

SEMESTER - V

PHAR-351

PHARMACEUTICAL CHEMISTRY – IV (BIOCHEMISTRY)

Unit-I :

- 1. Enzymes** :Nomenclature, enzymes-kinetics and mechanism of action, mechanism of inhibition of enzymes and isoenzymes in chemical diagnosis.
- 2. Co-enzymes:**Vitamins as co-enzymes and their significance. Metals as co-enzymes and their significance. [08]

Unit-II

- 3. Carbohydrate metabolism** : Glycolysis, Gluconeogenesis and Glycogenolysis. Metabolism of galactose and galactosemia. Role of sugar nucleotides in biosynthesis and pentose phosphate pathway.
- 4.** The citric acid cycle, significance, reactions and energetics of the cycle. [08]

Unit-III

- 5. Lipid metabolism** : Oxidation of fatty acids-oxidation & energetics, Biosynthesis of ketone bodies and their utilization, Biosynthesis of saturated and unsaturated fatty acids., regulation of lipid metabolism, essential fatty acids.
- 6. Biological Oxidation** : The respiratory chain, its role in energy capture & control, Energetics of oxidative phosphorylation, mechanism of oxidative phosphorylation. [08]

Unit-IV

- 7.** Biosynthesis of amino acids, catabolism of amino acids and conversion of amino acids to specialized products, biosynthesis of purine and pyrimidine., formation of deoxyribonucleotides.
- 8.** Biosynthesis of RNA, DNA replication, earcinogenesis & DNA repair mechanism. [08]

Unit-V

- 9.** Genetic Code and Protein synthesis, components of protein synthesis, inhibition of protein synthesis.
- 10.** Regulation of gene expression. (Prokaryote and Eukaryote) [08]

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PHARMACEUTICAL CHEMISTRY-IV (BIOCHEMISTRY)

PRACTICAL

1. Preparation of standard buffers (citrate, phosphate and carbonate) and measurement of pH.
2. Titration curve for amino acids.
3. Separation of amino acids by chromatography.
4. The separation of lipids by TLC.
5. Quantitative estimation of amino acids.
6. The determination of glucose by means of the enzyme glucose oxidase.
7. Enzymatic hydrolysis of glycogen by α & β amylase.
8. Effects of temperature on the activity of alpha amylase.
9. Estimation of cholesterol in Blood.
10. Estimation of Glucose in blood & urine.
11. Estimation of Urea in blood.
12. Estimation of ketone bodies in blood.
13. Qualitative analysis of inorganic as well as organic constituents of Urine.

BOOKS RECOMMENDED :

1. Jayaraman J., Laboratory Manual in Biochemistry, Wiley Eastern Limited.
2. Plummer, David J., An Introduction to Practical Biochemistry, Mc Graw Hill, New Delhi.
3. Singh S.P., Practical Manual to Biochemistry, CBS Publisher, New Delhi.

4. "Harpers Review of Biochemistry" Lange Medical Publication.
5. Conn E.E. & Stumph P.K., Outline of Biochemistry, John Willery & sons, New York.
6. Nelson DL & Cox MM, Lehninger Principles of Biochemistry, Macmillan Worth Publishers.
7. Stryer L., Biochemistry, WH, Freeman & Company, San Francisco.
8. Harrow B. & Mazur A., Text book of Biochemistry, W.B. Saunders Co., Philadelphia.

PH-352

**PHARMACEUTICS – V
(PHARMACEUTICAL TECHNOLOGY -I)**

Unit-I : Preformulation studies :

a) Study of physical properties of drug like physical form, particle size, shape, density, wetting, dielectric constant, Solubility, dissolution and organoleptic properties and their effect on formulation, stability and bioavailability. [08]

Unit-II : Liquid Dosage Forms: Introduction, types of additives used in formulations, vehicles, stabilizers, preservatives, suspending agents, emulsifying agents, solubilizers, colors, flavours and others, Manufacturing packaging & evaluation of clear liquids, suspensions and emulsions. [08]

Unit-III : Semisolid Dosage Forms : Definitions, types, mechanisms of drug penetration, factors influencing penetration, semisolid bases and their selection, General formulation of semisolids, clear gels & manufacturing procedure, evaluation and packaging. [08]

Unit-IV : Suppositories : Ideal requirements, bases, manufacturing procedure, packaging and evaluation.

Pharmaceutical Aerosols: Definition, Propellants, general formulation, manufacturing and packaging methods, pharmaceutical applications. [08]

Unit-V : Cosmetology and cosmetic Preparations : Structure of skin, formulation of cold cream, vanishing cream, cleansing cream, all purpose cream, protective cream, antiperspirants, deodorant, face powder. Hair structure, Shampoos, Conditioner, Shaving and after shaving products, Dentrifice & Mouthwash, Lipstick, Nail lacquer. [08]

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**PHARMACEUTICS-V
(PHARMACEUTICAL TECHNOLOGY-I)**

PRACTICAL

1. Preparation of cold cream, vanishing cream, cleansing lotion and creams. Moisturizing creams, Skin tonics, Hair creams, Hair Conditioners, Shampoos, Shaving creams and sticks. Tooth powder, Tooth pastes, After shave lotion and other cosmetic preparations.
2. Preparation, evaluation and packing of liquid orals like solutions, suspensions and emulsions, ointments, suppositories, eye drops, eye ointments etc.

SUGGESTED PRACTICALS

1. Preparation, Evaluation, and packing of (10 preparations =5 labs)

I- Liquid Orals

- | | | |
|----------------|---|--|
| a) Solutions | : | Strong Sodium salicylates oral solution BP |
| | : | Chloral hydrate BP |
| b) Suspensions | : | Magnesium sulphate oral suspension BP |
| | : | Milk of magnesia IP |
| | : | Aluminium hydroxide gel IP |
| c) Emulsions | : | Liquid paraffin oral emulsion BP |

II - Semi Solid

- d) Ointments : Salicylic acid ointment BP
: Whitfield ointment BP
: Compound benzoic acid ointment

III - Suppositories

- e) Suppositories : Glycerin suppositories BP
: Lactic acid suppositories BP

2. Preparation of cosmetic preparations (30 preparation = 10 labs)

- | | |
|----------------------|-----------------------------|
| 1) Cold cream | 16) Cream shampoo |
| 2) Vanishing cream | 17) Clear liquid shampoo |
| 3) Cleansing cream | 18) Shaving cream |
| 4) All purpose cream | 19) Brushless shaving cream |
| 5) Protective cream | 20) After shave lotion |
| 6) Foundation lotion | 21) Hair fixer gel |
| 7) Sunscreen lotion | 22) Tooth powder |
| 8) Face powder | 23) Tooth paste |
| 9) Body powder | 24) Mouth wash |
| 10) Hand cream | 25) Hair conditioner |
| 11) Face pack | 26) Anti dandruff shampoo |
| 12) Deodorant | 27) Depilatory cream |
| 13) Antiperspirant | 28) Bleach cream |
| 14) Shampoo- powder | 29) Hair setting lotion |
| 15) Oily shampoo | 30) Tooth gel |

BOOKS RECOMMENDED

1. Remington's Pharmaceutical Sciences, Vol. I & Vol. – II, Mack Publishing Co., U.S.A.
2. J.W. Cooper, & G. Gunn, Tutorial Pharmacy, Petman Books Ltd., London.
3. Lachman L., Lieberman H.A, Kanig J.L, Theory and Practice of Industrial Pharmacy, Lea & Febiger, Philadelphia, U.S.A.
4. H.C. Ansel, Introduction to Pharmaceutical Dosage Forms, Lea & Febiger, Philadelphia, U.S.A.
- 5 R.L. Juliano, Drug Delivery Systems, Oxford University Press, Oxford.
1. Harrys Cosmetology
2. Balsam and Sagarin, Cosmetics: Science and Technology.
3. Thomssen E.G. Modern Cosmetics, Universal Publishing Corporation.
4. Mittal B.M. & Saha R.N.-a handbook of cosmetics, Vallabh Prakashan.

PHAR-353

PHARMACOLOGY – I

Unit-I : 1. General Pharmacology – Introduction to pharmacology, sources of drugs, dosage forms & routes of administration, mechanism of action, concept of receptors, combined effect of drugs, factors modifying drug action, tolerance & dependence, absorption, distribution. [07]

Unit-II : Metabolism & excretion of drugs, principles of Clinical Pharmacokinetics. Adverse drug reactions & treatment of poisoning. ADME drug interactions, Bioassay of drugs & Biological standardization. Discovery & development of new drugs. [07]

Unit-III : Pharmacology of ANS-

- a) Neurohumoral transmission (autonomic & somatic)
- b) Parasympathomimetics, Parasympatholytics, Sympathomimetics, adrenergic receptor & neuron blocking agents, ganglionic stimulants & blocking agents. [08]

Unit-IV : Pharmacology of CNS

Neurohumoral transmission in CNS. General Anaesthetics, Alcohols & disulfiram, Sedatives hypnotics, Anti-anxiety agents & centrally acting muscle relaxants. Psychopharmacological agents (antipsychotics), antidepressants. Antiepileptic drugs. Antiparkinsonism drugs, Narcotic Analgesics & antagonists., Drug Addiction & drug abuse. [12]

Unit-V : Drugs acting on PNS

Neuromuscular blockers, Local anaesthetics. [06]

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PHARMACOLOGY- I**PRACTICAL**

1. Use of computer simulated CDs or Video cassettes for pharmacology practical whenever possible.
2. Preparation of different solutions for experiments. Drug dilutions, use of molar and w/v solutions in experimental pharmacology. Common laboratory animals and anesthetics used in animal studies. Commonly used instruments in experimental pharmacology. Some common and standard techniques.
3. Study of different routes of administration of drugs in mice/rats. To study the effect of hepatic microsomal enzyme inhibitors and induction on the pentobarbitone sleeping time in mice.
4. Recording of spontaneous motor activity, stereotype, analgesia, anticonvulsant activity, anti-inflammatory activity, and muscle relaxant activity of drugs using simple experiments.

BOOKS RECOMMENDED :

1. Ghosh, MN; Fundamentals of Experimental Pharmacology, Scientific Book Agency, Calcutta.
2. Grover J.K., Experiments in Pharmacy & Pharmacology, CBS Publishers, New Delhi.
3. Kulkarni S.K., Hand Book of Experimental Pharmacology, Vallabh Prakashan, Delhi.
4. Barar F.S.K: Text Book of Pharmacology, Interpoint, New Delhi.
5. Goodman & Gilman, The Pharmacological basis of Therapeutics, Editors: J.G. Hardman, L.E. Limbird, P.B. Molinos, R.W. Ruddon and A.G. Gil, Pergamon press.
6. Katzung, B.G. Basic & Clinic Pharmacology, Prentice Hall, International.
7. Laurence, DR & Bennet PN; Clinical Pharmacology, Churchill Livingstone.
8. Rang MP, Dale MM, Riter JM, Pharmacology Churchill Livingstone.
9. Tripathi, K.D. Essentials of Medical Pharmacology, Jay Pee Publishers, New Delhi.
10. Satoskar & Bhandarkar; Pharmacology & Pharmacotherapeutics., Popular Prakashan Pvt. Ltd. Bombay.

PHAR-354

**PHARMACEUTICAL CHEMISTRY -V
(MEDICINAL CHEMISTRY -I)**

Unit-I : Basic Principles of Medicinal Chemistry: Physicochemical aspects (Optical, geometric and bioisosterism) of drug molecules and biological action. Drug-receptor interaction including transduction mechanism, concept of prodrug. [08]

Mode of action, uses, structure activity relationship of the following classes of drugs (Synthetic procedures of individually mentioned drugs only)

Unit-II : Drugs acting at Synaptic and neuro-effector junction sites:

Cholinergic, Anticholinergic & Anticholinesterases-Neostigmine, Physostigmine, Methacholine, Pilocarpine, Atropine.

Adrenergic Drugs-Ephedrine, Isoproterenol, Amphetamine, Salbutamol, Terbutaline, Adrenaline. [08]

Unit-III:Drugs acting on the Central Nervous System :

General Anaesthetics-Thiopental, Ketamine, Methohexital.
Local Anaesthetics-Lignocaine, Benzocaine.

- Hypnotics and Sedatives-Phenobarbitone, Pentobarbitone.
 Opioid Analgesics-Pethidine, Methadone, Pentazocine. [08]
- Unit-IV:** Antitussives-Cramiphen, Dextromethorphen.
 Anticonvulsants-Phenytoin, Carbamazepine, Ethosuximide, Valproic Acid.
 Antiparkinsonism drugs-Carbidopa, Levodopa.
 CNS Stimulants-Caffeine, Nikethamide. [08]
- Unit-V :Psychopharmacological Agents :**
 Neuroleptics – Imipramine, Amitriptyline.
 Antidepressants – Meprobamate, Chlordiazepoxide, Diazepam.
 Antispasmodic and Antiulcer drugs-Dicyclomine, Ranitidine, Omeprazole.
 Neuromuscular Blocking Agents – Gallamine Triethiodide, Mephensin, Pancuronium. [08]

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**PHARMACEUTICAL CHEMISTRY-V
 (MEDICINAL CHEMISTRY-I)**

PRACTICAL

1. Synthesis of selected drugs from the course content involving two or more steps.
2. Establishing the pharmacopoeial standards of the drugs synthesized.

SUGGESTED PRACTICALS

1. Synthesis of Methyl salicylate.
2. To establish pharmacopoeial standards of Methyl salicylate.
3. Synthesis of Paracetamol.
4. To establish pharmacopoeial standards of Paracetamol.
5. To synthesize Benzocaine.
6. To establish pharmacopoeial standards of Benzocaine.
7. Synthesis of Phenytoin.
8. To establish pharmacopoeial standards of Phenytoin.
9. Synthesis of Hydantoin.
10. To establish pharmacopoeial standards of Hydantoin.
11. Synthesis of Barbituric acid.
12. To establish pharmacopoeial standards of Barbituric acid.

BOOKS RECOMMENDED :

1. Mann P G & Saunders B C, Practical Organic Chemistry, ELBS/Longman, London.
2. Furniss B A, Hannaford A J, Smith P W G and Tatehell A R, Vogel's Textbook of Practical Organic Chemistry, The ELBS/ Longman, London.
3. Pharmacopoeia of India, Ministry of Health, Govt. of India.
4. Wolff ME. Ed. Burger's Medicinal Chemistry, John Wiley & Sons, New York.
5. Degado J.N. and Remers W A R, 10th eds., Wilson and Giswold's Text book of Organic Medicinal and Pharmaceutical Chemistry, Lippincott, William & Wilkins.
6. Foye W C. Principles of Medicinal Chemistry, Lea & Febiger, Philadelphia.
7. Singh Harkrishan and Kapoor, V.K., Organic Pharmaceutical Chemistry, Vallabh Prakashan, Delhi.
8. Nogrady T, Medicinal Chemistry – A Biochemical Approach, Oxford University Press, New York, Oxford.
9. Finar I L. Organic Chemistry, Vol I & II, ELBS/ Longman, London.

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**PHARMACEUTICS – VI
 (PHYSICAL PHARMACY)**

Unit-I : (A) Matter, properties of Matter : States of matter, change in the state of matter, latent heats and vapor pressure, sublimation critical point, Eutectic mixtures, gases, relative humidity, liquid complexes, liquid crystals, glassy state, solids-crystalline, amorphous and polymorphism. [02]

(B) Kinetics and Drug Stability : General considerations & concepts, Degradative path ways, half life determination, Influence of temperature, light, solvent, catalytic species and other factors, Accelerated stability study, expiration dating. ICH guidelines for stability. [05]

(C) Buffers : Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity. [02]

Unit-II : Micromeritics and Powder Rheology : Particle size and distribution, average particle size, number and weight distribution, particle number, methods for determining particle volume, optical microscopy, sieving, sedimentation, measurement, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties. [07]

Unit-III : Surface and Interfacial Phenomenon : Liquid interface, surface and interfacial tensions, surface free energy, measurement of surface and interfacial tensions, spreading coefficient, adsorption at liquid interfaces, active agents, HLB classification, solubilization, detergency, adsorption at solid interfaces, solid- gas and solid-liquid interfaces, complex films, electrical properties of interface. [08]

Unit-IV : Viscosity and Rheology : Newtonian systems, Law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling ball, rotational viscometers.

Complexation : Classification of complexes, methods of preparation and analysis, applications. [08]

Unit-V : Dispersion Systems : Colloidal Dispersions : Definition, types, properties of colloids, protective colloids, application of colloids in pharmacy; Suspensions and Emulsions; Interfacial properties of suspended particles, settling in suspensions, theory of sedimentation, effect of Brownian movement, sedimentation of flocculated particles, sedimentation parameters, wetting of particles, controlled flocculation, flocculation in structured vehicles, rheological considerations; Emulsions-types, theories, physical stability. [08]

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PHARMACEUTICS – VI (PHYSICAL PHARMACY)

PRACTICAL

1. Determination of particle size, Particle size distribution and surface area using various methods of particle size analysis.
2. Determination of derived properties of powders like density, porosity, compressibility, angle of repose etc.
3. Determination of surface/ interfacial tension, HLB value and critical micellar concentration of surfactants.
4. Study of rheological properties of various types of systems using different Viscometers.
5. Studies of different types of colloids and their properties.
6. Preparation of various types of suspensions and determination of their sedimentation parameters.
7. Preparation and stability studies of emulsions.
8. Studies of different types of complexes and determination of their stability constants.

9. Determination of half-life, rate constant and order of reaction.
10. To study the influence of various factors on the rate of reaction.
11. Accelerated stability testing, shelf-life determination and expiration dating of pharmaceuticals.
12. Preparation of pharmaceutical buffers and determination of buffer capacity.
13. Experiments involving tonicity adjustments.

BOOKS RECOMMENDED :

1. Martin A, Bustamante P. & Chun A.H.C- Physical Pharmacy, Lea & Febiger, Philadelphia.
2. Shotten E & Ridgaway K, Physical Pharmaceutics, Oxford University Press, London.

SEMESTER –VI

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**PHARMACEUTICAL CHEMISTRY-VI
(MEDICINAL CHEMISTRY - II)**

Unit-I

Principles of Drug Design: Traditional analogs. Introduction to QSAR and mechanism based approaches, Computer –aided drug design and molecular modeling.

Mode of action, uses, structure activity relationship of the following classes of drugs (Synthetic procedures of individually mentioned drugs only)

Unit- II

Cardiovascular Agents – Antianginal & vasodilators, antiarrhythmics, antihypertensives, anticoagulants, antihyperlipidemics & cardiotonics – Nifedipine, Procainamide, Propranolol, Methyldopa, Captopril, Clofibrate, Warfarin, Phenidione. [08]

Unit-III Autocoids :

Antihistaminics :

- i) **H1 antagonists** – Diphenhydramine, Promethazine, Cyproheptadine, Cetrizine.
- ii) **H2 antagonists** – Ranitidine, Famotidine.

Antineoplastics :Chlorambucil, 5- Fluorouracil, Methotrexate. [08]

Unit-IV : Analgesics and Antipyretics – Aspirin, Mefenamic Acid, Ibuprofen, Diclofenac,

Antibacterials – Sulphamethoxazole, Sulphadiazine, Sulphacetamide, Nalidixic acid. [08]

Unit-V: Diuretics – Acetazolamide, Chlorthiazide; Frusemide, Spironolactone.

Diagnostic Aids: Iopanoic Acid [08]

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**PHARMACEUTICAL CHEMISTRY -VI
(MEDICINAL CHEMISTRY-II)**

PRACTICAL

1. Synthesis of selected drugs from the course content involving two or more steps.
2. Establishing the pharmacopoeial standards of the drugs synthesized.
3. Spectral analysis of the drugs synthesized.

BOOKS RECOMMENDED :

1. Mann P G & Saunders B C, Practical Organic Chemistry, ELBS/ Longman, London.
2. Furniss B S, Hannaford A J, Smith P W G and Tathell A R, Vogel's Textbook of Practical Organic Chemistry, The ELBS/ Longman, London.
3. Pharmacopoeia of India, Ministry of Health, Govt. of India.
4. Wolff ME, Ed. Burger's Medicinal Chemistry, John Wiley & Sons, New York.
5. Delgado J N and Remers W A R, Eds., Wilson And Gisworld's Text book of Organic Medicinal and Pharmaceutical Chemistry, J. Lippincott Co., Philadelphia.
6. Foye W C, Principles of Medicinal Chemistry, Lea & Febiger, Philadelphia.
7. Singh Harkishan and Kapoor, V.K., Organic Pharmaceutical Chemistry, Vallabh Prakashan, Delhi.

8. Nogrady, T, Medicinal Chemistry – A Biochemical Approach, Oxford University Press, New York, Oxford.
9. Finar I L, Organic Chemistry, Vol I & II, ELBS/ Longman, London.

PHAR-362

**PHARMACEUTICS-VII
(PHARMACEUTICAL TECHNOLOGY - II)**

Unit-I : **1. Capsules:** Advantages and disadvantages of capsule dosage form, material for production of hard gelatin capsule, size of capsules, methods 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 and storage of capsule dosage forms.

2. Micro-encapsulation : Types of microcapsule, importance of microencapsulation in pharmacy, microencapsulation by phase separation, co-acervation, multi orifice, spray drying, spray congealing, polymerisation, complex, formulation, emulsion, air suspension technique, coating pan and other techniques, evaluation of micro capsules. [08]

Unit-II : Tablets : (A) Formulation of different types of tablets, granulation technology on large-scale by various techniques, physics of tablets making, different types of tablet compression machinery and the equipments employed, evaluation of tablets.

(B) Coating of Tablets : Types of coating, film forming materials, formulation of coating solution, equipments for coating process, evaluation of coated tablet. Stability kinetics and quality assurance. [09]

Unit-III : (A) Approaches to Sustained and controlled release dosage forms. In-vitro methods of evaluation.

(B) Formulation and evaluation of Ophthalmic, Nasal and Ear products. [08]

Unit-IV : Parenteral Products :

Preformulation factors, routes of administration, water for injection, pyrogenicity, nonaqueous vehicles. Formulation details, containers and closures and their selection.

Prefilling treatment, washing of containers and closures, preparation of solution and suspensions, filling and sealing of ampoules, vial, infusion fluids, lyophilization & preparation of sterile powders, equipment for large scale manufacture and evaluation of parenteral products. [07]

Unit-V :

Surgical Products : Definition, primary wound dressing, absorbents, surgical cotton, surgical gauzes etc, bandages, adhesive type, protective cellulosic hemostasis, official dressings, absorbable and non absorbable sutures, ligatures and catguts.

Packaging of Pharmaceutical Products : Packaging component types, specifications and methods of evaluation, stability aspects of packaging equipments, factors influencing choice of containers, legal and other official requirements for containers, package testing. [08]

PHAR-362P

**PHARMACEUTICS-VII
(PHARMACEUTICAL TECHNOLOGY - II)**

PRACTICAL

1. Experiments to illustrate preparation, stabilization & physical evaluation of pharmaceutical products like powders, capsules, tablets, parenterals & microcapsules.
2. Evaluation of Materials used in pharmaceutical packaging.

SUGGESTED PRACTICALS

I – Preparation, Evaluation, Packing of the following dosage forms.

- a) Capsules : Chloramphenicol capsules IP

- b) Microcapsules : Coacervation Phase separation (Temperature change)
- c) Tablets : Uncoated – Paracetamol tablets IP
- d) Tablets : Film coated – Ibuprofen tablets IP
- e) Tablets : Enteric coated – Aspirin tablets
- f) Parenteral : Disodium EDTA injection IP (vials)
- g) Parenteral : Dextrose – NaCl IV infusion IP (Infusion boilers)
- h) Parenterals : Water for infection IP (Ampoule)
- i) Eye drops : Zinc sulphate IP
- j) Eye ointment : Sulphacetamide Sodium IP

II - Formulation and evaluation of sustained release dosage forms – Aspirin Extended release (Matrix embedding method, Granules USP/NF coating of granules)

III - Evaluation of packages – containers & closures.

BOOKS RECOMMENDED

1. Remington: The Science and Practice of Pharmacy Pharmaceutical Sciences Vol. I & III, Mack Publishing Company, U.S.A.
2. R.E. Avis, Pharmaceutical Dosage Forms :Parenteral Medication, Vol-I, Marcel Dekker-Inc, New York & Basel.
3. H.C. Ansel, Introduction to Pharmaceutical Dosage Forms, Lea & Febiger, Philadelphia, U.S.A.
4. R.C. Juliano, Drug Delivery Systems, Oxford University Press, Oxford.
5. Herbert A. Liebermann & Leon Lachman, Theory & Practice of Industrial Pharmacy, Lea & Febiger, Philadelphia, U.S.A.

PHAR-363

PHARMACOLOGY-II

Unit-I :

Pharmacology of CVS: Cardiac glycosides, Antihypertensive drugs, Antianginal drugs, Antiarrhythmics, Antihyperlipidemics, Therapy of Shock. [09]

Unit-II :

Drugs Acting on Hemopoietic System

Haematinics, Vit. K & anticoagulants, Fibrinolytics & antiplatelet drugs, Plasma Volume expanders.

Drugs Acting on Respiratory System

Anti-asthmatic drugs, Anti-tussives & Expectorants, Respiratory Stimulants. [08]

Unit-III : NSAIDS & Anti-gout Drugs.

Diuretics [08]

Unit-IV : Autocoids: Histamine, 5HT and their antagonists, Prostaglandins, Thromboxans, Leukotrienes, Angiotensin and Bradykinin

[08]

Unit-V : Drugs acting on GIT

Antacids and Antiulcer drugs, Laxatives and antidiarrhoeal Agents, Emetics and antiemetics. [07]

PHAR-363P

PHARMACOLOGY-II

PRACTICAL

1. To record the dose response curve (DRC) of Acetylcholine using ileum of rat.

2. To study the parallel shift of DRC in presence of competitive antagonist on DRC of Ach using rat ileum.
3. To study effect of physostigmine on DRC of each on rat ileum.
4. To study the CRC of histamine on guinea pig on ileum preparation & study the effect of antihistaminics.

BOOKS RECOMMENDED :

1. Ghosh, MN; Fundamentals of Experimental Pharmacology, Scientific Book Agency, Calcutta.
2. Grover J.K., Experiments in Pharmacy & Pharmacology, CBS Publishers, New Delhi.
3. Kulkarni S.K., Hand Book of Experimental Pharmacology, Vallabh Prakashan, Delhi.
4. Barar FSK :Text Book of Pharmacology, Interprint, New Delhi.
5. Goodman & Gilman, The Pharmacological basis of Therapeutics, Editors:-JG Hardman, Le Limbird, PB Molinoss, RW Ruddon & AG Gil, Pergamon Press.
6. Katzung, B.G. Basic & Clinical Pharmacology, Prentice Hall, International.
7. Laurence, DR & Bannet PN; Clinical Pharmacology, Churchill Livingstone.
8. Rang MP, Date MM, Riter JM, Pharmacology Churchill Livingstone.
9. Tripathi, K.D. Essentials of Medical Pharmacology, Jay Pee Publishers, New Delhi.
10. Satoskar & Bhandarkar; Pharmacology & Pharmacotherapeutics, Popular Prakashan Pvt. Ltd., Bombay.
11. Craig, C.R. and Stitzel, R.R., Modern Pharmacology, Little Brown and Co., 1994.

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PHARMACOGNOSY – III

Unit-I : (A) Study of the biological sources, cultivation, collection, Commercial varieties, chemical constituents, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following groups of drugs containing.

Glycosides	:		
1. Saponins	:	Liquorice, Ginseng, Dioscorea, Coleus species.	[04]
2. Cardioactive sterols	:	Digitals, Squill, Stropanthus & Thevetia.	[03]
3. Anthraquinone Cathartics	:	Aloe, Senna, Rhubarb & Cascara.	[03]

Unit-II : Others : Psoralea, Ammi majus, Ammi visnaga, Gentian, Saffron, Chirata, Quassia and Andrographis paniculata. [03]

(B) Utilization and production of phytoconstituents such as calcium sennsoides, Diosgenin, Solasodine & Podophyllotoxins. [03]

Unit- III : Studies of traditional drugs : Common Vernacular name, Biological sources, morphology, chemical nature of chief constituents, pharmacology, categories and common uses and toxicological activity of marketed formulations of following indigenous drugs : Amla, Kantkari, Satavari, Tylophora, Bhilwa, Kalijiri, Vach, Rasna. [07]

Unit-IV : Punarnava, Chitrak, Apamarg, Gokhru, Shankpushpi, Brahmi, Methi, Lehsun, Palash, Guggul, Gymnema, Shilajit, Tulsi, Nagarmotha, Majith, Malkanguni and Neem. [08]

Unit-V : Brief Introduction and principals of Ayurvedic, Unani , Siddha and Homeopathic systems of medicines. Introduction to Herbal Pharmacopoeia with special reference to. Arishtas, Asavas, Gutikas, Tailas, Churnas, Lehyas and Bhasmas. [07]

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PHARMACOGNOSY - III

PRACTICAL

1. Identification of crude drugs listed in theory.

2. Microscopic study of some important glycoside containing drugs as outlined above, Study of powdered drugs.
3. Standardization of some traditional drug formulations.

SUGGESTED PRACTICALS

1. Morphology and microscopy (powder) of Liquorice along with its chemical tests.
2. Morphology of Aloe and chemical tests on Aloe-extracts.
3. Morphology and microscopy (powder) of Rhubarb
4. Morphology of Psoralea, Ammimaus, Saffron and Chirata.
5. Morphology of Amla, Kantkari, Shatavari and Vach.
6. Morphology of Punarnava, Apamarg, Gokhru, and Shankhpushpi.
7. Morphology of Brahmi, Methi, Lehsun and Palash.
8. a) Morphology of Nagarmotha and Neem.
b) Identification Tests for Guggul lipids.
9. To study the following standards-
a) Loss on drying.
b) Extractive values.
c) Ash values.
d) pH of 1% solution, in water and alcohol of any Ayurvedic formulation (solid) available in the market.
10. To perform above studies (exp. 10) in any liquid Ayurvedic formulation.
11. Preparation of medicated oil.

PROJECT WORK

A report on marketed preparations based on traditional drugs mentioned in theory.

BOOKS RECOMMENDED :

1. Kokate C.K. "Practical Pharmacognosy" Vallabh Prakashan, New Delhi.
2. Wallis T.E. "Analytical Microscopy" J&A Churchill Ltd., London.
3. Trease, G.E., & Evans, W.C., Evans, W.C., "Pharmacognosy" Bailliere Tindall east Baorne, U.K.
4. Tyler V.E. et al : "Pharmacognosy" Lea & Febiger, Philadelphia.
5. Wallis. T.E. "Text Book of Pharmacognosy" J&A Churchill Ltd. London.
6. Kokate C.K. et al "Pharmacognosy" Nirali Prakashan, Pune.
7. Medicinal plants of India I&II, Indian council of Medical Reasearch, New Delhi.
8. Nadkarni A.K. Indian Materia Medica 1-2, Popular Prakashan (P) Ltd. Bombay.
9. Atal C.K. & Kapur BM. "Cultivation & utilization of Medicinal plants, RRL, Jammu.
10. Indian Herbal Pharmacopoeia, vol. I&II, ICMR & RRL, Jammu.
11. The wealth of India, Raw Materials (All volumes) Council of Scientific & Industrial Research, New Delhi.
12. Compendium of Indian Medicinal Plants I-IV, Rastogi & Malhotra.
13. Indian Ayurvedic Pharmacopoeia, Govt. of India.
14. Kokate CK, Gokhale AS, Gokhale SB, Cultivation of Medicinal Plants, Nirali Prakashan.

PHAR-365

PROFESSIONAL COMMUNICATION-II

Unit-I

1. Written skills:
 - Proposal writings formats.
 - Report writings
 - Business letters
 - Applications
 - Covering letters.

- Curriculum Vitae Designing [10]
- Unit-II**
2. Productivity, Time Management simulation exercise
 3. Leadership Skills.
 4. Team work 'BSC' – Boss, Subordinates & Colleagues [06]
- Unit-III**
5. Group Discussions (G.D)
 - Tips
 - GD [08]
- Unit-IV**
6. Corporate behaviour, corporate expectation, office etiquettes.
 7. Extempore [06]
- Unit-V**
8. Interview Tips:-
 - What student is supposed to do before the interview, during the interview, after the interview & on the day of interview.
 - Various questions that may be asked in an interview.
 - Model interview (Video-shooting & displaying optional)
 9. Exit Interview [10]

BOOKS RECOMMENDED

1. Raman, Meenakshi & Sharma Sangeeta, Technical Communications- Principles & Practice, Oxford University Press.
2. Sharma R.C. & Krishna Mohan, Business Correspondence & Report Writing, Tata Mc Graw Hill Co.
3. Lesikar RV, Lesikar's Basic Business Communication.

PHAR- 366 : ENVIRONMENT & ECOLOGY

Unit-I

Environment studies

- A- Definition, scope & importance
- B- Natural Resources – renewable & non renewable
- C- Use, utilization, exploitation and associated problems of forests, Water resources, Mineral resources, Food resources, Energy resources, Land resources.
- D- Equitable use of resources for sustainable life style, role of an individual in conservation.

Unit-II

Ecosystems

- A. Introduction, types features & functions of different ecosystems- Forest Grassland, Desert and Aquatic.
- B. Biodiversity & its conservation with special reference to India.

Unit-III

Environmental pollution- Air, Water, Soil, Marine, Noise, Thermal, Nuclear- Introduction causes and control measures.

Unit IV

Law related to Environmental Protection
 Air (Prevention and Control of pollution)Act 1987
 Water prevention & Control of Pollution Act. 1974

Unit-V

Environmental Protection Act -1986

Noise Pollution
 Hazardous Wastes
 Hazardous Chemical

Hazardous Microorganism
Biomedical Waste
Provisions applicable to drugs and cosmetic.

Reference

1. Principles of Environmental Studies, C. Manoharachary, P. Jyaranama Reddy, Pharma Book Syndicate, Hyderabad.
2. Handbook of Environmental Laws, Acts, Guidelines, Compliances & Standards Vol. I & II. R.K. Trivedy, Pharma Book Syndicate, Hyderabad
3. Relevant Acts & Rules published by Govt. of India with latest amendments.

SEMESTER –VII

PHAR –471

PHARMACEUTICAL ANALYSIS -III

Unit-I :

Ultraviolet and Visible Spectrophotometry : Electronic, excitation, quantitative laws, deviation from Beer's law, graphical presentation of data. Chromophores photometric error, instrumentation, single and double beam spectrophotometer.

Colorimetric methods : Chemistry of colorimetry, instrumentation, application (direct methods and indirect methods). Nephelometry & turbidimetry and densimetry. [08]

Unit-II :

Infra Red Spectrophotometry :Theory, characteristics absorbance, bands of organic functional groups, interpretation of infrared absorption spectra, preparation of sample, sample cells, IR instrumentation qualitative and quantitative applications in pharmaceutical analysis.

Fluorimetric Analysis :Theory, quantitative description, experimental factors affecting fluorescence intensity, factors affecting IC and F directly, relationship of fluorescence to molecular structure, instrumentation, correction of spectra, pharmaceutical applications. [08]

Unit-III

Nuclear Magnetic Resonance Spectroscopy

An introduction to the theory of ¹H-NMR, chemical shift & spin-spin coupling, spectra of (CH₃ CH₂ - OH, Cl-CH₂ OH, CH₃ - CHO, CH₃ (CH₂)₄ CH₃, C₆ H₆, CH₃ C₆H₅). [08]

Unit-IV

Mass Spectrometry

Introduction to mass spectra, molecular ion peak, fragmentation peaks, mass spectra of some simple compounds.

Flame Photometry

Origin of spectra, atomization and ionization, instrumentation, background emission, interference, qualitative & quantitative applications in pharmaceutical analysis. [08]

Unit-V

Theory, instrumentation and applications of:

Emission Photometry

Atomic absorption spectroscopy [08]

PHAR-471P

PHARMACEUTICAL ANALYSIS -III

PRACTICAL

1. Assay of at least 10 official formulation containing single and more active ingredients using instrumental techniques.
2. Interpretation of a few spectra.

BOOKS RECOMMENDED :

1. Pharmacopoeia of India, Ministry of Health, Govt of India.
2. Becket A.H. and Stenlake J.B. Practical Pharmaceutical Chemistry Vol. I and II, The Athlone Press of the University of London.
3. Chatten L.G. A text book of Pharmaceutical Chemistry Vol. I & II Marcel, Dekker, New York.
4. Willard H.H. and Merrit L. Jr and Dean J.A., Instrumental methods of analysis Van Nostrand Renhold, New York.
5. Obonson J.W.R. Undergraduate Instrumental Analysis, Marcel Dekker Inc, New York, 1970.
6. Parikh V.H. Absorption Spectroscopy of Organic Molecules Addison-Wesley Publishing Co., London 1974.
7. Silver stein RM & Webster FX, Spectrometric Identification of Organic Compounds, John Wiley & Sons.
8. Skoog V, Principles of Instrumental Analysis, Holler-Neimen

PHAR – 472

**PHARMACEUTICS -VIII
(BIOPHARMACEUTICS & PHARMACOKINETICS)**

Unit-1 :Introduction to Biopharmaceutics and Pharmacokinetics and their role in formulation, development and clinical setting.

Biopharmaceutics :

- (A) Passage of drugs across biological barrier (passive diffusion, active transport, facilitated diffusion and pinocytosis).
- (B) Factors influencing absorption – Physicochemical, physiological and pharmaceutical.
- (C) Drug distribution in the body, plasma protein binding. [08]

Unit-II : Pharmacokinetics :

- (A) Significance of plasma drug concentration measurement.
- (B) Compartment model and Non-compartment model. Definition and Scope.
- (C) Pharmacokinetics of drug absorption – zero order and first order absorption rate constant using Wagner – Nelson, Loo-Reigelman method. [08]

Unit-III:(A) Volume of distribution and distribution coefficient.

- (B) Compartment kinetics – One compartment and Preliminary information of multicompartement models. Determination of pharmacokinetic parameters from plasma and urine data after drug administration by intravascular and oral route.
- (C) Clinical Pharmacokinetics : Definition and scope [08]

Unit-IV:

- (A) Dosage adjustment in patients with and without renal and hepatic failure.
- (B) Pharmacokinetic drug interactions and their significance in combination therapy.

Unit-V :Bioavailability and Bioequivalence :

- (A) Measures of bioavailability, C-max, and area under the curve (AUC).
- (B) Review of regulatory requirements for conduction of bioequivalent studies. [08]

PHAR-472P

**PHARMACEUTICS-VIII
(BIOPHARMACEUTICS & PHARMACOKINETICS)**

PRACTICAL

4. Experiments designed for the estimation of various pharmacokinetic parameters with given data.
5. In *vitro* evaluation of different dosage forms for drug release.
6. Absorption studies – in vitro.
7. Statistical treatment of pharmaceutical data.

SUGGESTED PRACTICALS

1. In-vitro drug release study of the given powder dosage form using various dissolution media.
2. In-vitro drug release study of the given uncoated tablet dosage form using different dissolution media.
3. In-vitro drug release study of the given capsule dosage form using various dissolution media.
4. In-vitro drug release study of the given film coated dosage form using various dissolution media.
5. In-vitro dissolution study of the given sustained release dosage form.
6. In-vitro dissolution study of the given fast release (M.D, Dispersible etc.) dosage form.
7. To study the effect of hardness of tablet on dissolution rate.
8. To study the effect of various diluents on dissolution rate of dosage form (Tablets, Capsules, Ointment etc.).
9. To study the effect of formulation on drug release (powder, suspension etc.).
10. To determine the % protein binding of the given drugs.
11. To determine the effect of protein binding on drug bioavailability.
12. To calculate various Pharmacokinetic parameters from the given zero order drug release data.
13. To calculate various Pharmacokinetic parameters from the given first order drug release data.
14. To calculate the various Pharmacokinetic parameters from the given blood data of I.V bolus injection (one compartment model).
15. To calculate various Pharmacokinetic parameters from the given urinary excretion data of I.V bolus.injection using both methods (Rate of elimination & sigma minus method one compartment model).
16. To study the in-vitro drug- drug interaction.
17. To study the passive diffusion of the given drug using cellophane membrane.
18. To study the passive diffusion of the given drug using egg or goat membrane.
19. To determine the various Pharmacokinetic parameters from the given blood data of oral administration of dosage form.

DEMONSTRATION EXPERIMENTS

1. Dissolution Apparatus.
2. Preparation of Buffers & membranes.
3. Use of semilog paper.
4. Operation of colorimeter & U.V spectrophotometer.

BOOKS RECOMMENDED :

1. Notari, R.E, Biopharmaceutics and Pharmacokinetics – An introduction Marcel Dekker Inc. N.Y.
2. Rowland M, and Tozer T.N. Clinical Pharmacokinetics, Lea and Febiger, N.Y.
3. Wagner J.G. Fundamentals of Clinical Pharmacokinetics, Drugs Intelligence Publishers, Hamilton.
4. Wagner J.G. Pharmacokinetics for the Pharmaceutical Scientist, Technomic Publishing A.G. Basel, Switzerland.

PHAR – 473

PHARMACOLOGY -III

Unit-I : Pharmacology of Endocrine System

Hypothalamic & pituitary hormones, Thyroid hormones & Thyroid Drugs, Parathormone, Calcitonin & Vitamin D, Insulin, oral hypoglycemic agents & glucagon. [07]

Unit-II : ACTH & Cortico steroids, Androgens & anabolic steroids, Estrogens, Progesterone & Oral Contraceptives, Drugs acting on uterus. [08]

Unit-III : Chemotherapy

General Principles of Chemotherapy, Sulfonamides, Cotrimoxazole, Quinolones, Antibiotics – Penicillins, Cephalosporins, Chloramphenicol, Tetracyclines, Macrolides. [08]

Unit-IV : Chemotherapy of Parasitic infections, Tuberculosis, Leprosy, Malaria, Fungal infections, Viral diseases, Introduction to Immunomodulators and Chemotherapy of Cancer. [10]

Unit-V : Principles of Toxicology

Definition of poison, general principles of treatment of poisoning with particular reference to barbiturates, opioids, organophosphorous & atropine poisoning, Heavy metal Antagonists. [07]

PHAR-473P

PHARMACOLOGY- III

PRACTICAL

1. To calculate the pA₂ value of Atropine & chlorpheniramine.
2. Bioassay of Ach, histamine & oxytocin on suitable isolated preparations using matching assay, bracketing assay, three point assay & four point assay.

SUGGESTED PRACTICALS

Bioassay of histamine and acetylcholine using matching and interpolation method on rat guinea pig ileum.

BOOKS RECOMMENDED :

1. Ghosh M.N. Fundamentals of Experimental Pharmacology, Scientific Book Agency, Calcutta.
2. Grover J.K., Experiments in Pharmacy & Pharmacology, CBS Publishers, New Delhi.
3. Kulkarni S.K., Hand Book of Experimental Pharmacology, Vallabh Prakashan, Delhi.
4. Barar F.S.K : Text Book of Pharmacology, Interprint, New Delhi.
5. Goodman & Gilman, The Pharmacological basis of Therapeutics, Pergamon Press.
6. Editors :- J.G. Hardman, Le Limbird, PB Molinoss, RW Ruddon & AG Gil, Pergamon Press.
7. Katzung, B.G. Basic & Clinical Pharmacology, Prentice Hall, International.
8. Laurene, DR & Bennet PN; Clinical Pharmacology, Churchill Livingstone.
9. Rang MP, Dale MM, Riter JM, Pharmacology Churchill Livingstone.
10. Tripathi, K.D. Essentials of Medical Pharmacology, Jay Pee Publishers, New Delhi.
11. Satoskar & Bhandarkar : Pharmacology & Pharmacotherapeutics, Popular Prakashan Pvt. Ltd., Bombay.
12. Paul. L., Principles of Pharmacology, Chapman and Hall.

PHAR -474

PHARMACEUTICAL CHEMISTRY -VI

(MEDICINAL CHEMISTRY - III)

Mode of action, uses, structure- activity relationship of the following classes of drug(Synthetic procedures of individually mentioned drugs only).

Unit-I :

1. **Steroids and related drugs :** Introduction, Classification, Nomenclature & Stereochemistry.
(A) Androgens and Anabolic steroids – Testosterone, Stanozolol.
(B) Estrogens and Progestational agents – Progesterone, Estradiol.
(C) Adrenocorticoids – Prednisolone, Dexamethasone, Betamethasone. [08]

Unit-II :

Antibiotics-Penicillins, Semi-synthetic , penicillins, streptomycin, tetracyclines, Cephalosporins, Chloramphenicol, Fluroquinolones.

Antimycobacterial Agents: PAS, Ethambutol, Isoniazid, Dapsone [08]

Unit III:

Antimalarials: Cholroquine, Primaquine, Pyrimethamine

Antiamoebics: Metronidazole, Tinidazole, Diloxanide

Antiseptics & Disinfectants – Benzalkonium chloride

Anthelmintics- Mebendazole

Antifungals

[08]

Unit-IV : Anti – HIV agents – Zidovudine, Zalcitabine, Saquinavir.

Antivirals – Amantadine, Acyclovir, Lamivudine.

Prostaglandins – Misoprostol, Carboprost.

[08]

Unit-V Thyroid and Antithyroids – Carbimazole, Levothyroxine, Propylthiouracil, Methimazole. Insulin & Oral Hypoglycaemics – Chlorpropamide, Metformin, Tolbutamide, Glybenclamide. [08]

BOOKS RECOMMENDED :

1. Pharmacopoeia of India, Ministry of Health, Govt. of India.
2. Wolff ME, Ed. Burger's Medicinal Chemistry, John Wiley & Sons, New York.
3. Delagado J N and Remers W A R, Eds., Wilson And Gisworld's Text book of Organic Medicinal and Pharmaceutical Chemistry, J. Lippincott Co., Philadelphia.
4. Foye W C, Principles of Medicinal Chemistry, Lea & Febiger, Philadelphia.
5. Singh Harkrishan and Kapoor, V.K., Organic Pharmaceutical Chemistry, Vallabh Prakashan, Delhi.
6. Nogrady T, Medicinal Chemistry – A Biochemical Approach, Oxford University Press, New York, Oxford.
7. Finar I L, Organic Chemistry, Vol. I & II, ELBS/ Longman, London.
8. Hanch C, Comprehensive Medicinal Chemistry, Vol. IV, Quantitative Drug Design, Pergamon Press, Oxford.

PHAR-475

PHARMACOGNOSY-IV

Unit-1 : 1. Systematic study of source, cultivation, collection, processing, commercial varieties, chemical constituents, substitutes adulterants, uses, diagnostic macroscopic & microscopic features & specific chemical tests of following alkaloid containing drugs.

(A) **Pyridine-piperidine :** Tobacco, Areca & Lobelia.

(B) **Tropane :** Belladonna, Hyoscyamus, Datura, Coca & Withania.

(C) **Quinoline & Isoquinoline :** Cinchona, Ipecac & Opium..

(D) **Indole :** Ergot, Rauwolfia, Catharanthus & Nux-vomica.

[08]

Unit-II :

(E) **Imidazole :** Pilocarpus.

(F) **Steroidal :** Veratrum & Kurchi.

(G) **Alkaloidal amine :** Ephedra & Colchicum.

(H) **Glycoalkaloid :** Solanum.

(I) **Purines :** Coffee & Tea

(J) **Quinazoline :** Vasaka.

[08]

Utilization & production of phytoconstituents such as – Tropane Alkaloids, Isoquinoline & Quinoline Alkaloids.

Unit-III

(A) **World wide trade in Medicinal plants & derived product. Tropane alkaloids containing drugs, Cinchona, Ipecac, Rauwolfia, Taxol. Diosgenin, Digitalis, Liquorice, Papain, Ginseng, Aloe, Valerian, & plant laxatives.**

(B) Role of Medicinal & aromatic plants in National Economy.

[08]

Unit-IV

Biological sources, preparation, Identification tests and uses of following enzymes –

Diastase, papain, Penicillinase, Hyalluronidase, Streptokinase.

Plant Bitters & Sweeteners.

[08]

Unit-V : Introduction, classification & study of different chromatographic methods. Application of chromatographic techniques in evaluation of herbal drugs.

Historical development of plant tissue culture, type of culture, Nutritional requirement, growth & their maintenance. Application of plant tissue culture in pharmacognosy. [08]

PHAR-475P

PHARMACOGNOSY -IV

PRACTICAL

1. Identificaiton of crude drugs listed above.
2. Microscopic study of characters of any 8 selected drugs given in theory in entire and powder form.
3. Chemical evaluation of powdered drugs & Enzymes.
4. Chromatographic studies of some herbal constituents.
5. Some experiments in plant tissue culture.

SUGGESTED PRACTICALS

1. To study the morphology and microscopy of Datura and Withania.
2. To study the morphology and microscopy of Ipecac and Rauwolfia.
3. To study the morphology and microscopy of Catharanthus and Nux-vomica.
4. To study the morphology and microscopy of Ephedra and Kurchi.
5. To study the morphology and microscopy of Solanum and Vasaka.
6. a) Morphology of Areca, Colchicum.
b) Transverse section of Catharanthus leaf and Kurchi bark.
7. To study the TLC profile of Catharanthus leaf.
8. To study the TLC profile of Withania root.
9. Chemical test of Tea, Tobacco, Datura and Withania.
10. Chemical test of Nux-vomica, Ephedra, and Kurchi.
11. Introduction of plant-tissue culture techniques on laboratory scale.
12. Preparation of Agar slants.
13. To grow callus in any defined media.
14. Maintenance of callus culture.

PROJECT :

World wide trade of medicinal plants. (Monograph).

BOOKS RECOMMENDED :

1. Kokate, C.K. Practical Pharmacognosy, Vallabh Prakashan, Delhi.
2. Wallis T.E. Analytical Microscopy, J&A Churchill Ltd, London.
3. Ganborg & Wetter, Plant Tissue Culture Methods, National Research Council of Canada, Saskatchewan.
4. Clarke ECG, Isolation & Identification of drugs. The Pharmaceutical Press, London.
5. Trease, G.E. & Evans, W.C. "Pharmacognosy" Bailliere Tindall East Bourne, U.K.
6. Tyler V.E. etal Pharmacognosy, Lea & Febiger Phjadelphia.
7. Wallis T.E. Text book of Pharmacognosy" J&A Churchill Ltd. London.
8. Kokate, C.K. etal Pharmacognosy" Nirali Prakashan, Pune.
9. Atal & Kapur, Cultivation & Utilization of Medicinal Plants, RRL, Jammu.
10. Stahl, E, Thin Layer Chromatography. A laboratory handbook, Springer Verlog, Berlin.
11. Henry TA. The Plant Alkaloids, McGraw Hill, New York.
12. Dixit, V.K., Vyas. S.P. Pharmaceutical Biotechnology, CBS Publication, ND.
13. Street H.E. Tissue Culture & Plant Science, Academic Press, London.
14. Kokate, C.K. Gokhale AS, Gokhale SB, Cultivation of Medicinal Plants, Nirali Prakashan.

SEMESTER – VIII

PHAR –481

PHARMACEUTICAL BIOTECHNOLOGY

Unit-I : Immunology and Immunological preparations :

Principles, Antigen and haptens, immune system, Cellular, humoral immunity, immunological tolerance, antigen-antibody reactions and their applications, standardization and storage of BCG. [08]

Unit-II : Genetic Recombination

Transformation, conjugation, transduction, protoplast fusion and gene cloning and their applications, development of hybridoma for monoclonal antibodies, study of drugs produced by biotechnology such as activase, humulin, Humatrope. [08]

Unit-III : Antibiotics :

Historical development of antibiotics, Antimicrobial spectrum and methods used for their standardization. Screening of soil for organisms producing antibiotics fermenter, its design, control of different parameters. Isolation of mutants, factors affecting mutation. [08]

Unit-IV : Microbial Transformation :

Introduction, types of reactions mediated by microorganisms, Design of Bio-transformation process, selection of organisms, biotransformation processes and its improvements with special reference to steroids. [08]

Unit-V : Enzyme immobilization :

Techniques of immobilization of enzymes, factors affecting enzyme kinetics, study of enzymes such as hyaluronidase, penicillinase, streptokinase and streptodaranse, amylases and proteases Immobilization of Bacteria and plant cells. [08]

BOOKS RECOMMENDED :

1. S.P. Vyas and V.K. Dixit, Pharmaceutical Biotechnology, CBS Publication, New Delhi.
2. Prescott and Dunn's Industrial Microbiology, 4th Ed, 1987, CBS Publishers and Distributors, Delhi.
3. P.F. Stanbury & A. Ahhtar Principles of Fermentation Technology.
4. K. Kieslich Ed. Biotechnology Vol. 69 Verleg Chernie Switzerland 1984.
5. P.F. Standury & A. Whitaker & Hall S.J. Principles of Fermentation, Aditya Book Private Limited, New Delhi.
6. Crueger W. & Crueger A, Biotechnology-A Textbook of Industrial Microbiology, Panima Publishing Corporation, Delhi.

PHAR -482

NATURAL PRODUCTS

Unit-I :

1. Chemical & Spectral approaches to simple molecules of natural origin.
2. Biogenetics Investigations and basic metabolic pathways, (alkaloids, terpenes, steroids) Brief introduction to biogenesis of secondary metabolites of Pharmaceutical importance. [08]

Unit-II

Extraction, Isolation & Chemistry of –

i) **Glycosides** - Digitoxin, Digoxin, Hecogenin, Diosgenin & Sarasapogenin

ii) **Lignans**

iii) **Quassinoids**

iv) **Flavonoids (Quercetin)** [08]

Unit-III :

Alkaloids – Atropine & related compounds, quinine, reserpine, morphine, papaverine, ephedrine, ergot, and Vinca Alkaloids.

Natural Allergens, Photosensitizing agents and fungal toxins. [08]

Unit-IV:

Extraction, Isolation & Chemistry of –

Terpenoids- Camphor, Menthol, Citral, β - Carotene, α -Tocopherol, α -Pinene. [03]

Unit-V

Herbal Cosmetics and their formulation.

[02]

Recent developments of natural products used as anticancer agents, antidiabetics and immunomodulators.

PHAR-482P

NATURAL PRODUCTS

PRACTICAL

1. Laboratory experiments on Isolation, separation, purification of various groups of chemical constituents of Pharmaceutical significance.
2. Exercises on paper & thin layer chromatographic evaluations of herbal drug constituents.
3. Extraction of volatile oils & their chromatographic profiles.

SUGGESTED PRACTICALS

1. Isolation of caffeine from Tea leaves.
2. Isolation of piperine from Black Pepper.
3. Isolation of Hesperidin from Orange Peel.
4. Isolation of Clove oil from clove.
5. Isolation of Caraway oil from caraway.
6. Isolation of cumin oil from cumin.
7. To study the TLC profile of extracted oils.
8. To perform the column chromatography of any available herb.
9. To study the paper chromatographic profile of glycone portion separated from senna.
10. To Isolate the active constituent of any available drug with the help of preparative TLC.
11. Quantitative determination of Ascorbic acid present in Amla. (Fresh/ Dry).

BOOKS RECOMMENDED

1. Brain, K.R., & Turner T.D, The Practical evaluation of phytopharmaceutical, Wright, Bristol.
2. Sim, Medicinal Plant Alkaloids & Glycosides.
3. Kokate C.K., "Practical Pharmacognosy" Vallabh Prakashan, New Delhi.
4. Stahl E. "Thin layer chromatography" A Laboratory Hand Book, Springer Verlag, Berlin.
5. Harborne, J.B. Phytochemical Methods Chapman & Hall, International Ed, London.
6. Pharmacopoeia of India.
7. I.L. Finar "Organic chemistry" Vol. I & II ELBS, London.
8. O.P. Agarwal, "Chemistry of Organic Natural Product" Vol. I & II Goel Pub. House, Meerut.
9. Trease G.E. & Evan, W.C., "Pharmacognosy" Bailliere Tindall Eastbourne, U.K.
10. Tyler V.E. et al "Pharmacognosy" Lea & Febiger Philadelphia.
11. Kokate, C.K. "Pharmacognosy" Nirali Prakashan, Pune.
12. Pridham JB & Swain T. Biosynthetic pathway Higher plants, Academic Press, New York.

PHAR- 483

PHARMACEUTICAL INDUSTRIAL MANAGEMENT

Unit-I :

1. Concept of Management : Administrative Management (Planning, Organising Staffing Directing and Controlling). Entrepreneurship development, Operative Management (Personnel, Materials, Production, Financial, Marketing, Time/space, Margin/ Morale) Principles of Management (Co-ordination, Communication, Motivation, Decision making, leadership, Innovation Creativity, Delegation of Authority / Responsibility. Record Keeping), Identification of key points to give maximum thrust for development and perfection. [12]

Unit-II

Economics : Principles of economics with special reference to the Laws of demand and supply, demand schedule, demand curves labor welfare, general principles of insurance and inland and foreign trade, procedure of exporting and importing goods. [03]

Accountancy : Principles of Accountancy, Ledger posting and book entries preparation of trial balance, columns of a cash book, Bank reconciliation statement, rectification of errors, profits and loss account, balance sheet, purchase, keeping and pricing of stocks, treatment of cheques bills of exchange, promissory notes and bundles documentary bills. [04]

Unit-III

3. Pharmaceutical Marketing : Functions, buying, selling, transportation, storage financed feedback information, channels of distribution, wholesale, retail, department store, multiple shop and mail order business. [04]

4. Salesmanship : Principle of sales promotion, advertising, ethics of sales, merchandising, literature, detailing, Recruitment, training, evaluation, compensation to the pharmacist. [04]

Unit-IV

5. Market Research

(A) Measuring & Forecasting Market Demand - Major concept in demand measurement, Estimating current demand Geo-demo-graphic analysis. Estimating industry sales, Market share and future demand.

(B) Market segmentation & Market targeting. [06]

Unit-V

6. Materials Management : A brief exposure of basic principles of management major areas, scope, purchase, stores, inventory control and evaluation of materials management.

[04]

7. Production Management : A brief exposure of the different aspects of Production Management – Visible and Invisible inputs, Methodology of Activities Performance Evaluation Technique Process – Flow, Process Know-how, Maintenance Management. [03]

BOOKS RECOMMENDED :

1. Beri, Market Research – Tata Mc Graw Hill
2. Chary S.N, Production and Operative Management / Tata Mc Graw Hill.
3. Datta A.K., Material Management / PHI.
4. Chadwick Leslie, The essence of management accounting / PHI.
5. Massie L. Joseph Essentials of Management / PHI.
6. Barthwal R.R, Industrial Economics –. / New Age International.
7. Shreenivasan K.R., An Introduction to Industrial Management –/ Vikas.
8. Daver Rustam S. Salesmanship and Publicity –/ Vikas.
9. Mukopadhyay Sekhar, Pharmaceutical Selling, Sterling Publishers.
10. Koontz H, Wehrich H, Essentials of Management, Tata Mc Graw Hill.
11. Vidya sagar Pharmaceutical Industrial Management, Pharma Book Syndicate

PHAR- 484

HOSPITAL PHARMACY

Unit-I: Organization and Structure: Organization of a hospital and hospital pharmacy, Responsibilities of a hospital pharmacist. Pharmacy and therapeutic committee, Budget preparation and implementation.

Hospital Formulary: Contents, preparation and revision of hospital formulary.

Unit-II : Drug Store Management and Inventory Control: Organization of drug., Types of materials stocked, storage conditions.

Purchase and Inventory control: Principles, purchase procedures, purchase order, procurement and stocking.

Unit-III : Central Sterile Supply Unit and their Management: Types of materials for sterilization, packing of materials prior to sterilization, sterilization equipments, Supply of sterile materials.

Manufacture of Sterile and Nonsterile Products: Policy making of manufacturable items, demand and costing, personnel requirements, manufacturing practice, Master formula card, Production control, Manufacturing records.

Unit-IV: Drug information service: Sources of information on drugs, treatment schedules, procurement of information, computerized services (e.g. MEDLINE), Retrieval of information, Medication error.

Records and Reports : Prescription filling drug profile, Patient medication profile, case on drug interaction & adverse reactions, idiosyncratic cases etc.

Unit-V: Drug distribution systems in Hospitals : Out-patient dispensing, methods adopted, Dispensing of drugs to in-patients. Types of drug distribution systems Charging Policy, labeling, Dispensing of drugs to ambulatory patients, Dispensing of controlled drugs.

Nuclear Pharmacy : Introduction to Radiopharmaceutics- radio-active half life, Units of radio-activity. Production of radio pharmaceuticals, methods of isotonic 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.

BOOKS RECOMMENDED

1. Hasan, Hospital Pharmacy, Lea & Febiger, Philadelphia.
2. Merchant H.S. and Qadry J.S. Text Book of Hospital Pharmacy, B.S. Shah Prakashan, Ahmedabad.

PHAR -485

ELECTIVE

Any one of the following :

- (A) **Standardisation of herbal drugs.**
- (B) **Drug design.**
- (C) **Clinical; Pharmacy and Drug interactions**
- (D) **Pharmaceutical marketing.**
- (E) **Pharmaceutical Packaging**
- (f) **Novel drug delivery system**
- (G) **GMP, Quality Assurance & Validation**

(A) STANDARDISATION OF HERBAL DRUGS

Unit I – Commerce and quality control of natural medicinal plants products, organoleptic, microscopic, physical & chemical evaluation of crude drugs. [08]

Unit-II - Standardisation of plant material as per WHO guidelines. [08]

Unit-III -Methods of extraction and modern techniques for the isolation, purification, separation estimation and characterisation of active plant constituents. [08]

Unit-IV -Analysis of official formulations derived from crude drugs including some ayurvedic preparations. [08]

Unit-V -General methods of screening of natural products for following biological activity:

- | | | |
|----------------------|--------------------------|------------------|
| a) Anti-inflammatory | b) Hypoglycaemic | c) Antibacterial |
| d) Antifertility | e) Psychopharmacological | [08] |

BOOK RECOMMENDED

1. Trease, G.E. Evans W.C.,. Pharmacognosy ELBS.
2. Tyler Varro. E., Brady Lynn. R. Robbers J.E. Pharmacognosy
3. Wallis T.E.,.Text book of Pharmacognosy
4. Harborne Phytochemical methods of chemical analysis .
5. Pharmacopieal standards for Ayurvedic formulations CCRAS, Delhi.

6. Vapoorte, Swendson Chromatography of alkaloids.
7. Lala P.K., Elements of chromatography
8. Mottal.A.C. Clerk's isolation & identifications of drugs
9. Dhavan B.N. & Srimal R.C, The use of pharmacological techniques for evaluation of natural products. CDRI Lucknow.
10. Brain K.R. and Turner T.D, The practical evaluation of phytopharmaceuticals
11. Peach K. & Tracey MV, Modern methods of plant analysis
12. British herbal pharmacopocia.
13. Indian herbal pharmacopocia.
14. Chaudhary.R.R., Herbal drug industry

(B) DRUG DESIGN

Unit-I

A general study of the approaches to drug design- method of variation, study of the use of Biochemical & Physiological information involving new drugs. [08]

Unit-II

Physicochemical properties in relation to drug action; metabolic transformation of drugs and its role in development of new drug molecules; Metabolic antagonism. [08]

Unit-III

Stereochemical aspects of drug receptor interactions and mechanism of drug interaction. Isosterism and bioisosterism as guides to structural variations; Concepts of conformational analysis and its role in design and development of new drug molecules. [08]

Unit-IV

Principles of drug design: Analogue synthesis versus rational design; discovery of lead compounds, Pharmacophoric identification, Prodrugs and soft drugs. [08]

Unit-V

QSAR and introduction to molecular modeling, Computer Aided Drug Design. [08]

BOOKS RECOMMENDED:

1. E.J, Ariens: Drug Design, Academic Press, New York (1975).
2. S.H. Salkovisky, A.A. Sinkula and S.C. Valvani, Physical Chemical Properties of Drugs, Marcel Dekker Inc. New York.
3. M.E. Wolff, Burger's Medical Chemistry, John Willey and Sons, New York.
4. R.F, Doerge, Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry, J. Lippincott Co, Philadelphia.
5. Olson, Edward C "Computer Assisted Drug Design (American Chemical Society).
6. Burger A "A guide to chemical basis of Drug Design "John Wiley & Sons".

(C) CLINICAL PHARMACY AND DRUG INTERACTIONS

Unit-I

1. Introduction to Clinical Pharmacy. [08]

Unit-II

2. Basic concepts of pharmacotherapy,

Clinical Pharmacokinetics and individualization of Drug Therapy, Drug Delivery, Systems and their Biopharmaceutic & Therapeutic Considerations, Drug use during Infancy and in the Elderly (Pediatrics & Geriatrics). [08]

Unit-III

Drug use during Pregnancy, Drug induced Diseases, The Basics of Drug Interactions, General Principles of Clinical Toxicology, Interpretation of Clinical Laboratory Tests. [08]

Unit-IV

3. Important Disorders of Organ Systems and their Management:

Cardiovascular Disorders-Hypertension, Congestive Heart Failure, Angina, Acute Myocardial Infarction, Cardiac arrhythmias, CNS Disorders: Epilepsy, Parkinsonism, Schizophrenia, Depression, Respiratory Disease-Asthma, Gastrointestinal Disorders-Peptic ulcer, Ulcerative colitis. [08]

Unit-V

Hepatitis, Cirrhosis, Endocrine Disorders- Diabetes mellitus and Thyroid Disorders, Infectious Diseases-Tuberculosis, Urinary Tract Infection, Enteric Infections, Upper Respiratory Infections, Haematopoietic Disorders-Anemias, Joint and Connective Tissue Disorders-Rheumatic Diseases, Gout and Hyperuricemia, Neoplastic Diseases-Acute Leukaemias, Hodgkin's disease. [08]

4. Therapeutic Drug Monitoring.

5. Concept of Essential Drugs and Rational Drug use,

BOOKS RECOMMENDED

1. Barar F.S.K. Text Book of Pharmacology, Interprint, New delhi.
2. Goodman & Gilman, The Pharmacological basis of Therapeutics, 3, Editors :- JG Hardman, Le Limbird, PB Molinoss, RW Ruddon & AG Gill, Pergamon Press.
3. Katzung B.G. basic & Clinical Pharmacology, Prentice Hall, International.
4. Laurence, DR & Bennet PN; Clinical Pharmacology, Churchill Livingstone.
5. Rang MP, Dale MM, Ritter JM, Pharmacology Churchill Livingstone.
6. Tripathi, K.D, Essentials of Medical Pharmacology, Jay Pee Publishers, New Delhi.
7. Satoskar & Bhandarkar; Pharmacology & Pharmastherapeutics, Popular Prakashan Pvt, Ltd. Bombay.
8. Davidson's Principles and Practice of Medicine, ELBS/Churchill Livingstone.
9. Herfindal E.T. and Hirashman J.L., Clinical Pharmacy and Therapeutics Williams and Wilkins.
10. Parthasarathi G, Nyfort-Hansen K, Nahata M.C., A Textbook of Clinical Pharmacy Practice- Essential Concepts and Skills, Orient Longman.

(D) PHARMACEUTICAL MARKETING

Unit-I Principles of marketing management, Introduction to pharmaceutical marketing, Identification of the marketing, Market behaviour, Prescribing habits of physician, Patient motivation, Market analysis. [08]

Unit-II Drug development and the marketing research interface, Diversification and specialisation, Marketing generic drugs. [08]

Unit-III Economic and competitive aspects of pharmaceutical industry- Advertising, Detailing, Retail competition, International marketing. [08]

Unit-IV Distribution channels in pharmaceutical marketing – Manufacturer, Wholesaler, Retailer, Hospital & Government agencies, Selection of stockists and distributors. [08]

Unit-V Controls- Internal control and external control. [08]

BOOKS RECOMMENDED

1. Smith, Mickey C, "Principles of pharmaceutical marketing", CBS Publishers & Distributors.
2. Kotler, Philip "Marketing Management". Pearson Education Asia.

(E) PHARMACEUTICAL PACKAGING

Unit-I

1. New concepts in pharmaceutical packaging.
2. Package systems, package design research. [08]

Unit-II

3. Packaging materials with special reference to polymers, metals, glass and plastics, control of packaging materials.
4. Blister and strip packaging. [08]

Unit-III

5. Testing of containers & closures, Pharmacopoeial tests and specifications, Defects in packages.
6. Stability of package and packaging material.

7. Ancillary materials used in packaging. [08]

Unit-IV

8. Sterilization of packaging materials.

9. Packaging of Parenterals, Ophthalmic and aerosols. [08]

Unit-V

10. Corrugated fibre board materials, Pointing requirements, label and leaflets preparation, Legal requirement. [08]

BOOKS RECOMMENDED:

1. Ross, Packaging of Pharmaceuticals.

2. Joseph D.O. Brien, Medical Device Packaging Handbook.

3. Griffin, Drug and cosmetic Packaging.

4. Barail, Packaging Engineering.

5. Harburn, Quality-Control of Packaging Materials in Pharmaceutical Industry.

6. Kac Chensney, Packaging of Cosmetics and Toiletries.

(F) NOVEL DRUG DELIVERY SYSTEM

Unit-I

1. Theory of controlled release drug delivery systems.

2. Release and diffusion of drugs from C.D.D.S., General methods of design and evaluation of C.D.D.S. [08]

Unit-II

3. Carriers for drug delivery systems, Prodrugs, Physical, chemical and biomedical engineering approach to achieve controlled drug delivery.

4. Microencapsulation: Methods, kinetics of drug release from microcapsules technology and applications. [08]

Unit-III

5. Transdermal drug delivery systems: Theory, formulation and evaluation, Iontophoresis.

6. Implants and inserts: Types, design and evaluation methods, Osmotic pumps. [08]

Unit-IV

7. Targeted Drug delivery systems: Concept of drug targeting, importance in therapeutics, methods in drug targeting, drug immobilization techniques, nanoparticles, liposomes, neosomes, pharmacosomes and erythrocytes. [08]

Unit-V

8. Advances in drug delivery systems. An Introduction to buccal, nasal, ocular, pulmonary colonic delivery, etc. [08]

BOOKS RECOMMENDED

1. Roiche, Design of Biopharmaceutical Properties Through Prodrugs and Analogs.

2. Jolles and Wooldbridge, Drug Design: Facts or Fantasy.

3. Julian, Drug Delivery Systems.

4. Robinson and Vincent, Controlled Drug Delivery.

5. Robinson, Sustained and Controlled Drug Delivery Systems.

6. Noxon, Microencapsulation.

7. Chien, Novel Drug Delivery Systems.

8. Deasy, Microencapsulation and Related Processes.

9. Gutcho, Microencapsulation and Related Processes.

10. Lisbeth, Illum & Davis, Polymers in Controlled Drug Delivery.

(G) GMP, QUALITY ASSURANCE & VALIDATION

Unit-I

1. Requirements of GMP, CGMP1, GLP, USFDA, WHO guidelines and ISO 9000 series. [08]

Unit-II

2. Documentation- Protocols, Forms and maintenance of records in Pharmaceutical industry.
3. Preparation of documents for new drug approval and export registration. [08]

Unit-III

4. Basic concept of quality assurance, Quality assurance systems, Sources and control of quality variation- raw materials, containers, closures, personnel, environment etc [08]

Unit-IV

5. Concepts in validation, validation of manufacturing and analytical equipment, Process validation in manufacturing dosage formulations, applications of process validation.

Unit-V

6. In process quality control tests, IPQC problems in pharmaceutical industries.
7. Sampling plans, Sampling and operating characteristics curves. [08]

BOOKS RECOMMENDED:

1. Willing, Tuckerman and Hitchings, Good Manufacturing Practices for Pharmaceuticals.
2. OPPI, Quality Assurance.
3. Loftus and Nash, Pharmaceutical Process Validation.
4. Florey, Analytical Profile of Drugs (All volumes).
5. Indian Pharmacopoeia.
6. United States Pharmacopoeia.
7. British Pharmacopoeia.
8. Garfield, Quality Assurance Principles for Analytical Laboratories.

PHAR-485 P
Project on Elective

U.P. TECHNICAL UNIVERSITY LUCKNOW



Revised Syllabus

IIIrd and IVth Year

[Effective from the session 2006-07]

BACHELOR OF PHARMACY