Syllabus

GPAT - 2018

ALL INDIA COUNCIL FOR TECHNICAL EDUCATION
Nelson Mandela Marg, Vadsant Kunj,
New Delhi-110 070
PHYSICAL CHEMISTRY

1. Composition & physical states of matter
Intermolecular forces & their impact on the state of the matter. Various physical properties of matter, dipole moment, dielectric constant, Van Der Waal's equation & critical phenomenon, liquefaction of gases, aerosols.

2. Colligative Properties
The liquid state, vapor pressure, ideal & real solutions. Raoult's law, elevation of boiling point, depression of freezing point, osmotic pressure, determination of molecular weight based on colligative properties.

3. Thermodynamics

4. Refractive index
Refractive index, specific refractivity, molar refractivity, refractometers.

5. Solutions

6. Electrochemistry
7. Ionic equilibrium
Theory of conductivity, equivalent conductance, mobility of ions, specific conductance.

8. Kinetics
Order of reactions, derivation & internal form of rate laws, molarities of reaction, derivation of rate constants.
1. Matter, properties of matter
States of matter, change in the state of matter, latent heat and vapor pressure, sublimation-critical point, eutectic mixtures, gases, aerosols- inhalers, relative humidity, liquid complexes, liquid crystals, glasses state, solid crystalline and amorphous polymorphism.

2. Micromeritics and powder rheology
Particle size and distribution, average particle size number and weight distribution, particle number, methods of determining particle size and volume, optical microscopy, sieving, sedimentation, determining surface areas, permeability, adsorption, derived properties of powders, porosity, packing arrangement densities, bulkiness and flow properties.

3. 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.

4. 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, application of theology in pharmacy.

5. Dispersion systems
a. Colloidal dispersions: Definition, types, properties of colloids, protective colloids, application of colloids in pharmacy.

6. Complexation
Classification of complexes, methods of preparations and analysis, applications.
7. Buffer

8. Solubility
a. Miscibility-influence of foreign substances
   three component systems;
   - dielectric constant and solubility,
   - solubility of solids in liquids
   - ideal and non-ideal solutions
   - solvation and association in solutions
   - solubility of salts in water
   - solubility of slightly soluble and weak electrolyte
   - calculating solubility of weak electrolytes as influenced by pH, influence of solvents on the solubility of drugs
   - combined effect of pH and solvents, distribution of solutes between immiscible solvents, effect of ionic dissociation and molecular association on partition, extraction, preservatives action of weak acids in emulsions, drug action and distribution coefficient.

ORGANIC CHEMISTRY

1. General principles
A brief review of classification & sources of organic compounds, sp\(^3\), sp\(^2\), sp hybridization, sigma & pi- bonds, bond lengths, bond angles & bond energies along with their significance in reactions should be carried out. An overview of bond polarization, hydrogen bonds, inductive effects, resonance, and hyperconjugation be taken. Concept of homolytic & heterolytic bond fission, acidity & basicity with different theories should be covered briefly. Ease of formation & order of stabilities of electron deficient & electron rich species along with the reasons for the same should be covered. Relationships between energy content, stability, reactivity & their importance in chemical reactions should be covered. Calculations for determining empirical & molecular formula should be covered.

2. Different classes of compounds
The following classes of compounds should be taught in detail with respect to their IUPAC / systematic nomenclature, industrial [wherever applicable] & laboratory methods of preparations, physical properties & chemical reactions with emphasis on reaction mechanisms [arrow based] & stereochemistry [wherever applicable].
- Alkanes [including cyclic compounds]
- Alkenes [including cyclic compounds]
- Alkynes [only open-chain compounds]
- Aliphatic hydroxyl compounds
- Alkyl halides
- Aldehydes & Ketones
- Carboxylic acids
- All functional derivatives of carboxylic acids.

3. Protection & deprotection of groups
Introduction to protection & deprotection of functional groups. Two examples each for amino, hydroxyl, & carbonyl groups. The significance of these in syntheses should be explained.

4. Aromaticity & chemistry of aromatic compounds
Concept of aromaticity, Huckel's rule & its use in determining the aromatic/non-aromatic

5. Different aromatic classes of compounds
The following classes of compounds with respect to their IUPAC / systematic nomenclature, industrial [wherever applicable] & laboratory methods of preparations, physical properties & chemical reactions with emphasis on reaction mechanisms [arrow based] & stereochemistry [wherever applicable].

- Aromatic hydrocarbons.
- Phenolic compounds.
- Aromatic & aliphatic amines.
- Diazonium salts.
- Aromatic nitro- compounds, aryl halides, & ethers.

6. Polycyclic aromatic hydrocarbons
Syntheses & reactions with mechanisms of bi & tricyclic fused carbocyclic rings like naphthalene, anthracene, & phenanthrene.

7. Carbonyl Chemistry
   Carbonyl chemistry involving group conversions & their reaction mechanisms along with stereochemistry wherever applicable.
   b. Reduction of arylsulfonhydrazine/hydrazones to alkanes.
   c. Bamford Steven reaction.
   d. DCC Oxidation of alcohol.
   e. Michael addition / 1,4-addition / conjugate addition.
   f. Mannich condensation / reaction.
   g. Robinson annulation.
   h. Stobbe condensation.
   i. Darzen's glycidic ester synthesis.
   j. Beckmann rearrangement.
   k. Baeyer Villiger rearrangement.
   l. Curtius, Wolff, & Lossen rearrangements.
   m. Willgerodt rearrangement.
   n. Pinacol-pinacolone rearrangement.
o. Methylene transfer reactions. Use of diazomethane & sulphur ylides in the same.
p. Mono- & dialkylation in 1,3-dicarbonyl compounds.
q. Formation & use of enol ethers, enol acetates & enamines as protective groups & in regiospecific alkylations.

8. 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] should also be covered. Syntheses & reactions of three to six-membered rings in detail. Syntheses of five & six-membered rings containing mono- or any diheteroatoms [O, S, & N]. Syntheses of quinoline, isoquinoline, benzoxazole, benzothiazole, & benzimidazole, benzotriazole, and benzothiazole.

9. Bridged rings
Bridged ring systems & their nomenclature.C₈, C₉, C₁₁ bridged bicyclic alkanes. Chemistry of hexamine, morphan, biperiden, amantadine, diazabicyclo[2.2.2] octane

10. Kinetic & thermodynamic control
Kinetic & thermodynamic control of sulfonation, enolate anion formation & alkylation of enamine reactions.

11. Stereochemistry
12. Carbohydrates

13. Amino acids & proteins

14. Pericyclic reactions
Pericyclic reactions. Concept of HOMO & LUMO. Drawing of HOMO & LUMO of 1, 3-butadiene, allylic cation, radical & anion, & 1, 3, 5-hexatriene, Diel's-Alder & retro Diel's Alder reaction.
I. Pharmaceutical Inorganic Chemistry

1. Pharmaceutical Impurities
Impurities in pharmaceutical substances, sources, types & effects of impurities. Limit tests for heavy metals like lead, iron, arsenic, mercury & for chloride & sulphate as per Indian Pharmacopoeia [I. P.].

2. Monographs
(a) Monograph & its importance, various tests included in monographs as per I. P. A study of the following compounds with respect to their methods of preparation, assay, & pharmaceutical uses of sodium citrate, calcium carbonate, copper sulphate, light & heavy kaolin, ammonium chloride & ferrous gluconate.

3. Isotopes
Isotopes- stable & radioactive, mode & rate of decay. Types & measurement of radioactivity. Radiopharmaceuticals & their diagnostic & therapeutic applications in pharmacy & medicine such as $^{125}$I, $^{32}$P, $^{51}$Cr, $^{60}$Co, $^{59}$Fe, $^{99}$Tc-M. Radiocontrast media, use of BaSO$_4$ in medicine.

4. Dentifrices, desensitizing agents, & anticaries agents

II. Medicinal Chemistry

5. Therapeutic classes of drugs
The following topics should be dealt with covering nomenclature [including stereochemical aspects], biological activity [including side & toxic effects], mode of action, structure-activity relationship [where ever applicable] & syntheses of reasonable molecules.

1. General anesthetics.
2. Local anesthetics.
3. Diagnostic agents.
5. Antiseptics, disinfectants, sterilants, & astringents.

6. Various classes of therapeutic agents
A detailed study of the following classes with respect to drug nomenclature, classification, physicochemical properties, mode of action [MOA], structure-activity relationships [SAR],
wherever applicable, synthesis of simple & prototype molecules, drug metabolism, therapeutic uses & side effects. Drug resistance, wherever applicable, should be covered in respective classes of drugs.

a. Antimarialis
b. Antiamoebic agents.
c. Anthelmintic agents.
d. Antibacterial sulpha drugs [only].
e. Quinolone antibacterials.
f. Antimycobacterial drugs.
g. Antifungal agents.
h. Antiviral agents including HIV & anti-HIV drugs.
i. Thyroid & antithyroid drugs.
j. Antiallergic agents.
k. Antiulcer agents & Proton Pump Inhibitors.
l. Hypoglycemic agents.

7. Different classes of therapeutic drugs
A detailed study of the following classes with respect to drug nomenclature, classification, physicochemical properties, mode of action [MOA], structure-activity relationships [SAR], wherever applicable, synthesis of simple & prototype molecules, drug metabolism, therapeutic uses & side effects. Drug resistance, wherever applicable, should be covered in respective classes of drugs.

I. a. Sedative-hypnotics
   b. Antiepileptic agents.
   c. Neuroleptics.
   d. Anti-anxiety drugs.


   Anticancer agents.

8. Different classes of therapeutic drugs
A detailed study of the following classes with respect to drug nomenclature, classification, physicochemical properties, mode of action [MOA], biosynthesis, structure-activity
relationships [SAR], wherever applicable, synthesis of simple & prototype molecules, drug metabolism, therapeutic uses & side effects. Drug resistance, wherever applicable, in respective classes of drugs.


II. Adrenergic drugs. Neurotransmitters & their role. General & specific adrenergic agonists & antagonists [up to alpha-2 & beta-2 only].


IV. Drugs used in neuromuscular disorders. Drugs used in the treatment of Parkinson's disease. Central & peripheral muscle relaxants.

V. Hypertensive, antihypertensive, & antianginal agents.

VI. Diuretics.

VII. Eicosanoids. Prostaglandins, prostacyclins, & thromboxanes. Their biochemical role, biosynthesis, & inhibitors.

9. Introduction to quantitative structure-activity relationship. [QSAR]. Linear free energy relationship. Hammett's equation. Use of substituent constants such as π, σ, E, & physicochemical parameters such as pKa, partition coefficient, Rm, chemical shifts, molar refractivity, simple & valance molecular connectivity to indicate electronic effects, lipophilic effects, & steric effects. Introduction, methodology, advantages & disadvantages/limitations of Hansch analysis.


1. Pharmacy Profession & Introduction to Pharmaceuticals
Pharmacy as a career, evaluation of Pharmacy, earlier period middle to modern ages. Definition, importance of pharmaceuticals, areas concerned, scope of Pharmaceutics, history and development of the profession of Pharmacy and Pharmaceutical industry in India. A brief review of present Indian Pharma. Industry in global perspective.

2. Introduction to dosage form
Definition of the drug. New drug and dosage form. The desirable properties of a dosage form, the need of dosage form. Ideas about the available type of dosage forms and new drug delivery system.

3. Sources of drug information
Introduction to Pharmacopoeia with reference to IP, BP, USP and International Pharmacopeia. Study of structure/features (index) general notice and compartment of monographs of excipients, drug and drug product. Other sources. Textbooks, journals, internet (drug information system, online database, patient/consumer information and non-print material. Classification of information, primary, secondary and tertiary. Nomenclature of the drug.

4. Allopathic dosage form

5. Crude extract
Infusion, decoction, maceration, percolation, tincture and extract. Methods of preparations of dry, soft and liquid extract.

6. Allergenic extract
Types of allergens, preparation of extract, testing and standardization of extracts.
7. Biological products
Absorbable and non-absorbable material types, sutures and ligatures, processing, manufacturing, sterilization, packing, QC tests of materials like catgut and nylon.

8. Pharmaceutical Plant, location, layout
Plant location and layout of an industry. Various factors affecting locational aspects of chemical and pharmaceutical plants. The layout of plant building and importance of flow sheet, the difference between scientific process and technological process, the layout of various departments, equipment, and product layout v/s process layout.

9. Dosage Form Necessities and Additives
Antioxidants, preservatives, coloring agents, flavoring agents and diluting agents, emulsifying agents, suspending agents, ointment bases, solvents, and others.

10. Powders
Advantages and limitations as dosage form, manufacturing procedure and equipment, special care and problems in manufacturing powders, powders of IP, effervescent granules and salts.

11. Capsules

12. Tablets
Types, ideal requirement, classification, granulation methods, general formulation, compression machines, different types of tooling’s, difficulties in tableting, troubleshooting aspects, evaluation, sugar coating, compression coating, film coating, problems in tablet coatings and their troubleshooting aspects. IP formulations.

13. Parenterals - product requiring sterile packaging
Definition, types advantages and limitations, general formulation, vehicles, production procedure, production facilities, controls, tests, selected IP injections, sterile powders, implants, emulsions, suspensions.

14. Suspensions
Formulation of deflocculated and flocculated suspension, manufacturing procedure, evaluation methods, IP suspensions.

15. Emulsions
Types, emulsifying agents, general formulation, manufacturing procedure, evaluation methods, IP emulsions.

16. Suppositories
Ideal requirements, bases, manufacturing procedure, evaluation methods, IP products.

17. Semisolids
Definitions, bases, general formulation, manufacturing procedure, evaluation methods, IP products.

18. Liquids (solutions, syrups, elixirs, spirits, aromatic water, liquid for external uses)
Definition, types, general formulation, manufacturing procedure, evaluation methods, IP products.

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

20. Ophthalmic preparations
Requirement, formulation, methods of preparation, containers, evaluation, IP products.

21. Preformulations
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, hydrolysis, oxidation, recemization, polymerization, isomerization, decarboxylation, enzymatic decomposition, formulation additives, stabilizers, suspending and dispersing agents dyes, solid excipients etc. and its effect on quality of finished product.

22. Stability of formulated products
Requirements, drug regulatory aspects, pharmaceutical products stability, shelf life, overages, containers, closures.
Reaction rate and order, acid-base catalysis, destabilization and accelerated stability testing.
23. Prolonged Action Pharmaceuticals
Benefits, limitations, oral products, terminology, drug elimination rate, types and construction of implants products, product evaluation, parenteral products, absorption and evaluation.

24. Novel Drug delivery system
Critical fluid technology, transdermal drug delivery system, controlled drug delivery system, multiple emulsion, nanoparticles, targeted drug delivery system, aerosols, inhalation & new products reported etc.

25. GMP and Validation
Introduction to GMP, QC and QA. Concept and need of good manufacturing practice guidelines. Elements of GMP covering controls of area and processes and product. Regulations related to GMP. Introduction of the validation process. Types of validation. The brief methodology of process, equipment and instrument validation.

26. Packaging Materials

27. Cosmetics
Formulation and preparation of dentifrices, hair creams, lipsticks, face powders, shaving preparations, skin creams, shampoos, hair dyes, depilatories, manicure preparations etc.

28. Pilot plant scale-up techniques
Need, organization and layout, scale-up techniques for solid and liquid dosage forms. Technology transfer.
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.
   Adverse drug reactions.
   Discovery and development 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:
   Therapeutic use of nitric oxide and nitric oxide donors. Clinical condition in which nitric oxide may play a part.
   **Peptides and proteins as mediators:**
   General Principal of peptide pharmacology Biosynthesis and regulation of peptides Peptide antagonists. Protein and peptide as drugs.

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. Drugs used in Myasthenia Gravis.

4. Pharmacology of central nervous System
   General anesthetics. Alcohols and disulfiram. Sedatives, hypnotics and centrally acting muscle relaxants, Psychopharmacological agents: Antipsychotics, antidepressants, antianxiety agents, anti-manics and hallucinogens.
   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. Drugs used in the therapy of shock.
Haematinics, anticoagulants and haemostatic agents.
Fibrinolytics and antiplatelet drugs.
Blood and plasma volume expanders.

6. Drugs acting on urinary system
   Diuretics and anti-diuretics.

7. Drugs acting on Respiratory system
   Anti-asthmatic drugs, Mucolytics and nasal decongestants, Anti-tussives and expectorants.
   Respiratory stimulants

8. Pharmacology of Endocrine system

9. Chemotherapy
   General principles of chemotherapy. Sulphonamides and co-trimoxazole.

10. Autacoids and their Antagonists
    Histamine, 5-HT and their agonists and antagonists.
    Prostaglandins, thromboxanes and leukotiienes. pentagastrin, cholecystokin in, angiotensin, bradykinin and substance P.,Analgesic, anti-pyretic, anti-inflammatory and anti-gout drugs.

11. Pharmacology of drug acting on the gastrointestinal tract
    Antacids, anti-secretary and antiulcer drugs.

12. Chronopharmacology
    Definition of rhythm and cycles. Biological clocks and their significance leading to
chronotherapy.

13. Immnopharmacology
   Immunostimulants and immunosuppressants.

14. Vitamins & Minerals
   Vitamin deficiency diseases and their management. Role of minerals in health & diseases.

15. Principles of toxicology
   Definition of poison. General principles of treatment of Poisoning. Treatment of poisoning due to Heavy metals, insecticides, opioids and other addict forming drugs. Study of acute, sub acute and chronic toxicity as per OECD guidelines (guidelines 420,423,425,407,408,451/452; only names and significance, detailed procedures and minute details are not expected).
PHARMACOGNOSY

1. Introductory Pharmacognosy
Historical development, modern concept and scope of Pharmacognosy. The significance of Pharmacognosy in various systems of medicine practiced in India viz: Ayurveda, Unani, Homeopathic and Siddha.

2. Classification of crude drugs
Based on alphabetical, morphological, pharmacological, chemical, taxonomical and chemotaxonomic methods: organized and unorganized drugs: official and unofficial drugs. Plants, animals and minerals: marine products: plant tissue culture.

3. Factors influencing quality of crude drugs
Exogenous factors: temperature, rainfall, daylight, altitude and soil. Endogenous factors: Mutation, polyploidy, & hybridization in medicinal plants. Production factors including collection, drying, storage and transport methods. Study of morphological and histological characters of crude drugs, Ergastic cell inclusions, anatomical structures of both monocot and dicot stems, leaves and roots: barks, fruits and seeds.

4. Techniques in microscopy
Details of mountants, clearing agents, chemomicroscopic (microchemical) reagents.

5. 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.

6. Principles of plant classification
Diagnostic features and medicinal significance of important plants with special reference to:

Algae: Rhodophyceae (Agar, Alginic acid, Diatoms).
Fungi: Ergot, Yeast and penicillium.
Gymnosperm: Pinaceae (Turpentine, Colophony), Gnetaceae (Ephedra).
Angiosperm: Apocynaceae, Asteraceae, Lamiaceae, Rubiaceae, Rutaceae, Solanaceae, Scrophulariaceae, Leguminosae, Papaveraceae, Acanthaceae and Apiaceae.
**Pteridophytes:** Male fern.

**7. Pharmaceutical aids**
Biological sources, chemical constituents, adulterants and uses of: Starches, acacia gum, tragacanth, sterculia, guar gum, pectin, arachis oil, castor oil, sesame oil, cottonseed oil, olive oil, cotton, silk, wool, regenerated fibers, asbestos, kaolin, prepared chalk, kieselguhr.

**8. Animal products**
Biological sources, chemical constituents, adulterants and uses of: Shellac, cochineal, cantharides, wool fat, lard, beeswax, honey, musk, lanolin, gelatin.

**9. Plant products**
Introduction to plant bitters, sweeteners, nutraceuticals, cosmeceuticals and photosensitizing agents.

**10. Toxic drugs**
Study of allergens, hallucinogens, narcotics.

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

**12. Natural pesticides and insecticides**
Introduction to herbicides, fungicides, fumigants and rodenticides tobacco, pyrethrum, & neem.

**13. Adulteration and evaluation of crude drugs**
Different methods of adulteration: Evaluation of drugs by organoleptic, microscopic, physical, chemical and biological methods. Deterioration of herbal drugs by insects.

**14. 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.
15. Biogenetic pathways

16. Carbohydrates & lipids
Biological sources, salient morphological features, chemical constituents, and uses of: Plantago, bael, chaulmoogra oil, neem oil, shark liver oil, cod liver oil, guggul lipids.

17. Tannins
Biological sources, morphology, chemical constituents, chemical test and uses of: Pale catechu, black catechu, nutgalls, Terminalia belerica, Terminalia chebula, Terminalia arjuna.

18. Volatile oils
Biological sources, morphology, chemical constituents, adulterants and uses of: Black pepper, turpentine, mentha, coriander, cardamom, cinnamon, cassia, lemon peel, orange peel, lemongrass, citronella, cumin, caraway, dill, spearmint, clove, anise, star anise, fennel, nutmeg, eucalyptus, chenopodium, ajowan, sandalwood.

19. Resinous drugs
Classification, formation, sources, chemical constituents, identification test, adulterants and uses of: benzoin, Peru balsam, tolu balsam, colophony, myrrh, asafoetida, jalap, colocynth, ginger, turmeric, capsicum, cannabis, podophyllum.

20. Glycosides
Nature and classification. Biological sources, morphology, chemical constituents, adulterants and uses of: Digitalis, strophanthus, squill, thevetia, oleander, cascara, aloe, rhubarb, senna, quassia, dioscorea, quillaia, glycyrrhiza, ginseng, gentian, wild cherry, withania, bitter almond. Biosynthesis of cardiac and anthraquinone glycosides.

21. Alkaloids
Nature, classification, biological sources, morphology, chemical constituents, adulterants and uses of: Areca nut, belladonna, hyoscyamous, stramonium, duboisea, coca, coffee, tea, cinchona, opium, ipecac, nux vomica, ergot, rauwolfia, vinca, kurchi, ephedra, colchicum,
vasaca, pilocarpus, aconite, Solanum xanthocarpum. Biosynthesis of tropane, cinchona and opium alkaloids.

22. 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.

23. Phytopharmaceuticals
Isolation, identification and estimation of: caffeine, eugenol, digoxin, piperine, tannic acid, diosgenin, hesperidin, berberine, calcium sennosides, rutin, glycyrrhizin, menthol, ephedrine, quinine, andrographolides and guggul lipids.

24. 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.

25. Herbal formulations

26. Worldwide trade of crude drugs and volatile oils
Study of drugs having high commercial value and their regulations pertaining to trade.

27. Herbal cosmetics
Importance of herbals as shampoos (soapnut), conditioners and hair darkeners, (amla, henna, hibiscus, tea), skin care (aloe, turmeric, lemon peel, vetiver).

28. Traditional herbal drugs
Common names, sources, morphology, active constituents and uses (traditional, folklore), pharmacological and clinical uses of: punarnava (Boerhaviadiffusa), shankhpushpi (Convolvulus...
29. Plants based industries and research institutes in India
Knowledge about the herbal products being manufactured by premier herbal industries and thrust area of the institutes involved in plant research.

30. Patents
Indian and International patent laws, proposed amendments as applicable to herbal/natural products and processes: Intellectual Property Rights with special reference to phytoconstituents.

31. Ayurvedic system of medicine
Theory, basic concept, diagnosis, various branches of treatment in ayurveda, types of the drug formulation in Ayurveda and important Ayurvedic drugs and their uses, formulation of asavas, arishtas, watika, churna, tailas, ghruta, lep.

32. Homeopathic system of medicine
Theory, basic concept, diagnosis, treatment, source of homeopathic medicines and important homeopathic drugs and their uses.
PHARMACEUTICAL ANALYSIS

1. **Importance of quality control in pharmacy**

2. **Acid-base titrations**


   Definition, different types of buffers [chemical & biological], & their composition. Buffer capacity, buffered isotonic solutions. Calculations involving preparation of various buffer capacity solutions. Biological & pharmaceutical applications of buffers.

3. **Non-aqueous titrations**


4. **Oxidation-reduction titrations**

   Definition of oxidation, reduction, oxidizing & reducing agent. Equivalent weight, the concept of half reactions. Systematic balancing of half reactions with respect to:
a. Oxalic acid-KMnO₄,
b. FeSO₄-meric nitrate, &
c. I₂-sodium thiosulphate solution titrations.

Calculation of equivalent weight of oxalic acid, KMnO₄, FeSO₄, permanganate & I₂ from half-
reactions. Calculation of factors for titrations mentioned in a, b & c.

a) Redox titrations:
   KMnO₄ as a self indicator, it's preparation, standardization, & use in the assay of ferrous
   gluconate tablets, H₂O₂, & NaNO₂ solution.

b) Iodimetric & iodometric titrations. Definitions & difference between iodimetry &
   iodometry. Preparation, standardization of iodine solution. Assay of ascorbic acid &
   sulphur ointment by iodimetry. Assay of copper sulphate & ferric chloride by iodometry.

c) Bromometric titrations.

d) Iodate titrations. Definition. Preparation, standardization & use of KIO₃ in the assay of
   ascorbic acid & KI.

e) Cerimetric titrations. Preparation, standardization & use of ceric solutions in the assay
   of paracetamol tablets. Its advantages over permanganate solutions.

f) Bromine titrations. Preparation, standardization & use of bromine solution in the assay
   of phenol & isoniazid tablets.

g) Potassium dichromate titrations. Preparation, standardization & use of potassium
   dichromate solution in the assay of ferrous ammonium sulphate.

5. Precipitation titrations
The principle of solubility product & sparingly soluble salts.
Titrants & indicators used in Mohr's, Volhard's, & Fajan's methods. Preparation &
standardization of silver nitrate & ammonium thiocyanate solutions. Assay of sodium chloride
by Mohr's method, use of nitrobenzene in the assay of halides, ammonium chloride, & thiourea
by Volhard's method. Calculation of factors in argentometric titrations. Titration curve method.
General applications of precipitation titrations.

6. Complexometric titrations
Difference between double salts & co-ordinate compounds. Definitions of coordination number
of metal ions, ligands- uni-, bi-, & multidentate. Complexing, chelating, & sequestering agents
with respective examples. Structure of complexes of platinum with ammonia. Ethylenediamine
tetraacetate [EDTA] as a multidentate ligand in complexometry. Coordinate compounds of
EDTA with bi-, tri-, & tetravalent metal ions. Stability of complexes & factors affecting it, use of buffers in EDTA titrations. Selective analysis of ions based on pH adjustments, use of masking & demasking agents, pM or metal ion indicators. Standardization of EDTA solution, titration curves, and examples of assays carried out by direct & back titrations & by replacement of one complex by the other. Applications of complexometry in the assays of calcium gluconate, milk of magnesia, zinc undecenoate ointment, & aluminium hydroxide gel. Assay of NaF by indirect titration.

7. Gravimetry

8. 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, emulsion problem in extractions. Applications in pharmacy.

9. Potentiometry
Theory, ion-selective electrodes, measurement of potential, red-ox titration curve, pH measurement, the relation of pH to potential. Applications in pharmacy.

10. Miscellaneous methods of analysis

11. Calibration
Calibration of instruments.

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

13. 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 such as barrier cell, photocell, photomultiplier tube. Photodiode array detector. Applications of this technique in qualitative & quantitative estimations giving emphasis on problem-solving. Fieser-Woodward rules for calculations of theoretical $\lambda_{max}$ values.

14. Spectrofluorimetry

15. Flame photometry & atomic absorption spectrometry
Principle & instrumentation with emphasis on working & importance of different components. Temperature, flame absorption & emission profiles. Interferences & their avoidance. Quantitative estimations & applications.

16. Infrared spectrometry

17. Proton nuclear magnetic resonance spectrometry
The principle involved in the technique. Knowledge about fundamental terms involved such as quantized absorption, flipping of nucleus, spin number, magnetic moment, magnetogyric ratio, relaxation, etc. Equations relating these terms to the frequency of radiation & magnetic field
[without derivation of the equations]. Types of relaxation processes. Low & high-resolution instruments. A brief discussion on the low-resolution instrumentation [60 MHz]. Quantitative knowledge of the relationship between MHz & magnetic field. An introduction to superconduction magnets. Solvents & reference standards used. Setting up of NMR scale. Sample preparation. Shielding & deshielding of a proton & its effect on chemical shifts. Discussion on & importance of equivalent & non equivalent protons [number of signals], chemical shifts [position of signal] & their calculation from the spectrum, chemical shifts of different H's, splitting [multiplicity] of a signal, coupling constants [J values] , integration [area under the signal]. Importance of these terms in identification [or confirmation] of different functional groups. Significance & contribution of J value in stereochemistry. Prediction [expected theoretical values] of chemical shifts & multiplicities for all protons from simple structures containing up to 12-15 carbons. An introduction to FT-technique & its significance in $^{13}$C-NMR spectrometry.

18. Mass spectrometry

19. Polarography.

20. Nephelometry & Turbidimetry

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], comparison of TLC & HPTLC. A brief introduction to high pressure / performance liquid chromatography [HPLC].

**22. Miscellaneous**
1. Cell
Revision of ultrastructure of the cell, functions of various cellular constituents. Applications of biochemical principles to the pharmacy.

2. Carbohydrates

3. Proteins

4. Lipids
Different types of lipids. Their functions, digestion, absorption & metabolism. (Beta-Oxidation of fatty acids with energetics. Biosynthesis of cholesterol [from acetate], adrenocorticoids, androgens, progesterone, estrogens, & bile acids / salts. Ketone bodies, their formation & biochemical significance. Diseases associated with lipid metabolism.

5. Vitamins
Definition. Classification, structures [except B12] biochemical role, sources, daily requirements, & deficiency symptoms. Vitamins as co-factors in biochemical reactions.

6. Biological oxidations & reductions

7. Enzymes

8. Nucleic acids
Different types of nucleic acids [NAs] & their composition. Purine & pyrimidine bases, sugars, &

Eliptocytosis, spherocytosis, HNPCC, diabetes insipidus.
BIOTECHNOLOGY

1. Plant Cell and Tissue Culture
Structure of plant cell, DNA, Genes and chromosomes.
   1. Cell and tissue culture,
      a. Requirements.
      b. Callus culture, suspension culture, batch culture.
      c. The concept of somatic hybridization, somatic embryogenesis.
   2. Processes and applications,
      a. Isolation and immobilization of enzymes and plant cells and application.
      b. Protoplast and cell fusion.
      c. Germplasm conservation.
      d. Production of secondary metabolites by plant tissue culture.
      e. Gene transfer techniques.

2. Animal Cell Culture
Introduction to animal cell culture, medium used in ATC. Use of FCS, primary culture, secondary culture, cell line. Cloning: concept and application with technical hurdles. Transgenic animals as a source of food, organs and tissues, concept of xenotransplant.

3. Fermentation Technology and Industrial Microbiology
   1. Fermentation as a biochemical process, types of fermentation.
   2. Fermenter - working and construction, accessory components, modification.
   3. Fermentation monitoring and in situ recovery of products.

4. Recombinant DNA Technology
Basic concepts
   a) Introduction.
   b) Role of a restriction endonuclease, DNA ligase, DNA polymerase, Reverse transcriptase.

5. Process and Applications
   a) Constructing Recombinant DNA molecules.
      ■ DNA Clones sources of DNA for cloning.
      ■ DNA vectors, role of expression vectors.
      ■ Host cell for recombinant work.
      ■ Method for screening and selecting transformants.
- Expression of foreign genes.
- Uses of recombinant DNA.

b) PCR and applications.
   - Human gene therapy concept and applications.

c) Drug delivery systems in gene therapy.

**6. Biotechnology Derived Products**

a) Sources and upstream processing.
   - Introduction.
   - Escherichia coli as a source of recombinant, therapeutic protein.
   - Additional production systems,
     - Yeast.
     - Fungal production systems.
     - Transgenic animals.
     - Transgenic plants.
     - Insects cell-based systems.
   - Upstream processing.

b) Downstream processing.
   - Product analysis,
     - Introduction.
     - Protein-based contaminant.
     - Removal of an altered form of the protein of interest from the product stream.
   - Determination of protein concentration.

c) Immunological approaches to detection of contaminant, Endotoxin and other pyrogenic contaminants.
   - Pyrogen detection.
   - DNA as a contaminant.
   - Microbial and viral contaminant.
   - Viral assays.
   - Miscellaneous contaminants.
   - Validation studies.

d) Production and purification of recombinant proteins like, Insulin, Growth hormones, somatostatin, interferons, only examples of recombinant blood products.
**MICROBIOLOGY**

1. **Introduction to Microbiology**

   Scope and application to pharmacy field. Whittaker’s Five Kingdom concept, historical development - biogenesis Vs. abiogenesis, Germ theory of fermentation, Germ theory of disease, the contribution of Leeuwenhoek, Robert Koch, Jenner, Louis Pasteur and Ehrlich.

2. **Microscopy and staining technique**

   The principle, ray diagram, construction, working and applications of light compound, dark field, phase contrast, Fluorescence & electron microscope. The concept of resolving power, Magnification power, numerical aperture and angular aperture and working distance. The principle application of oil immersion microscopy. Theory of staining, principle and technique of staining procedure - Monochrome, Gram, acid-fast, negative, capsule, endospore.

3. **Biology of Microorganisms**

   Cultural characteristics, pure culture techniques

4. **Fungi and Viruses**

   b) Fungi:- Introduction, general characteristics, morphology, the industrial and medical significance of Saccharomyces Cerevisiae, Penicillium and Aspergillus, Candida Albicans, Epidermophyton, and trichophyta.
   c) Viruses: - Introduction, structure and general properties Bacteriophages - Lytic and Lysogenic cycle, Epidemiological uses of Bacteriophages, human viruses - Cultivation and Multiplication virus-host cell interaction, Pathogenesis of HIV and Prions, types of Tumor viruses.

5. **Aseptic Technique**

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

6. Sterilization & Disinfection
   a) Concept and classification, principle and methods of sterilization, Mechanisms of cell injury.
   b) Construction, working & applications of moist heat & dry heat sterilizer, gamma radiation sterilizer, filtration sterilizer. Indicators of sterilization, microbial death, kinetic terms-D value, z value.
   c) Terminology of chemical antimicrobial Agents, Chemical classification of different disinfectants, characteristics of ideal disinfectants, factors affecting the action of disinfectants, evaluation methods (RW Coeff.), Kelsey Sykes test, Chick Martin test.

7. Microbial spoilage
   Types of spoilage, factors affecting spoilage of pharmaceutical products.

9. Vaccines & Sera
   Manufacturing (seed lot system) and quality control of bacterial vaccines & Toxoids (Tetanus, TAB, Cholera, BCG, DPT), Viral vaccine (Polio- Salk Sabin, Rabies, MMR, Hepatitis, Chickenpox, influenza), Antisera (diphtheria, tetanus), antiviral Antisera (rabies). Preparation of allergenic extracts & diagnostics.

10. 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.
PATHOPHYSIOLOGY

1. Basic principles of cell injury and adaptation
   Causes, pathogenesis and morphology of cell injury, apoptosis and necrosis.

2. Basic mechanisms of inflammation and repair

3. Disorders of fluid, electrolyte and acid-base balance

4. Disorders of homeostasis: white blood cells, lymphoid tissues, and red blood cells related diseases.

5. Immunopathology including amyloidosis
   a) Host parasite Relationship: - normal microbial flora of human body, infection vs. disease, Pathogenicity vs. Virulence, Koch & Rivers Postulates, Reservoir of infection-sources of infection, Portals of Entry, Portals of exit, vectors of infection, communicability of disease, recognized symptoms of microbial disease, classification of immunity.

   • External defense mechanism of host: Skin, Mucus membrane, chemical Secretions, Naturally occurring microbial flora.
   • Internal defense Mechanism: Inflammation, fever, natural killer Cells, Phagocytic Cells, Soluble mediators-complement Lymphokines, Interferons.

   b) Immune response:
      • Specific immunity & immune response
      • Humoral immunity antibody response, mediators of Humoral immunity, basic structure of antibody, antibody classes & functions, maturation of immune response, immunologic memory.
      • Antigens: specificity & Immunogenicity, Natural vs. artificial Antigens, Soluble, cellular antigens, thymus independent antigen, adjuvant.
• Hypersensitivity and its types


6. Infectious diseases

Hepatitis - Infective hepatitis.

7. Neoplastic diseases


8. Pathophysiology of common diseases

Parkinsonism. Schizophrenia. Depression and mania
Diabetes mellitus.
Peptic ulcer and inflammatory bowel disease. Cirrhosis and alcoholic liver diseases.
Acute and chronic renal failure.
Asthma and chronic obstructive airway diseases.

9. Laboratory tests for Liver function tests and kidney function tests
BIOPHARMACEUTICS AND PHARMACOKINETICS

1. 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.
      - Gastrointestinal absorption - physicochemical considerations.
      - Gastrointestinal absorption-role of the dosage form.

2. Bio-availability & Bio-equivalence
   Quality parameters of dosage forms. Assay methods & its validation.


3. Bio-pharmaceutical statistics
CLINICAL PHARMACY AND THERAPEUTICS

2. Clinical trials, type and phases of clinical trials, placebo, ethical and regulatory issues including Good clinical practice in clinical trials.
3. Therapeutic drug monitoring, adverse drug reaction (ADR), types of ADR, Mechanism of ADR. Drug interaction, Monitoring and reporting of ADR and its significance.
4. Drug information services, Drug interactions.
5. Drug interaction in pediatric and geriatric patients, drug treatment during pregnancy, lactation and menstruation.
6. Pharmacovigilance, Therapeutic drug monitoring, Neutraceuticals, essential drugs and rational drug usage.
7. Age-related drug therapy: concept of posology, drug therapy for neonates, pediatrics and geriatrics. Drugs used in pregnancy and lactation.
8. Drug therapy in gastrointestinal, hepatic, renal, cardiovascular and respiratory Disorders.
10. Drug therapy in infections of respiratory system, urinary system, infective meningitis, TB, HIV, malaria and filaria.
11. Drug therapy for thyroid and parathyroid disorders, diabetes mellitus, menstrual cycle disorders, menopause and male sexual dysfunction.
13. Drug therapy for rheumatic, eye and skin disorders.

HUMAN ANATOMY & PHYSIOLOGY

1. **Cell physiology**
   Cell, Cell junctions, transport mechanisms, homeostasis, ion channels, secondary messengers.

2. **The Blood**
   Composition and functions of blood, RBC, WBC, platelets. Homeostasis, blood groups, mechanism of clotting. Introduction to disorders of the blood.

3. **Gastrointestinal tract**
   Structure of the gastrointestinal tract, functions of its different parts including those of liver,
pancreas and gallbladder, various gastrointestinal structures and their role in the digestion and absorption of food.

4.  **Respiratory System**  
Structure of respiratory organs, functions of respiration mechanism and regulation of respiration, respiratory volumes and vital capacity.

5.  **Autonomic nervous system**  
Physiology and functions of the autonomic nervous system. Mechanism of neurohumoral transmission in ANS.

6.  **Sense organs**  
Structure and physiology of eye (vision), ear (hearing), taste buds, nose (smell) and skin.

7.  **Skeletal System**  

8.  **Central Nervous system**  
Functions of different parts of the brain and spinal cord. Neurohumoral transmission in the central nervous system, reflex action, electroencephalogram, specialized functions of the brain, cranial nerves and their functions.

9.  **Urinary System**  

10.  **Endocrine Glands**  
Basic anatomy and physiology of pituitary, thyroid, parathyroid, adrenal glands and pancreas. Local hormones. A brief introduction to disorders of various endocrine glands.

11.  **Reproductive System**  
Structure and functions of male and female reproductive system. Sex hormones, physiology of menstrual cycle, and various stages of pregnancy and parturition.

12.  **Cardiovascular system**
Anatomy of heart and blood vessels, physiology of blood circulation, cardiac cycle, conducting system of the heart, heart sound, electrocardiogram, blood pressure and its regulation.

13. **Lymphatic system**
Composition, formation and circulation of lymph. Spleen and its functions.
PHARMACEUTICAL ENGINEERING

1. **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 and pressure including mathematical problems.

2. **Heat transfer**
Source of heat, mechanism of heat transfer, the laws of heat transfer, steam and electricity as heating media, determination of requirement of the amount of steam/electrical energy, steam pressure, boiler capacity, mathematical problems on heat transfer, steam traps and reducing valve, lagging etc.

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

4. **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, mathematical problems on distillation.

5. **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, mathematical problems in drying.

6. **Size reduction and size separation**
Definition, objectives of size reduction, factors affecting size reduction, laws governing in energy and power requirement of a mill, types of mills including ball mill, hammer mill, fluid energy mill, micronizer, Quadro co-mil, multi mill etc.

7. **Extraction**
Theory of extraction, extraction methods, equipment for various types of the extraction
process.

8. **Mixing**
Theory of mixing, solid-solid, solid-liquid and liquid-liquid mixing equipment.

9. **Crystallization**

10. **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, mathematical problems on filtrations, optimum cleaning cycle in batch filters. Principles of centrifugation, industrial centrifugal filters and centrifugal sedimentars.

11. **Dehumidification and humidity control**
Basic concept and definition, wet bulb and adiabatic saturation temperatures, psychometric count and measurement of humidity, application of humidity measurement in pharmacy, equipment for humidification and dehumidification operations
12. **Refrigeration and air conditioning**  
Principles and applications of refrigeration and air conditioning.

13. **Material of constructions**  
General study of composition, corrosion, resistance, properties and applications of the materials of construction with special reference to stainless steel, glass, ferrous metals, cast iron, non-ferrous metals, copper and alloys, aluminum and alloys, lead, tin, silver, nickel and alloys, chromium and non-metals, stone, slate, brick, asbestos, plastics, rubber, timber, concrete. Corrosion and its prevention with reference to commonly used material in pharmaceutical plants.

14. **Automated process control systems**  
A process variable, temperature, pressure, flow level and vacuum and their measurement. Elements of automatic process control and introduction to automatic process control. Elements of computer-aided manufacturing (CAM).

15. **Industrial hazards & safety precautions**  
Mechanical, chemical, electrical, fire, dust, noise hazards, Industrial dermatitis, accident, records, safety requirements/equipment etc.
1. **Introduction to management**
   Types of management. Basic concepts of management, management process, function and principles. Levels of management, pharmaceutical management art, science or profession. Social responsibilities of management, functions of management.

2. **Planning and Forecasting**

3. **Organization**
   Definition, nature, theories, functions, line and staff organization concepts.

4. **Research Management**
   R & D organizations and research categories. Elements needed for an R & D organization. Technology transfer.

5. **Inventory Management**
   Objective and functions of inventory control. Types of inventories. Requirements of effective inventory control.

6. **Communication**
   Nature, types of communication, process, channels and barriers of communication. Limitations of communications. Importance in pharmaceutical industries.

7. **Marketing Research**
   New product selection, product management, advertising.

8. **Leadership and motivation**
   Leadership: meaning, nature, leadership styles. Theories of leadership. Motivation: meaning, nature, importance. Theories of motivation.

9. **Human resource and development (HRD)**
Definition, HRD methods, HRD process, HRD in Indian industry.

10. **GATT**
General Agreement on Tariff and Trade and its impact on the pharmaceutical industry. History of GATT, its impact on the pharmaceutical industry. Pharmaceutical market in India.

11. **World trade organization (WTO) and trade-related intellectual property rights (TRIPS)**

12. **Standard institutions and regulatory authorities**
   1. Bureau of Indian Standards (BIS).
   3. United States of Food and Drug Administration (USFDA).
   5. International Conference on Harmonization (ICH).
   6. World Health Organization (WHO).
PHARMACEUTICAL JURISPRUDENCE


2. The Pharmacy Act 1948 (inclusive of recent amendments).

3. Drugs and Cosmetics Act 1940, Rules 1945, including New Drug applications.

4. Narcotic Drugs and Psychotropic Substances Act, and Rules thereunder.


9. Drug (Price Control) Order.

10. Shops and Establishment Act.


16. An Introduction to Standard Institutions and Regulatory Authorities such as BIS, ASTM, ISO, TGA, USFDA, MHRA, ICH, WHO.


DISPENSING & HOSPITAL PHARMACY

1. Introduction to laboratory equipment, weighing methodology, handling of prescriptions, labeling instructions for dispensed products.


3. Preparations of formulations involving allegation, alcohol dilution, isotonic solution.

4. Study of current patent and proprietary products, generic products and selected brand products, indications, contraindications, adverse drug reactions, available dosage forms and packing of

- Antihypertensive drug
- Antiamoebic drugs
- Antihistaminic drugs
- Antiemetic drugs
- Antacids and ulcer healing drugs.
- Antidiarrheals and laxatives
- Respiratory drugs
- Antibiotics
- Analgesics and antipyretic drugs.

8. Compounding and dispensing of following prescriptions

- Mixtures
- Solutions
- Emulsions
- Lotions (External preparations)
- Liniments (External preparations)
- Powder
- Granules
- Suppositories
- Ointments / Paste
- Cream
- Incompatibility: Prescription based on physical, chemical and therapeutic incompatibility. Tablets
9. **Reading and counseling of prescriptions from the clinical practice.**

- Designing from mock Pharmacy: Layout and structure of retail Pharmacy, compounding, dispensing, storing, labeling, pricing, recording and counseling of prescription.
- Procurement of information for the given drug for drug information services.
- Preparation of Hospital Formulary.

### RECOMMENDED STANDARD REFERENCE BOOKS

**FOR PHARMACEUTICS and related subjects:**

2. **Introduction to the Pharmaceutical Sciences,** By Nita K. Pandit.
7. **Biopharmaceutics & Pharmacokinetics,** D. M. Brahmankar.
8. **Modern Pharmaceutics,** Gilbert S. Banker and Christopher Rhodes.
10. **Martin’s Physical Pharmacy and Pharmaceutical Sciences,** Patrick J. Sinko, Lippincott Williams & Wilkins, 2011
12. **Handbook of Cosmetic Science and Technology,** Third Edition
14. **Pharmaceutical Excipients**
15. Developing Solid oral Dosage form: Pharmaceutical Theory & Practice
16. Pharmaceutical Preformulation and Formulation, Mark Gibson
17. Foundation of Pharmacokinetics, Aldo Rescigno
18. Ansel's Pharmaceutical Dosage Forms and Drug Delivery System, Allen, LV
19. Biopharmaceutics and Clinical Pharmacokinetics, Notari, RE
20. Cooper and Gunn's Tutorial Pharmacy, Carter, SJ
23. Martin's Physical Pharmacy and Pharmaceutical Sciences, Patrick J. Sinko, Lippincott Williams & Wilkins, 2011

REFERENCE BOOKS FOR PHARMACEUTICAL CHEMISTRY/MEDICINAL CHEMISTRY:
8. Indian Pharmacopoeia all editions and volumes.

10. Bentley and Driver's Textbook of Pharmaceutical Chemistry, Atherden, Im
11. Burger's Medicinal Chemistry, 6 vol, Abraham, DJ
13. Stereochemistry of organic compounds, Ernest Eliel, Wiley India.

15. Reaction mechanism in organic chemistry- S M Mukherjee and S P Singh, MacMilan


17. Drug design – Dr. V.M. Kulkarni and Dr. K.G. Bothara

18. Photochemistry and Pericyclic reactions by J. Singh

19. Pericyclic reactions- Ian Fleming

20. Pericyclic reactions - W. Carrurther

**REFERENCE BOOKS FOR PHARMACEUTICAL ANALYSIS:**

1. Indian Pharmacopoeia all editions and volumes
5. INSTRUMENTAL METHODS OF ANALYSIS by H.H. Willard, L.L. Merrit and J.A. Dean
6. Introduction to Spectroscopy- D.L. Pavia, G.M. Lampman, G.S. Kriz
7. Principles of Instrumental analysis- Skoog, Holler, Crouch
10. Instrumental methods of chemical analysis- H.Kaur, Pragati Prakashan
REFERENCE BOOKS FOR HUMAN ANATOMY/PHYSIOLOGY/
PATHOPHYSIOLOGY,/PHARMACOLOGY:

2. Goodman & Gilman's the Pharmacological Basis of Therapeutics, Laurence L. Brunton
3. Basic & Clinical Pharmacology, Bertram G. Katzung, Susan B Masters, Anthony J Trevor
6. Goodman & Gilman’s The Pharmacological Basis of Therapeutics
9. Essential of Medical Pharmacology, KD Tripathi

REFERENCE BOOKS FOR PHARMACOGNOSY:

2. Pharmacognosy, Tyler, 8th edition, Lea and Febiger, Philadelphia
4. Textbook of Pharmacognosy-Noel M Ferhuson
5. Textbook of Pharmacognosy-C.S.Shah and J.S.Qadry
7. Textbook of Pharmacognosy and Phytochemistry-Dr.Biren Shah
8. Textbook of Pharmacognosy-T.N.Vasudevan, Kirti Laddha
REFERENCE BOOKS FOR MARKETING MANAGEMENT:


REFERENCE BOOKS FOR BIOCHEMISTRY:


REFERENCE BOOKS FOR MICROBIOLOGY: