

## **Final Year B.Pharm**

- 401. Technology of Drugs & Cosmetics & GMP [Theory]**
- 402. Biopharmaceutics & Dosage Form Design (Theory)**
- 403. Medicinal Chemistry -II [Theory]**
- 404. Pharmacology & Drug Bio-Evaluation [Theory]**
- 405. Hospital And Clinical Pharmacy (Theory)**
- 406 Pharmacognosy-III ( Phytopharmaceuticals )Theory**
- 407 Elective**

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## 401. Technology of Drugs & Cosmetics & GMP [Theory]

### 1. **Liquid dosage forms:** [ 4 ]

Introduction, types of additives used, vehicles, stabilizers, preservatives, emulsifying agents, solubilizers, colors, flavours , manufacturing, packaging and evaluation of ideal suspensions and emulsions official in pharmacopoeia.

### 2. **Semisolid dosage forms:** [ 4 ]

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

### **Tablets:** [ 12 ]

a. Introduction to types of tablets , formulation of different types of tablets, excipients, granulation techniques, machinery for large scale granulation, physics of tablet making, compression machinery , In process controls, processing problems , Evaluation parameters and equipments.

b. Coating of tablets: objectives, types of coating, film forming materials, formulation of coating solution, equipment for coating, coating process, evaluation of coated tablets , coating defects, specialized coating process.

### 3. **Capsules:** [ 8 ]

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

### 4. **Microencapsulation.** [ 3 ]

Introduction, techniques of microencapsulation, characterisation and applications.

### 5. **Parenteral products:** [ 16 ]

a. Preformulation factors, routes of administration, vehicles- aqueous, nonaqueous; pyrogenicity, Pyrogen testing, isotonicity and methods of its adjustment, modern methods for preparing WFI

b. Formulation details, containers and closures -types, characteristics, selection.

c. Prefilling treatment- washing of containers and closures, an introduction to glass, plastic and rubber as materials of containers and closures of parenteral products.

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- preparation of solution and suspensions, filling and closing of ampoules , vials, infusion fluids, ophthalmic preparations, lyophilization & preparation of sterile powders, equipment for large scale manufacturing and evaluation of parenteral products.
- d. Aseptic techniques, sources of contamination and method of prevention, design of aseptic area, Laminar flow benches, services and maintenance.
6. **Pharmaceutical aerosols: [ 3 ]**  
Definition, propellants, general formulation, containers, selection of components, manufacturing and packaging methods, pharmaceuticals applications, evaluation of aerosols.
7. **Cosmetic technology: [ 6 ]**  
Fundamentals of cosmetic science, structure and functions of skin, hair, formulation, preparation and packaging of cosmetics for skin - Sunscreen, moisturizers, cold cream, and vanishing cream, hair - Shampoo and conditioners, dentifrice- powders, gels, paste and manicure preparations like nail polish, lipsticks, eye lashes, brief introduction on baby care products, shaving cream.
8. **Packaging of pharmaceutical products: [ 4 ]**  
Packaging components, types, specifications, stability aspects of packaging, packaging equipments, factors influencing choice of containers, legal and other official requirements for containers, package testing.
9. **Labeling of pharmaceuticals: FDA requirements. [ 2 ]**
10. **Good Manufacturing Practice For Pharmaceuticals: [ 10 ]**  
Introduction, WHO guidelines, practice of GMP- Procedure (SOP'S), Building, Equipment, Personnel, Components, Documentation, Containers, Labeling, Laboratory Control, Distribution Records, Recovery & Reprocessing .
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### Technology of Drugs & Cosmetics And GMP: [Practical]

1. Preparation, evaluation and packing of liquid orals like solutions, suspensions and emulsions, ointments, suppositories, aerosols, eye drops, eye ointments, etc.
2. Preparation of pharmacopoeial extracts and galenical products utilizing various methods of extraction.
3. Formulation of various types of cosmetics for skin, hair, dentifrice and manicure preparation.
4. Experiments to illustrate preparation, stabilization, physical and

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biological evaluation of pharmaceutical products like powders, capsules, tablets, parenterals, microcapsules

5. Evaluation of materials used in pharmaceutical packaging.

### Books Recommended:

1. Theory and Practice of Industrial Pharmacy by Lachman.
  2. Remington's Pharmaceutical Sciences.
  3. Textbook of Pharmaceutical Formulation by Mithal.
  4. Pharmaceutical Dosage Forms: Tablets by Lachman and others.
  5. Pharmaceutical Dosage Forms: Disperse Systems by Lieberman and others.
  6. Pharmaceutical Dosage Forms: Parenteral Medication by Lieberman and others.
  7. Microencapsulation by Benita.
  8. Pharmaceutical Dosage Forms and Drug Delivery Systems by Ansel & others.
  9. GMP for Pharmaceuticals by Willig and Storker.
  10. Cosmetics and Toiletries Industry by Williams and Schmitt.
  11. Cosmetics: Formulation Manufacture and Quality Control by P.P. Sharma.
  12. Cosmetics by Poucher.
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## 402. Biopharmaceutics & Dosage Form Design (Theory)

### 1. Introduction to biopharmaceutics and pharmacokinetics [ 1 ]

History and their role in formulation development & therapeutics and clinical setting.

### 2. Biopharmaceutics : [ 8 ]

- a. Definition, absorption, distribution, metabolism(biotransformation) and excretion (elimination) of drugs, physicochemical, biological and pharmaceutical factors altering biopharmaceutical performance of drugs. Passage of drugs across biological barrier (passive diffusion, active transport, facilitated diffusion and pinocytosis). Factors influencing absorption- physiochemical, physiological and pharmaceutical. Drug distribution in the body, plasma protein binding.
- b. Bioavailability and equivalence, federal requirements, methods of determination of bioavailability using blood level and urinary excretion data. Design and evaluation of bioavailability assessment.

### 3. Pharmacokinetics: [ 10 ]

- a. Definition and scope, significance of plasma drug concentration measurement.
- b. Compartment model:
- c. Pharmacokinetics of drug absorption, zero order and first order absorption rate constant using Wagner- Nelson and Loo-Riegelman method.
- d. Volume of distribution and distribution coefficient.
- e. Compartment kinetics-one compartment and two compartment models. Determination of pharmacokinetics parameters from plasma and urine data after drug administration by intravascular and oral route.
- f. Curve fitting (Method of Residuals), regression procedures.
- g. Clearance concept, mechanism of renal clearance, clearance ratio, determination of renal clearance.
- h. Hepatic elimination of drugs, first pass effect, extraction ratio, hepatic clearance, biliary excretion, extrahepatic circulation.
- i. Non-linear pharmacokinetics with special reference to one compartment model after I.V. drug administration, Michaelis-Menten Equation, detection of non-linearity (Saturation mechanism).
- j. In-vitro, in-vivo correlation

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- k. Numericals related to pharmacokinetic parameters using one compartmental models
- 4. **Non-Compartmental Models: [ 2 ]**  
Statistical Moments, Application, bioavailability determination, Linear system pharmacokinetics. Unit impulse response, Deconvolution, application in bioavailability determination etc.
- 5. **Clinical pharmacokinetics : [ 4 ]**
  - a. Definition and scope.
  - b. Dosage adjustment in patients with renal and hepatic failure.
  - c. Dosage regimen adjustment for ref.
  - d. Pharmacokinetic drug interaction significance in combination therapy.
- 6. **Bioavailability and bioequivalence : [ 10 ]**
  - a. Measures of bioavailability, C<sub>max</sub>, t<sub>max</sub>, AUC
  - b. Design of single dose bio-equivalent statistics, study designs, crossover designs, study protocol, log transformation of pharmacokinetic data, sequence effect, outliers
  - c. Overview of regulatory requirement of bio-equivalence study.
- 7. **Preformulation studies : [ 6 ]**
  - a. Study of physical properties of drug like physical form, particle size, density, wetting, dielectric constant, solubility, dissolution and organoleptic property and their effect on formulation, stability and bioavailability.
  - b. Study of chemical properties of drugs like hydrolysis, oxidation, reduction, racemization, polymerization etc., and their influence on formulation and stability of products.
  - c. Study of prodrugs in solving problems related to stability, bioavailability and elegance of formulations.
- 8. **Design, development and process validation [ 8 ]**  
methods for pharmaceutical operations involved in the production of pharmaceutical products with special reference to tablets, suspensions. Prospective, retrospective validation, organizing of validation, validation for dry heat, moist heat, filtration, ethylene oxide, radiation sterilization, Validation of parenterals, Solid dosage forms: validation of raw materials, Definition and control of process variables, guidelines, validation protocols
- 9. **Stabilization and stability testing [ 5 ]**  
Protocol for various pharmaceutical products, ICH guidelines for stability testing

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10. **Performance evaluation methods: [ 2 ]**
- Invitro dissolution studies for solid dosage forms, methods, interpretation of dissolution data.
  - Bioavailability studies and bioavailability testing protocol and procedures.
11. **Design, development, production and evaluation of controlled [ 16 ] release formulations.**

Introduction, design of Control release Drug Delivery Systems (Biopharmaceutic pharmacokinetic, pharmacodynamic, characteristics of drug) Pharmacokinetic principles in design , development of CDDS, drug release models, oral , parenteral, ophthalmic, transdermal CDDS. Drug targeting, Evaluation of CDDS, Bioavailability testing

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### Biopharmaceutics & Dosage Form Design [Practical]

- Experiments to illustrate absorption of drugs in various models.
- Experiments to illustrate protein binding of drugs, K and N values of binding process.
- Determination of plasma half life, elimination constant using plasma drug profile.
- Determination of pharmacokinetics of single compartmental analysis.
- Experiments to illustrate curve fitting, area under the blood level curves, binding, bioequivalence determinations.
- Preformulation studies including drug-excipients compatibility studies, effect of stabilizers, preservatives etc. in dosage form design.
- Experiments demonstrating improvement in bioavailability through prodrug concept.
- Stability evaluation of various dosage and their expiration dating.
- Dissolution testing and date evaluation for oral solid dosage forms.
- Evaluation of Bioequivalence of some marketed products.
- In vivo bioavailability evaluation from plasma drug concentration and urinary excretion curves.
- Design, development and evaluation of controlled release formulations.

### Books Recommended:

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1. Physical Pharmacy by Martin
  2. Theory and Practice of Industrial Pharmacy by Lachman.
  3. Remington's Pharmaceutical Sciences.
  4. Textbook of Pharmaceutical Formulation by Mithal.
  5. Pharmaceutical Dosage Forms: Tablets by Lachman and others.
  6. Pharmaceutical Dosage Forms: Disperse Systems by Lieberman and others.
  7. Pharmaceutical Dosage Forms: Parenteral Medication by Lieberman and others.
  8. Microencapsulation by Benita.
  9. Pharmaceutical Dosage Forms and Drug Delivery Systems by Ansel & others.
  10. Controlled and Novel Drug Delivery by N.K. Jain.
  11. Drug Stability by Carstensen.
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### 403. Medicinal Chemistry -II [Theory]

1. **Drug Metabolism and concepts in prodrug. [ 7 ]**
2. **Synthetic procedures of selected drugs, mode of action, uses, structure activity relationship including physiochemical aspects of the following classes of drugs should be covered.**[Biochemical approaches in drug designing wherever applicable should be discussed.]
  - a. **Drugs acting on the Central Nervous System: [ 24 ]**

General Anesthetics, Local anesthetics, Hypnotics and sedatives, Opioid analgesics, antitussives, Anticonvulsants, Antiparkinsonian drugs, CNS stimulants, psychopharmacological agents [neuroleptics, antidepressants, anxiolytics], Non-Steroidal Antiinflammatory Drugs(NSAID)  
SAR of Local anaesthetics, Benzodiazepines, Phenothiazines.  
Synthesis of Procaine, Lignocaine, Diazepam, Nitrazepam, Phenobarbitone, Hexobarbitone, Pethidine, Methadone, Theophylline, Nikethamide, Chlorpromazine, Amitryptiline, Meprobamate, Paracetamol, Aspirine, Diclofenac, Ibuprofen, Indomethacin, Phenylbutazone, Barbituric acid, benzocaine, bupivacaine, caffeine, carbamazepine, chlordizepoxide, ethosuccimine Fluphenazine, Haloperidol, alopurinol, imepramine, pentobarbitone, phenytoine, probanacid, prochlorperazine, reserpine, sodiumpentothenate, trilocaine, valproic acid.
  - b. **Drugs acting on Cardiovascular System: Cardio tonics, [ 17 ]**

Antihypertensive Agents, Antianginal and Vasodilators, Lipid lowering agents(Anti hyperlipidemic agents), Pressure drugs (Antihypotensive agents), Miscellaneous ( Antiplatelets, Thrombolytic drugs, Anticoagulants and Coagulants) SAR of Cardiotonics including synthetic drugs.  
Synthesis of Clonidine , Nifedipine, Nicorandil, Propranolol, Sotalol, Procainamide, Atenolol, Diltiazam, Tolazocin, Clofibrate, Hydralazine, Mecamilamine, Guanethidine, Warfarin, Acebutalol, analapril, theophylline, captopril, isosorbidedinitrate, metoprolol, oxprinolol, prazosine.

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- c. **Steroids and related drugs: Steroidal nomenclature and stereo [ 6 ]**  
chemistry, Androgens and Anabolic agents, Estrogens and Progestational agents, Adrenocorticoids. Estradiol, estrone, Hydrocortisone, Progesterone, testosterone. SAR of Adrenal cortex hormones.
  - d. **Diuretics [ 7 ]**  
SAR of Clorthiazides, a,b - Unsaturated ketones. Synthesis of Furosemide, Chlorthiazide, Hydrochlorothiazide and Acetazolamide. Chiorthalidone, D-mannitol, ethacrynic acid, triamprine, trimethadione.
  - e. **Amino acids, proteins and peptide hormones; [ 10 ]**
    - 1. Thyroid and Antithyroid drugs.,
    - 2. Insulin and oral hypoglycemic agents  
Synthesis of Carbimazole
    - 3. Peptidomimetics and nucleotidomimetics
  - f. **Pharmaceutical Aids: Solvents and vehicles, Preservatives [ 4 ]**  
and antioxidants, coloring agents, Flavouring agents, sweetening agents, acidifying agents, etc.
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### 403 Medicinal Chemistry -II [Practical]

- 1. **Experiments designed on drug metabolism**
  - a. Preparation of s9 and microsomes from tissue homogenates and standardization of protein.
  - b. Effect of phenobarbital pretreatment on microsomal cytochrome p-450, cytochrome b5 and NADPH-cytochrome C-reductase and comparison of microsomes from control.
  - c. Determination of microsomal aminopyrine, demethylase and P-nitroanisole o-demethylase activities.
  - d. Determination of microsomal azo and nitroreductase activities.
- 2. Submission of a pilot project along with the economics of one drug.
- 3. Synthesis of selected drugs.
- 4. Establishing the pharmacopeial standards and spectral studies.

#### Books Recommended:

- 1) Medicinal Chemistry by Burger
- 2) Text book of Organic Medicinal and Pharm. Chem. by Wilson & Gisvold
- 3) Principles of Medicinal Chemistry by Foye, Williams and Lemke

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- 4) A Hand book of Organic Analysis by Clarke
  - 5) A Text book of Practical Organic Chemistry by Vogel
  - 6) Quantitative Organic Analysis by Cheronis
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### 404. Pharmacology & Drug Bio-Evaluation [Theory]

1. **Bioassay of drugs and Biological standardization: [ 6 ]**  
Importance, principles and methods of bioassay. Pyrogen testing, discovery and development of New Drugs. Bioassay methods of important drugs.
2. **Pharmacology of Central Nervous System (CNS): [ 20 ]**
  - a. Neurohumoral transmission in the C.N.S.
  - b. General Anesthetics.
  - c. Alcohols and disulfiram.
  - d. Sedatives-hypnotics, Anti-anxiety agents and centrally acting muscle relaxants.
  - e. Psychopharmacological agents:- antipsycotics, antidepressants, antimaniacs and hallucinogens
  - f. Antiepileptics drugs.
  - g. Anti- Parkinsonian drugs.
  - h. Analgesics, Antipyretics, Anti-inflammatory and Antigout drugs.
  - i. Narcotic Analgesics and Antagonists.
  - j. C.N.S. Stimulants.
  - k. Drug Addiction and Drug Abuse.
3. **Pharmacology of cardiovascular system. [ 12 ]**
  - a. Digitalis and cardiac glycosides.
  - b. Antianginal and Vasodilator drugs.
  - c. Anti-arrhythmic drugs.
  - d. Antihypertensive drugs.
  - e. Antihyperlipidemic drugs.
  - f. Drugs used in the therapy of shock.
4. **Drugs Acting on the Hemopoietic System. [ 4 ]**
  - a. Haematinics.
  - b. Anticoagulants, Vitamin K and hemostatic agents.
  - c. Fibrinolytic and anti-platelet drugs.
  - d. Blood and plasma volume expanders.
5. **Drugs Acting on the Urinary System : [ 3 ]**
  - a. Fluid and electrolyte balance.
  - b. Diuretics.
6. **Drugs Acting on the Respiratory System : [ 4 ]**
  - a. Anti-asthmatic drugs including bronchodilators.
  - b. Anti-tussives and expectorants.
  - c. Respiratory stimulants
7. **Drug Acting on the Gastrointestinal Tract : [ 6 ]**
  - a. Antacids, Antisecretory and Anti-ulcer Drugs.
  - b. Laxatives and antidiarrhoeal drugs.
  - c. Appetite stimulants and suppressants.
  - d. Emetics and anti-emetics.

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- e. Miscellaneous; carminatives, demulcents, protectives, mucolytics, Adsorbants, Astringents, Digestants and Enzymes.
8. **Pharmacology of Endocrine system ; [ 12 ]**
- a. Hypothalamic and pituitary hormones.
  - b. Thyroid hormones and antithyroid drugs, parathormone, calcitonin and vitamin D.
  - c. Insulin, oral hypoglycemic agents & glucagon
  - d. ACTH and corticosteroids.
  - e. Androgens and anabolic steroids.
  - f. Drugs acting on the uterus.
  - g. Estrogen, Progesterone & Oral contraceptives.
9. **Recent Advances: [ 5 ]**
- Nitric oxide & free radicals, Endothelins, Preliminary aspect of Molecular Pharmacology, Dermatological Pharmacology, Ocular Pharmacology, Gene therapy, Bone metabolism.
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### Pharmacology & Drug Bio-Evaluation (Practical)

1. **Experiments on Isolated preparations of Animals tissues or using computer softwares or tracings:**
- a. To calculate the PA<sub>2</sub> value of atropine using acetylcholine as an agonist on rat ileum preparation.
  - b. To calculate the PA<sub>2</sub> value of mepyramine or chlorpheniramine using histamine as agonist on guineapig ileum.
  - c. To find out the strength of the given sample of agonist & antagonist e.g. Acetylcholine, Histamine, 5-HT, Oxytocin, Atropine, Pheniramine etc. using a suitable isolated muscle preparation by Three point Assay, Four point Assay, graphical method, matching method etc..
2. To study the Anti-secretory and anti-ulcer activity using pylorus ligated rats using computer software.
3. To demonstrate the effects of certain clinically useful drugs on human volunteers like Antihistaminics, Anti-anxiety and sedative drugs, Beta blockers etc..
4. Experiments on Central Nervous System (Only demonstration or using Computer Software):
- Recording of spontaneous motor activity, stereotype analgesia, anticonvulsant activity, anti-inflammatory activity and muscle relaxant activity of drugs using simple experiments.

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## Books Recommended:

1. Pharmacological basis of therapeutics by Goodman & Gillman
  2. Medical pharmacology by Goth
  3. Pharmacology by Gaddum
  4. Pharmacology and pharmacotherapeutics by Satoskar & Bhandarkar
  5. Essentials of Pharmacotherapeutics by F.S.K. Barar
  6. Lewis Pharmacology by Crossland
  7. Textbook of pharmacology by Bowman & Rand
  8. Essentials of medical pharmacology by K.D. Tripathi
  9. Pharmacology by Rang & Dale
  10. Elements of Pharmacology by Dr. Derasari & Dr. Gandhi
  11. Drug interactions by Hansten
  12. Introduction to general toxicology by Aries Simonsis & Offermeier
  13. Toxicology: The basic science of poisons by Casorett & Doull
  14. Clinical pharmacology by Lawrence
  15. Principles of drug action by Goldstein Aronow & Kalaman
  16. Drug Treatment by Avey
  17. Fundamentals of experimental pharmacology by M.N. Ghosh
  18. Handbook of experimental pharmacology by S.K. Kulkarni
  19. Pharmacological experiments on isolated preparations by Perry
  20. Practicals in pharmacology by Dr. Goyal
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## 405. Hospital And Clinical Pharmacy (Theory)

### Part-I Hospital Pharmacy

1. **Organisation and structure: [ 6 ]**  
Organisation of a hospital and hospital pharmacy. responsibilities of a hospital pharmacist pharmacy and therapeutic committees, budget preparation and implementation.
2. **Hospital formulary : Contents preparation and revision of hospital formulary. [ 2 ]**
3. **Drug distribution systems in hospitals: [ 12 ]**
  - a. Outpatient dispensing method adopted.
  - b. Dispensing of drugs to patients. Types of drug distribution systems. Charging policy, labeling.
  - c. Dispensing of drugs to ambulatory patients.
  - d. Dispensing of controlled drugs.
4. **Central sterile supply unit and their management: [ 4 ]**  
Types of materials for sterilization, packing of materials prior to sterilisation, sterilisation equipments, supply of sterile materials.
5. **Manufacture of sterile & Nonsterile products : [ 8 ]**  
Policy making of manufacturable items, demand and costing, personnel requirements, manufacturing practice, Master formula card, production control, manufacturing records.
6. **Drug Information Services: [ 3 ]**  
Sources of Information on drugs, disease treatment schedules, procurement of information. Computerised services (eg. MEDLINE), retrieval of information, medication errors.
7. **Records and reports: [ 5 ]**  
Prescription filling, drug profile, patient medication profile, cases on drug interaction and adverse reactions, idiosyncratic cases, etc.
8. **Nuclear pharmacy**
9. **Introduction to radiopharmaceuticals: [ 8 ]**  
Radio active half life,. Units of radioactivity, production of radio pharmaceuticals, methods of isotopic tagging, preparation of radio isotopes in laboratory using Radiation dosimetry, Radio isotope generators, permissible radiation dose level, radiation hazards and their prevention, specifications for radio active laboratory.

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## Part-II Clinical Pharmacy:

1. **Introduction to clinical pharmacy. [ 1 ]**
2. **Basic concepts of pharmacotherapy [ 4 ]**
  - a. Clinical pharmacokinetics and individualisation of drug therapy.
  - b. Drug delivery systems and their Biopharmaceutic & therapeutic considerations.
  - c. Drug use during Infancy and in the Elderly [pediatrics & Geriatrics].
  - d. Drug use during pregnancy.
  - e. Drug induced diseases.
3. **Interpretation of clinical laboratory tests and its significance. [ 2 ]**
4. **Important disorders of organ systems and their management :**
  - a. Cardiovascular disorders ; Hypertension, Congestive Heart failure, Angina, [ 4 ]  
Acute Myocardial Infraction, Cardian Arrhythmias.
  - b. CNS Disorders ; Epilepsy, Parkinsonism, Schizophrenia, Depression. [ 3 ]
  - c. Respiratory Disease: Asthma. [ 1 ]
  - d. Gastrointestinal Disorders: Peptic ulcer Disease, Ulcerative colitis, [ 2 ]  
Hepatitis, cirrhosis
  - e. Endocrine Disorders [ 2 ]
  - f. Infectious diseases: Tuberculosis urinary tract infection, Enteric Infections, [ 3 ]  
upper respiratory infections
  - g. Hemopoietic Disorders: Anemias. [ 1 ]
  - h. joint and connective Tissue Disorders: Rheumatic Diseases, [ 2 ]  
Gout and Hyperuricemia.
  - i. Neoplastic Disorders: Acute Leukaemias Hodgkin!s Disease and [ 2 ]  
carcinoma of Breast.
5. **Drugs in clinical toxicology [ 3 ]**  
Introduction, general treatment of poisoning, systemic antidotes, treatment of insecticide, heavy metal, narcotic drugs, barbiturates and organophosphorus poisoning.
6. **Drug interactions: [ 2 ]**  
Introduction, mechanism, drug-food interactions, drug-drug interactions with reference to analgesics, diuretics, GIT, hypoglycemics, cardiovascular drugs and vitamins.
7. **Therapeutic drug monitoring [ 1 ]**
8. **Concept of Essential Drug and Rational Drug use. [ 1 ]**

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9. **Modern Dispensing aspects- Clinical pharmacists and patient counseling [ 2 ]**  
and advice for the use of common drugs, medication history.
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### 406 Pharmacognosy-III ( Phytopharmaceuticals )Theory

1. Chemical and spectral approaches to simple molecules of natural origin. [ 3 ]
2. Concept of stereo isomerism taking examples of natural product. [ 2 ]
3. Chemistry and biogenesis of medicinally important monoterpenes, [ 10 ] sesquiterpenes, diterpenes and triterpenes.
4. Carotenoids: beta-carotenes, alpha-carotenes, vitamin-A, Xanthophylls of [ 3 ] medicinal importance.
5. Steroids: Chemistry and biosynthesis of hecogenin, diosgenin and [ 6 ] sarasapogenin.
6. Alkaloids: Chemistry and biogenesis of atropin and related compounds; [ 10 ] quinine, reserpine, morphine, papaverine, ephedrine, ergot and Vinca alkaloids.
7. Chemistry of medicinally important iridoids. [ 5 ]
8. Chemistry of penicillin, stryptomycin and tetracyclines. [ 7 ]
9. World-wide trade in medicinal plants and derived products with special [ 1 ] reference to Diosgenin (Dioscorea), taxol (Taxus sps), Digitalis, Tropane alkaloid containing plants, papain Cinchona, Ipecac, Liquorice, Ginseng, Aloe vera, Valerian, Rauwolfia and plants containing laxatives.
10. A brief account of plant based industries and institutions involved in [ 7 ] work on medicinal and aromatic plants in India. Utilization and production of phytoconstituents of Poppy, Ergot, Cinchona, Ipecac, Tropane Alkaloids, Vinca, Aloes, Senna, Ispaghula, Digitalis, Dioscorea and Solanum Khasianum.
11. Utilization of aromatic plants and derived products with special reference [ 5 ] to Menthol, Citral , Sandalwood oil, Vetiver oil, Geranium oil and Eucalyptus oil.
12. Tissue culture : Historical development, types of cultures, nutritional [ 5 ] requirements, growth and their maintenance. Applications of plant tissue culture in pharmacognosy.
13. Marine pharmacognosy ; studies on novel natural products from marine [ 5 ] sources.
14. Natural allergens and photosensitizing agents. [ 2 ]

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15. Phytochemical screening : Selection of method (Preparation of an extract) Screening for alkaloids, polycyclic compounds( saponins, sterols, cardenolides and bufadienolide, flavonoids and leucoanthocyanidins, tannins and polyphenols) anthraquinones, Cynogenetic glycosides, amino acids in plant tissues and carbohydrates (gums,mucilages). [ 2 ]
  16. Role of medicinal and aromatic plants in national economy. [ 1 ]
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### Pharmacognosy-III ( Phytopharmaceuticals ) Practicals

1. Laboratory experiments on isolation, separation and purification of various groups of chemical constituents of pharmaceutical significance.
2. Exercises on paper and thin layer chromatographic evaluations of herbal drug constituents.
3. Isolation of some selected phytoconstituents studied in theory.
4. Extraction of volatile oils and their chromatographic profiles.
5. Some experiments in plant tissue culture.

### Books Recommended:

1. Pharmacognosy by G.E.Trease and W.C.Evans
2. Text book of Pharmacognosy by T.E.Wallis
3. Pharmacognosy by V.E.Tylor,L.R.Brady and J.E.Robbers
4. The Wealth of India (Raw Material & Industrial Product)
5. Compendium of Indian Medicinal Plants Vol. I,II,III & IV
6. Cultivation and Utilization of Aromatic Plants by Atal & Kapoor
7. Cultivation and Utilization of Medicinal Plants by Atal & Kapoor
8. Text book of Pharmacognosy by Steiniger and Hansel
9. Text book of Pharmacognosy by Ramsted
10. Powdered Vegetable Drugs by B.P.Jeckson & D.W.Snewden
11. Biosynthetic products for cancer chemotherapy by George pattit vol I,II,III, plenum press Newyork
12. Natural products as Medicinal agents Ed. J.L.Beal, and Reinhard Hippocrates Verleg
13. Medicinal plant glycosides- Sim. Toronto.
14. Medicinal plant Alkaloids- Sim. Toronto.
15. Indian Medicinal Plants by Kirtikar and Basu.
16. Phytochemische praktikum by wagner.
17. Natural products by Ikan R Israel Uni. Press, Jarusalem 1969
18. Experimental pharmacognosy by Tylar V.E and Schwarting A.E, borgess publication.
19. Isolierum Und Kennenzeikhnung by stahl E and Schild W.
20. Ayurvedic pharmacopeia.

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21. Practical Pharmacognosy by Iyenger
  22. Practical Pharmacognosy by C.K.Kokate
  23. I.P., B.P., U.S.P.
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## 407 Elective

Dissertation assigned by respective department (subjects) of major specialization

of pharmaceutical sciences i.e.

Pharmaceutics

Pharmaceutical Chemistry

Pharmacology

Pharmacognosy

Hospital & Clinical Pharmacy

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