pharmaceutical Analysis

1. Extraction techniques

Liquid-liquid extraction, separation of mixtures by extraction. Distribution law. Successive & multiple extraction [Craig method], continuous counter-current extraction. Effect of temperature & pH on extraction. Inert solute, associate ion pair formation.

2. General principles of spectroscopy

Wave-particle duality, wave properties, particulate properties. Line & band spectrum. Electromagnetic spectrum. Absorption & emission spectroscopy. Understanding of terms absorbance, transmittance, absorptivities, molar absorptivity, $E_{1\text{cm } 1\%}$, λ_{max} , the effect of solvent & pH on λ_{max} .

3. Ultraviolet-visible Spectrometry

Different electronic transitions. Auxochromes & their effects, auxochromic, bathochromic & hypsochromic shifts [red & blue shifts]. Beer-Lambert law, its derivation, deviations in Beer's law. Single & double beam spectrophotometers covering sources of radiations, different monochromators, detectors, Photodiode array detector. Applications of this technique in qualitative & quantitative estimations.

4. Infrared spectrometry

The principle, different stretching & bending vibrations. Components [& their working] of a dispersive instrument. Fourier transform [FT] technique, FT instruments & their comparison with dispersive instruments. Sample handling techniques. Functional group & fingerprint regions in the spectrum. Functional groups identification & their use in the characterization of compounds.

5. Mass spectrometry

Principle. Low & high-resolution instruments. Components & importance of each in brief. Different types of mass spectrometric techniques. Brief knowledge of Chemical Ionization mass spectrometry. Calculations of hydrogen deficiency index [HDI] or unsaturation index [UI]. Base or parent peak, molecular ion, $M + 1$, $M + 2$ peaks. Calculations of molecular weight based on $M + 1$ & $M + 2$ peaks. Formation of molecular ion & further fragmentation. Rearrangements in mass spectrometry. Major modes of fragmentations of hydrocarbons, hydroxyl compounds, aldehydes, ketones, carboxylic acids, and amines.

6. Chromatography.

Principle, rate & plate theory, Van Deemter equation & the parameters affecting separation/band broadening. Classification of chromatography, retention factor. A detailed study of thin layer chromatography [TLC], preparative TLC, paper chromatography [PC], column chromatography, gas chromatography [GC / GLC].

Qualitative & quantitative applications of the above techniques. An introduction to high performance TLC [HPTLC], A brief introduction to high pressure / performance liquid chromatography [HPLC].

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