Solapur University, Solapur
Third Year B. Pharmacy
(w.e.f. June 2012)
Semester-V

Sub Code	Subject	Teaching scheme (Hours/week)	Semester Examination			Sessional examination		Maximum marks for the subject	Minimum marks for Passing the subject
			Duration (Hours)	Maximum marks	Minimum marks for passing	Duration (Hours)	Maximum marks		
3.5.1	Solid Dosage Forms	3	3	80	32	1	20	100	40
3.5.2	Biopharmaceutics	3	3	80	32	1	20	100	40
3.5.3	Medicinal Chemistry-I	3	3	80	32	1	20	100	40
3.5.4	Pharmaceutical Analysis-III	3	3	80	32	1	20	100	40
3.5.5	Pharmacology-I	3	3	80	32	1	20	100	40
3.5.6	Biotechnology	3	3	80	32	1	20	100	40
Practical									
3.5.7	Solid Dosage Forms	3	4	80	32	3	20	100	40
3.5.8	Medicinal Chemistry-I	3	4	80	32	3	20	100	40
3.5.9	Pharmaceutical Analysis-III	3	4	80	32	3	20	100	40
3.5.10	Biotechnology	3	4	80	32	3	20	100	40
3.5.11	Project*	3							
Maximum Marks for the Semester - 1000									
Minimum marks for passing the semester - 500									

Semester-VI

Sub Code	Subject	Teaching scheme (Hours/week)	Semester Examination			Sessional examination		Maximum marks for the subject	Minimum marks for Passing the subject
			Duration (Hours)	Maximum marks	Minimum marks for passing	Duration (Hours)	Maximum marks		
3.6.1	Semisolid Dosage Forms	3	3	80	32	1	20	100	40
3.6.2	Medicinal Chemistry-II	3	3	80	32	1	20	100	40
3.6.3	Pharmaceutical Analysis-IV	3	3	80	32	1	20	100	40
3.6.4	Pharmacology-II	3	3	80	32	1	20	100	40
3.6.5	Clinical Pharmacology	3	3	80	32	1	20	100	40
3.6.6	Pharmacognosy-II	3	3	80	32	1	20	100	40
Practical									
3.6.7	Semisolid Dosage Forms	3	4	80	32	3	20	100	40
3.6.8	Medicinal Chemistry-II	3	4	80	32	3	20	100	40
3.6.9	Pharmaceutical Analysis-IV	3	4	80	32	3	20	100	40
3.6.10	Pharmacognosy-II	3	4	80	32	3	20	100	40
3.6.11	Project*	3	4	80	32	3	20	100	40
Maximum Marks for the Semester - 1000									
Minimum marks for passing the semester - 500									

*The project for Semester-V will be continued in Semester-VI. The Project examination will be conducted by the colleges at the end of Semester-VI and the list of successful candidates shall be submitted to the University.

Third Year B. Pharmacy

Semester-V

3.5.1 Solid Dosage Forms

1 Tablets:

Introduction, advantages & disadvantages, types of tablets.

Formulation development: Preformulation of drugs and additives, introduction to tablet additives, need of granulation, mechanisms, manufacturing processes and equipments for wet granulation and dry granulation processes, characterization and evaluation of granules, mechanism, manufacturing process and equipments for Direct compression technique, Tablet compression machines, types of press tooling, manufacturing problems and remedies thereof, evaluation of tablets as per IP.

Tablet Coating: introduction and concept of tablet coating, types of tablet coating including Sugar, film and enteric coating, materials, processes employed and equipments for tablet coating, manufacturing problems during tablet coating and remedies, evaluation of coated tablets

Layouts of tablet manufacturing section

2 Capsules:

Introduction to capsule as a dosage form and concept of size selection of capsules

Hard gelatin capsules: Preparation of hard gelatin capsule shell, standards and defects thereof, Formulation, filling, processing and capsule filling equipments, problems in capsule filling and remedies thereof, in-process quality control and quality control parameters.

Soft gelatin capsules: formulation and development, manufacturing, processing and equipments, in-process quality control and quality control parameters.

3 Microcapsules/Microspheres (Microencapsulation):

Importance of microcapsule and microsphere in pharmacy, methods of preparation: Phase separation, coacervation, multi-orifice centrifugal methods, spray congealing, polymerization and Air suspension technique, pan coating and other techniques, evaluation of microcapsules.

References:

1. Remington “The science and practice of pharmacy” 21st Ed., Mack publishing company, 2005.
2. James J.Wells “ Pharmaceutical Preformulation: The physicochemical properties of drug substances “ Ellis Horwood, Chichester, UK,1988
3. H.C.Ansel; N.G.Poporich; L.V.Allen “Pharmaceutical dosage forms and Drug Delivery systems” 9th edition, Wolters kluwer- Lippincott Williams and wilkins, 2009.
4. L.Lachman; H.A.Liberman; J.L.Kanig “The Theory and Practice of Industrial Pharmacy” 3rd edition; Verghese publishing House, Mumbai 1991. Special Indian edition, 2009.
5. M.E.Aulton “Pharmaceutics: The design and manufacture of medicines” 3rd edition; Churchil livingstone, 2007.
6. Bentley’s “Test book of Pharmaceutics” Bailliere Tindall; 8th edition; ELBS Publication, 1996.
7. G.S.banker, R.K.Chalmers “Pharmaceutics and Pharmacy Practice “J.B. Lippincott Company, Philadelphia, PA, 1982.
8. J.Swarbrick; J.C.Boylan “Encyclopedia of pharmaceutical technology” Marcel Dekker, 1998.
9. H.A.Lieberman, L.Lachman and J.B.Schwart “Pharmaceutical dosage forms: Tablets” Marcel Dekker, Vol. I, II, III 1998.

3.5.7 Solid Dosage Forms

1. **Tablets:**

   Preparation and evaluation of tablets by direct compression.

   Preparation and evaluation of tablets by wet granulation.

   Preparation and evaluation of tablets by dry granulation.

   Evaluation of granules- Carr's Index and Hausner's ratio.

   Evaluation of Tablets: Hardness, Friability, Weight variation, Tablet porosity, Dimensions, Disintegration time, Dissolution time.

2. **Capsules:**

   Filling of powder/granules in hard gelatin capsule and its evaluation as per official compendia.

3. **Tablet Coating (Demonstration)**

4. **Microencapsulation:**

   Preparation and evaluation of microencapsulated products.

5. **Visit to Pharmaceutical Manufacturing Plant**

3.5.2 Biopharmaceutics

1. **Introduction to Biopharmaceutics, Pharmacokinetics:**
   Their role in drug and formulation development, Biopharmaceutical Classification System

2. **Biopharmaceutics:**
   Absorption: Mechanisms and factors affecting drug absorption, theories of dissolution
   Distribution: Factors affecting distribution. binding of drugs to plasma and tissue components, miscellaneous factors, volume of distribution, distribution coefficient and effective partition coefficient.
   Elimination: Routes of elimination, factors affecting elimination, enzyme induction and enzyme inhibition, clearance, extraction ratio, extra-hepatic circulation.

3. **Pharmacokinetics:**
   Significance of plasma drug concentration measurement.
   Pharmacokinetic models - Definition and classification.
   Compartment kinetics- One compartment model- I.V. Bolus Dosing, I.V. infusion and extra-vascular administration, multi-compartment models (No mathematical derivation).

4. **Non-linear pharmacokinetics:**
   Causes of Non-linearity, Michaelis Menten equation

5. **Bioavailability and bioequivalence:**
   Measures of bioavailability, C_{max}, t_{max}, and Area Under-Curve (AUC).
   Curve fitting (method of Residuals), regression procedures.
   Design of single dose bioequivalence study and relevant statistics.
   ICH guidelines and review of regulatory requirements for conduction of bioequivalent studies.

References:

1. Notari R.E. “Biopharmaceutics and Pharmacokinetics - An Introduction” Marcel Decker.
2. Lachman L., Lieberman H.A., Kanig J.L. “The Theory and Practice of Industrial Pharmacy”. Varghese Publishing House.
3. Milo Gibaldi, “Biopharmaceutics & Clinical Pharmacokinetics" Lea & Febiger, Philadelphia.
4. Leon Shargel and Andrew B.C. “Applied Biopharmaceutics & Pharmacokinetics” Appleton Century-Crofts.
5. Swarbrick J. “Current Concepts in Pharmaceutical Sciences: Dosage form design and Bioavailability”. Lea & Febiger, Philadelphia.
6. Brahmankar D.M, Jaiswal S.B, “Biopharmaceutics and Pharmacokinetics-A Treatise”, Vallabh Prakashan, New Delhi.
7. Rowland and Tozer: “Textbook of clinical Pharmacokinetics”, Walter-Kluwer (India) Ltd, New Delhi, 2007
8. Jambhekar S.S. and Breen P.J. “Basic Pharmacokinetics”, Pharmaceutical Press, London, 2009
9. Bhise S.B., Dias R.J., Dhawale S.C. and Mali K.K. “Lab Manual of Biopharmaceutics and Pharmacokinetics, Trinity Publishing House, 2011
10. Niazi S. “Handbook of Bioequivalence Testing”, Informa Healthcare, New-York, 2007
11. Dr. Shobha Rani H., Sehgal R. and Dr. Rajat Sethi. “Elements of Pharmacovigilance”, Kongposh Publications, New Delhi
12. ICH Guidelines Website

3.5.3 Medicinal Chemistry-I

1. **Basic principles of medicinal chemistry:**
   Physiochemical properties of drug molecule and biological action (solubility, surface activity, dissociation constant, drug shape, bio-isosterism, molar refractivity, partition coefficient, hydrogen bonding, ionization, complexation protein binding).

2. **Introduction to receptor concept:**
   Introduction, affinity, receptor and biological response, drug-receptor interaction, forces involved in drug receptor interactions, receptor theories, conformational flexibility and multiple mode of action.

3. **Metabolism:**
   Introduction to drug metabolism
   Factors affecting drug metabolism (Genetic factors, Physiological factors, Pharmaceutical factors)
   Metabolic processes
   Phase I (Oxidation, Reduction, Hydrolysis)
   Phase II (Conjugation- Glucouronide, Acetylation, Methylation, Sulfate conjugation)

4. **The following classes of drugs should be studied in relation to:**
   Classification
   Chemical nomenclature
   Mechanism of action
   Synthesis of compounds with asterisk*
   Structure-activity relationship (SAR)
   Uses

a. Oral Hypoglycemic agents
First and second generation of Sulfonyl ureas, Tolbutamide*, Chlorpropamide*, Tolazamide, Acetohexamide, Glyburide, Glipizide, Glimepiride, Biguanides, Metformin, Phenformin.

b. Diuretics
Osmotic diuretics- Mannitol
Carbonic anhydrase inhibitors- Acetazolamide, Methazolamide, Dichlorophenamide.
Thiazide Diuretics- Chlorthiazide, Hydrochlorthiazide*, Chlorothalidone.
Loop diuretics- Ethacrynic acid, Furosemide*
Potassium sparing Diuretics- Spironolactone, Triamterene

c. Antiamoebic Agents
Ipecac Alkaloids- Emetine
Azole- Metronidazole*, Tinidazole
Others- Diloxanide furoate

d. Anthelmintics
Trematode diseases (Schistosomiasis) - Lucanthone, Hycanthone, Niridazole, Oxamniquine, Praziquantel.
Cestode disease (Tapeworm) - Niclosamide*
Nematode infections - Onchocerciasis ("river blindness") - Diethylcarbamazine
Gastrointestinal nematode infections - Benzimidazole like Mebendazoles*, Parabendazole
Others- Pyrantel pamoate, Levamisole

e. Antibiotics

β-lactam antibiotics- Penicillins - Penicillins-G and Penicillins-V, Amphicillin, Amoxicillin, Oxacillin, Cloxacillin, Dicloxacillin, Nafcillin. Methicillin, Becampicillin, Pivampicillin
Cephalosporins- Cephalexin, Cephalethin, Cefaxitin, Cefuroxime, Cefotaxime, Cefepine, cefpirone.
Tetracyclines
Macrolides
Aminoglycoside
Polypeptides
Lincomycins

References:

1. Chemistry by Ashutosh Kar, 1st edition, New Age International Publications.
2. Vogel's Elementary M.E. Wolf:Burger's Medicinal Chemistry, John Wiley and Sons, New York.
3. R.F. Doerge, Wilson & Gisvold's: Textbook of Organic Medicinal and Pharmaceutical Chemistry, Lippincott.
4. W.O. Foye: Principles of Medicinal Chemistry, Lea & Febiger, Philadelphia.
5. D. Lednicer and L.A. Mitschier: Ale Organic Chemistry of Drug synthesis Vol. 1, II & III John Wiley and Sons, New York.
6. S.N. Pandeya: A Textbook of Medicinal chemistry, Vol-I, S.G.Publishers, Varanasi.
7. Ashutosh Kar: Medicinal Chemistry, Wiley Eastern, Ltd., New Delhi
8. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry by Wilson and Gisvold, J. Lippincot Co. Philadelphia.
9. Medicinal Chemistry-A Biochemical Approach by Nogrady T, Oxford University Press New York, Oxford.
10. Antibacterial Chemotherapeutic Agents by SL Dax, Blackie Academic and Professional Publications, Chapman and Hall, 1997.
11. Principles of Medicinal Chemistry by Kadam SS, Mahadik KR, Bothara KG, Vol. I & II, 10 th Edition, Nirali Prakashan.
12. Introduction to Medicinal Chemistry' – How Drugs Act and Why by Alex Gringauz,
13. Willey-VCH Publication 1997.
14. Practical Organic Chemistry by Mann FC & Saunders BC, The English Language
15. Book Society and Longman Group Limited, London.
16. Vogel's A Text book of Practical Organic Chemistry by Vogel, 3rd edition, The English language book society and Longman group limited, London.
17. Advanced practical Medicinal Practical Organic Chemistry Small Scale Preparation by Arthur I.,2nd Edition, Part-I, CBS Publication.

3.5.8 Medicinal Chemistry-I

Synthesis and characterization (Melting Point, TLC, Element/s detection and Functional group tests) of the following compounds

1. 8-Hydroxyquinoline
2. Benzylideneacetophenone (Chalcone)
3. 2,3-Diphenylquinoxaline
4. Fluorescein
5. Dibenzylacetone
6. Coumalic acid
7. 7-Hydroxy-4-methylcoumarin

3.5.4 Pharmaceutical Analysis-III

1. **Basic concepts in Spectroscopy:**
   Introduction: Electromagnetic radiation, EMR spectrum, wavelength, wave number, frequency, atomic spectra, molecular spectra.

2. **UV-Visible absorption spectroscopy:**
   Introduction, Origin and theory of UV spectra, Bathochromic and Hypsochromic shift, Choice of solvents, Beer-Lamberts Law, Instrumentation: Light sources UV & Visible, Monochromators: Filters, Gratings. Cells: Silica, glass, quartz, Detectors: Photo tubes, Photo diodes. Readout system, Spectrophotometer: Single beam spectrophotometer, Double beam spectrophotometer, Standard absorptivity value, Use of calibration graph, Single or Double standardization, Optimum conditions for spectrophotometric measurements, Quantitative spectrophotometric assay of medicinal substances, assay of substances in multi component sample, Application to structural analysis with special emphasis on Woodward Feiser rule.

3. **Fluorescence Spectroscopy:**
   Introduction, Fluorescence spectra, Excitation and emission spectra, Instrumentation, Factors affecting fluorescence intensity, Quantitative aspects, Applications of spectrofluorimeters and photofluorimeters.

4. **Atomic absorption spectrophotometry:**
   Principle, Differences between atomic absorption spectroscopy and flame emission Spectroscopy, Advantages of AAS over FES, Instrumentation-Single and double beam Spectrophotometers, Limitation, Applications.

5. **Flame Photometry:**
   Principle, Instrumentation, Interferences in Flame Photometry, Applications.

References:

1. Bassett J, Denny R C, Jeffery G H, Mendharn J, Vogel's Textbook of Quantitative Inorganic Analysis, ELBS, Longman, London.
2. Grant- Statistical Quality control (McGraw Hill).
3. Beckett A H and Stenlake J B, Practical Pharmaceutical Chemistry Vol. I and II, The Anthlone Press of University of London.
4. Gary Christian- Analytical Chemistry (John Wiley).
5. Instrumental methods of Analysis- Ewing.
6. Higuchi & Brochmann- Hanssen- Pharmaceutical Analysis- (Interscience).
7. Garrat- The quantitative analysis of Drug (Toppan & Co.)
8. Analytical Chemistry an introduction, Skoog, West, Holler, 6th Edition.
9. Florey- Analytical profiles of drug substances (Academic press).
10. Vogel Text Book of Practical Organic Chemistry – 5th edition
11. Pharmaceutical Analysis Vol. II, A. V. Kasture, S. G. Wadhodkar, K. R. Mahadik, H. N. More, Nirali Publication.
12. Instrumental methods of Analysis- Willard, Dean, Merrit and settle- (Wadsworth Pub. Co.)
13. Merck Index
14. Pharmaceutical Drug analysis by Ashutosh Kar.
15. Principles of Instrumental analysis, Skoog, Holler, Nieman, 5th Edition.
16. IP, BP, USP, EP and International Pharmacopoeia.
17. Meites-Hand book of Analytical Chemistry (McGraw Hill).
18. Hamilton, Simpson and Ellis- Calculation of Analytical Chemistry (McGraw Hill).
19. Instrumental methods of Chemical Analysis by B. K. Sharma, 13th Edition.
20. Spectrometric Identification of Organic Compounds by Silverstein, Webster, 6th Edition.
21. P.S. Kalsi. Spectroscopy of organic compounds (New age international Ltd.)
22. William Kemp. Organic spectroscopy. (ELBS)
23. Instrumental methods of chemical analysis, G.R.Chatwal and S.K.Anand, Himalaya publishing house.

3.5.9 Pharmaceutical Analysis-III

1. Study of UV-Visible spectrophotometer, colourimeter, fluorimeter, flamephotometer.
2. Calibration of UV-Visible spectrophotometer as per I.P.
3. Assay of following formulations/ drugs using UV-Visible determination as per I.P.
   Paracetamol Tablet
   Rifampicin Capsule
   Albendazole Tablet
4. Colourimetric estimations: Any two
5. Assay by fluorimetry - Quinine sulphate.
6. Determination of Na^+ or K^+ from NaCl or KCl by flame photometry after preparing calibration curve.

3.5.5 Pharmacology-I

1. **General principles of pharmacology:**
   Introduction to Pharmacology- Definitions and scope of pharmacology.
   Nature and sources of drugs, Essential drug (medicine) concept.
   Routes of drug administration with special reference to their advantages and disadvantages.

2. **Pharmacokinetics:**
   Biological membranes- structure, types, properties and functions of biological membranes.
   Physicochemical factors and processes in transfer of drugs across the biological membranes.
   Drug absorption, Bioavailability, factors affecting Drug Absorption and Bioavailability.
   Distribution, Protein Binding and Storage of Drugs in body.
   Metabolism (Biotransformation) - General considerations, Phase-I & Phase-II, CYP-450 system, Enzyme Inhibition, Enzyme Induction.
   Excretion (Elimination).

3. **Pharmacodynamics:**
   Site and Mechanisms of drug action.
   Drug Receptors- Basic discussion about receptors, classification and families of receptors, Drug effects and regulation of receptors.
   Drug-receptor interactions and their effects, affinity, intrinsic activity and efficacy, dose response relationships and therapeutic index, biological half life.
   Drug Toxicity in man - Toxic effects of drugs on different systems, organs & tissues and its clinical significance.

4. **Pharmacology Autonomic Nervous System:**
   Autonomic Nervous system-General Considerations
   Cholinergic drugs
   Anti-cholinergic drugs
   Neuromuscular blocking agents
   Adrenergic drugs
   Anti-adrenergic drugs
   Ganglion stimulants and blockers
   Skeletal Muscle relaxants

References:

1. Satoskar R.S. and Bhandarkar S.D.: Pharmacology & Pharmacotherapeutics, Popular Prakashan, Bombay.
2. Tripathi K.D.: Essentials of Medical Pharmacology, Jaypee Brothers, Medical Publishers, New Delhi.
3. Goodman and Gillman: Pharmacological Basis of Therapeutics, McGraw-Hill, Medical Publishing Division, NewYork.
4. Rang H.P. and Dale M.M.: Pharmacology, Churchill Livingstone, Edinbergh.
5. Katzung B.G.: Basic and Clinical Pharmacology, Lange Medical Publications, California.
6. Bowman W.C. and Rand M.J.: Textbook of Pharmacology, Blackwell Scientific Publications, Oxford.
7. Craig C.R. and Stitzel R.E.: Modern Pharmacology, Little Brown and Co., Boston.
8. Melman K.I. and Morelli H.F.: Clinical Pharmacology: Basic Principles in Therapeutics, Macmillan Press, New York.
9. Laurence D.R. and Bennett P.N.: Clinical Pharmacology, Churchill Livingstone, Edinburgh.
10. P.N Bennett & M J Brown.: Clinical Pharmacology, Churchill Livingstone, Edinburgh.
11. Bevan J.A. and Thompson J.H.: Essentials of Pharmacology, Harper and Row Publishers, Philadelphia.

12. Drill V.A.: Pharmacology in Medicine, McGraw Hill Co., New York.
13. Grollman A.: Pharmacology & Therapeutics, Lea & Fabiger, Philadelphia.
14. Avery G.S.: Drug Treatment, Adiss Press, Sydney.
15. Das M.M. and Dutta S.K.: Ghosh's Modern Concepts on Pharmacology & Therapeutics, Hilton & Co., Calcutta.
16. Krantz and Carr: Pharmacology Principles of Medical Practice, Williams & Wilkins Co, Baltimore.
17. Pharmacopoeia of India (1985), Controller of publication, Delhi.
18. Pradhan S.N., Maickel R.P. and Dutta S.N.: Pharmacology in Medicine-Principles and Practice, S.P. Press International Inc., Maryland.
19. P Jagadish Prasad.: Conceptual Pharmacology, Universities Press(India), Pvt Ltd. Hyderabad.

3.5.6 Biotechnology

1. **Introduction:**
   Definition, scope related to pharmaceutical industry and achievements.

2. **Fermentation technology:**
   Construction and working of conventional fermenter, downstream processing, fermentation monitoring, in-situ recovery of fermentation products. Bioconversion and biotransformation, General applications of fermentation in manufacturing of antibiotics (Penicillin, streptomycin) dextran, Vitamin B12, Production of single cell proteins, Definition of BOD and COD

3. **Tissue culture:**
   Plant tissue culture - Introduction to plant cell, media & laboratory requirements for tissue culture Types of tissue and cell cultures: Callus, suspension, Protoplast culture & protoplast fusion, Germplasm storage & cryopreservation
   Animal tissue culture– Requirements, media, culture techniques for anchor dependant and anchor independent animal cells, passaging, trypsinization, preservation of cell cultures, cell growth.

4. **Enzyme technology:**
   Enzyme production, Methods for enzyme immobilization (adsorption. Covalent binding. Entrapment. Matrices with example) Applications.

5. **Genetic Engineering:**
   Central dogma (DNA replication, transcription and translation) Details of restriction endonuclease, Ligases, vectors (plasmid, cosmid), rDNA Technology, gene transfer, gene expression Polymerase chain reaction (PCR), DNA sequencing, Blotting techniques and electrophoresis, Gene machine, Production of Insulin, Human growth hormone, Interferon. DNA hybridization, Human gene therapy.

6. **Immunology and health:**
   Immunological products- vaccines & sera – definitions and classification outline of general method of preparation of bacterial & viral vaccines. Hybridoma technology and MAbs production, Applications of MAbs.

References:

1. U. Satyanarayana., Biotechnoligy, 1st Edition, 2005, Books and Allied (P) Ltd. Kolkata.
2. Trevan Keshav, Biotechnology, 4th Edition, 1990, New Age International Ltd. Pub., New Delhi
3. Casida L. E., Industrial Microbiology, 2000, New Age International, Delhi.
4. Freifelder David, Molecular Biology, 2nd Edition, 1998, Narosa Publishing House.
5. Kumar H. D., Textbook of Biotechnology, II Ed., 1991, East West Press Pvt. Ltd., New Delhi
6. Hugo W. B., Russell A. D., Pharmaceutical Microbiology, 6th Edition, 1998
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10. Singh B. D., Biotechnology, 2001, Kalyani Publisher.
11. Tortora, An introduction to microbiology, 9th edition, Pearson publication

3.5.10 Biotechnology

1. Industrial Microbiology

Soil sampling for micro-organisms and screening them for antibiotic/ enzyme (cellulose etc.) producing organism.
Fermentation of antibiotics / vitamins / wine.

2. Plant Biotechnology

Preparation of plant cell culture media
Development of callus or tissue culture

3. Molecular Biology

Replica plating for selection and isolation of bacteria.
Isolation of DNA / RNA / plasmid DNA from blood cells / plant cells or bacterial cells.
Quantitation of extracted DNA (OD_{260} / OD_{280})
SDS PAGE or Gel electrophoresis
Colorimetric estimation of DNA or RNA

4. Enzyme technology

Immobilization of enzymes and cells by calcium alginate/ Gelatin/ agar
Enzyme activity
Restrictional digestion activity of restrictional enzyme on DNA or RNA

5. Immunology

Antigen-Antibody reaction.

Semester-VI

3.6.1 Semisolid Dosage Forms

1. **Introduction:**
   Classification, structure of skin, penetration, absorption and bioavailability of drugs, factors affecting drug permeability.

2. **Ointments:**
   Ointment bases and their selection, properties of the drug and the base governing drug release from ointments, manufacturing processes and equipments, packaging and evaluation.

3. **Creams:**
   Definition, advantages and disadvantages, types, ingredients, formulation and stability of creams and evaluation.

4. **Gels and Jellies:**
   Definition, natural and synthetic gelling materials, types of gels, formulation and components, stability and evaluation.

5. **Paste:**
   Definition, advantages and disadvantages, types, ingredients, formulation and evaluation.

6. **Cosmetics:**
   Definition, Classification, Formulation and Evaluation of following preparations;
   Skin: Vanishing cream and cold cream.
   Eyes: eye shadow, Mascara.
   Lips: Lipstick.

References:

1. Banker and Rhodes. Modern Pharmaceutics, 4th ed 2002 Marcel Dekker Inc.
2. E.A.Rawlins: Bentley's Textbook of Pharmaceutics, University Printing House, Oxford, 1988.
3. James Swarbrick and James C. Boylan: Encyclopedia of pharmaceutical Technology, Marcel Dekker Inc. New York.
4. L. Lachman, H. A. Lieberman and J. L. Kaing: The Theory and practice of Industrial Pharmacy, Vargheese Publishing House, Mumbai, 1987.
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6. Martin: Physical Pharmacy, Varghese Publishing House, Mumbai, 1991.
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8. Remington's "The Science and Practice of Pharmacy", 20th Ed; 2000, Lippincott. Williams and Wilkins.
9. Sanju nanda, Arun Nanda, Roop K.khar, Cosmetic Technology, Birla publication, 2007.
10. E.G.Thomssen, Modern Cosmetics, Universal Publishing Corporation, 2006.

3.6.7 Semisolid Dosage Forms

Formulation, Preparation and Evaluation of the following dosage forms.

1. **Ointments:**

   Pain balm

   Antifungal ointment

   Medicated Gel

   Anti-acne preparation

   Non staining Iodine ointment with Methyl Salicylate

   Evaluation Parameters: pH, Spreadability & Organoleptic properties.

2. **Creams**: any two
3. **Gels**: any two
4. **Paste**: any two
5. Study of Batch Manufacturing Record

3.6.2 Medicinal Chemistry-II

The following classes of drugs should be studied in relation to:

Classification
Chemical nomenclature
Mechanism of action
Synthesis of compounds with asterisk*
Structure-activity relationship (SAR)
Uses

1. **Sulphonamides:**
   Sulphamethoxazole, Trimethoprim, Sulphacetamide, Sulphapyridine, Sulphasalazine, Sulphamoxol, Sulphafurazole, Sulphaguanidine, Sulphadoxine, Sulphadimidine

2. **Quinoline Antibacterial agents:**
   Nalidixic acid*, Norfloxacin, Ciprofloxacin, Sparfloxacin

3. **Anti-Tubercular And Antileprotic Agents:**
   Isoniazide*, Ethambutol, Pyrazinamide, Ethionamide*, Paraminosalicylic acid*, DOT (Direct Observation Therapy)

4. **Anti-Neoplastic Agents:**
   Alkylating agents like Mechlorethamine, Chlorambucil, Mitomycin C, Busulfan, Carmustine, Lomustine, Dacarbazine and Procarbazine.
   Antimetabolites like Azaserine, Methotrexate*, 5-Fluorouracil, Ara-C, 6-MP and 6-TG
   Antibiotics like Dactinomycin, Doxorubicin, Bleomycin
   Natural products like Vincristine, Vinblastine, Paclitaxel (only highlights of structure)
   Miscellaneous compounds like Cisplatin and some newer derivatives
   Note on Combination Therapy.

5. **Antivirals:**
   Viral replication
   Nucleoside derivative- Amantadine*, Iodoxuridine, Vidarabine , Acyclovir*
   Reverse transcriptase inhibitor
   Nucleoside derivative - Zidovudine, Lamivudine, Stavudine
   Nucleotide derivative – Tenofovir, Adefovir
   Non nucleoside - Nevirapine

6. **Antifungals:**
   Azole- Ketoconazole, Clotrimazole*, Fluconazole, Itraconazole, Griseofulvin, Tolnaftate, Flucytosine.

7. **Antimalarials:**
   Life cycle of parasite and drugs acting on the various stages
   Cinchona alkaloids - Artemisine and derivatives, Synthetic Antimalarials
   4-Aminoquinoline - Chloroquine* and others
   8-Aminoquinoline - Primaquine* and others
   9-Aminoacridine - Quinacrine
   2,4-Diamino pyrimidines - Pyrimethamine*, Trimethoprim
   Quninoline methanol derivative - Mefloquine
   Folic acid inhibitors

References:

1. Chemistry by Ashutosh Kar, 1st edition, New Age International Publications.
2. Vogel's Elementary M.E. Wolf:Burger's Medicinal Chemistry, John Wiley and Sons, New York.
3. R.F. Doerge, Wilson & Gisvold's: Textbook of Organic Medicinal and Pharmaceutical Chemistry, Lippincott.
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15. Book Society and Longman Group Limited, London.
16. Vogel's A Text book of Practical Organic Chemistry by Vogel, 3rd edition, The English language book society and Longman group limited, London.
17. Advanced practical Medicinal Practical Organic Chemistry Small Scale Preparation by Arthur I.,2nd Edition, Part-I, CBS Publication.

3.6.8 Medicinal Chemistry-II

Synthesis and characterization (Melting Point, TLC, Element/s detection and Functional group tests) of the following compounds:

1. *p*-Aminobenzoic acid
2. Sulpanilamide
3. Benzotriazole
4. Benzimidazole
5. 1,2,3,4-Tetrahydrocarbnole
6. Nicotinic acid / Isonicotinic acid
7. Phenyl toluene -*p*-sulfonate

3.6.3 Pharmaceutical Analysis-IV

1. Infrared spectroscopy:

I.R. regions, requirements for I.R. absorption, vibrational and rotational transitions, dipole changes, types of molecular vibrations, potential energy diagrams (harmonic oscillator and non-harmonic oscillator), Vibrational frequency, factors influencing vibrational frequencies, vibrational modes (normal mode, combination bands and overtone bands), Instrumentation: light source, frequency selector, sample preparation, detectors, double beam I.R. Spectrophotometer (schematic diagram), Qualitative applications (identification of functional groups, identity by fingerprinting).

2. Polarimetry:

Introduction to electromagnetic properties of lightwaves. monochromatic radiation, production of linearly polarized light, definitions – circular birefringence, left and right circularly polarized light, optical rotatory dispersion, molecular ellipticity, circular dichroism, Instrumentation: Light source, polarizer, sample cell, analyzer, Anisotropic crystals, Nicol's Prism, Determination of optical activity (Half shade effect), Applications.

3. Refractometry:

Specific and molar refraction, Refractive index, Measurement of angle of refraction, Instrumentation and applications.

4. Electrochemical Analysis:

Definitions of all types of electrochemical analysis.

Conductometry:

Introduction, measurement of conductivity, conductivity apparatus, conductometric titrations, applications of conductometric titrations & high frequency titrations

Potentiometry:

Introduction, Different types of electrodes, measurement of electrode potential and pH, Applications including potentiometric titrations.

Polarography: Introduction, Principle, Dropping Mercury Electrode and Other Mercury Electrodes, Polarogram, half wave potential, Linear Scan& Differential Pulse Polarography, applications covering non-aqueous polarography

Amperometry: Introduction, Instrumentation and Applications including amperometric titrations.

5. Thermal analysis:

Differential Scanning Calorimetry (DSC): Definition, Types, Instrumentation, Principle, applications. Thermogravimetric Analysis (TGA): Introduction, Definition, Types, Instrumentation, Principle, applications. Differential Thermal Analysis (DTA): Introduction, Definition, Principle Instrumentation, applications.

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5. Gary Christian- Analytical Chemistry (John Wiley).
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8. Garrat- The quantitative analysis of Drug (Toppan & Co.)
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13. Instrumental methods of Analysis- Willard, Dean, Merrit and settle- (Wadsworth Pub. Co.)
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15. Pharmaceutical Drug analysis by Ashutosh Kar.
16. Principles of Instrumental analysis, Skoog, Holler, Nieman, 5th Edition.
17. Latest editions of IP, BP, USP, EP and International Pharmacopoeia.
18. Meites-Handbook of Analytical Chemistry (McGraw Hill).
19. Hamilton, Simpson and Ellis- Calculation of Analytical Chemistry (McGraw Hill).
20. Instrumental methods of chemical analysis, G.R. Chatwal and S.K. Anand, Himalaya.
21. Spectrometric Identification of Organic Compounds by Silverstein-Webster, 6th Edition.
22. P.S. Kalsi. Spectroscopy of organic compounds (New age international Ltd.)

3.6.9 Pharmaceutical Analysis-IV

1. Study of polarimeter, conductometer, potentiometer.
2. Assay of dextrose injection by polarimetry.
3. To determine the specific rotation of sucrose of different concentrations and determine the intrinsic rotation.
4. Calibration of Refractometer and measurement of RI of some organic solvent.
5. Calibration of conductometer.
6. Conductometric titration (Strong acid Vs Strong base and Weak acid Vs Strong base).
7. Calibration of pH meter.
8. Potentiometric analysis: - pKa determination of phosphoric acid / boric acid.
9. Potentiometric titration of (Strong acid Vs Strong base and Weak acid Vs Strong base).
10. Demonstration experiments on identification of functional groups from IR spectra.

3.6.4 Pharmacology-II

Basic pharmacology (classification, mechanism of action, pharmacokinetics, pharmacological actions, adverse effects, contraindications, therapeutic uses, drug interaction, dosage, symptoms and treatment of poisoning) and Clinical Management of diseases and drugs acting on following categories:

1. **Drugs acting on Cardiovascular System:**
   Diuretics
   Congestive Heart Failure- Cardiac glycosides.
   Antihypertensive drugs.
   Antianginal and Vasodilator drugs, including calcium channel blockers and beta adrenergic antagonists.
   Antiarrhythmic drugs
   Antihyperlipedemic drugs
   Drugs used in the therapy of shock.

3. **Pharmacology of drugs acting on blood and blood forming organs:**
   Haemopoietics.
   Coagulants and Anticoagulants.
   Thrombolytics and Antiplatelet agents.

4. **Pharmacology of autacoids and their antagonists:**
   Histamine and histamine antagonists.
   5-HT and 5-HT antagonists.
   Kinins, and angiotensin.
   Lipid derived autocoids: Prostaglandins, Leukotrienes & Platelet Activating Factor.

5. **Drugs acting on Respiratory tract:**
   Drugs for the treatment of cough, bronchial asthma and COPD

6. **Drugs acting on Gastrointestinal tract:**
   Drugs for the treatment of peptic ulcers
   Drug therapy of Ulcerative colitis and Crohn's disease
   Emetics and antiemetics
   Drugs for the treatment of constipation and diarroehea

7. **Principles of Toxicology:**
   Definition of poison, general principles of treatment of poisoning with particular reference organophosphorous and atropine poisoning.
   Heavy metals and heavy metal antagonists

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5. Katzung B.G.: Basic and Clinical Pharmacology, Lange Medical Publications, California.

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3.6.5 Clinical Pharmacology

1. Introduction to Clinical pharmacology

2. Clinical Pharmacokinetics:

Definition and Scope
Dosage adjustments in patients with hepatic and renal failure
Chronic Pharmacology- Consequences of prolonged drug administration
Withdrawal symptoms due to discontinuation
Individualization of drug therapy

3. Evaluation of drugs in humans:

Experimental Therapeutics
Ethics of research
Rational introduction of a new drug
Need for statistics
Types of Trials, Designs and Size
Meta-analysis
Pharmacoepidemiology

4. Unwanted effects and adverse drug reactions:

Definition
Attribution and degrees of certainty
Sources of ADR, Allergy etc. in response to drug

5. Drug Interactions:

General considerations
Types of drug interactions
Factors contributing to the occurrence of drug interactions
Mechanisms of drug interactions
Using of drug interaction information

6. Clinical Case Studies:

COPD, Bronchial Asthma
CHF, Acute MI

7. Drug therapy in Pregnancy, Neonates, Paediatric and Geriatric Patients

References:

1. P.N Bennett & M J Brown.: Clinical Pharmacology, Churchill Livingstone, Edinburgh.
2. Melman K.I. and Morelli H.F.: Clinical Pharmacology: Basic Principles in Therapeutics, Macmillan Press, New York.
3. Herfindal E.P. “Textbook of Therapeutics: Drug and Disease Management”
4. Richard H. “Drug Interactions Guide”
5. Speight T.M. “Avery's Pharmacology”, 4th edition, Adis Press, Auckland, 1997
6. Wang H. and Chow S. C. “*Encyclopedia of Clinical Trials”*, Wiley, 2007
7. Katzung B.G.: Basic and Clinical Pharmacology, Lange Medical Publications, California
8. Seth S. D.: Textbook of Pharmacology, Elsevier Publications.
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11. Bhattacharya S.K, Parantapa S, Arunabha Ray: Pharmacology, Elsevier publication.
12. Harrison’s Principles of Internal Medicine.
13. Dipiro, Pharmacotherapy- A Pathophysiologic Approach.

3.6.6 Pharmacognosy-II

1. Introduction to Quantitative Microscopy with reference to leaf constants

2. General biosynthetic pathway of phytoconstituents along with various metabolites

3. Systematic Pharmacognostic study:
   Carbohydrates and derived products: Agar, Acacia, Isabgol, Starch
   Resins and their combinations: Benzoin, Cannabis, Ginger, Podophyllum, Turmeric
   Tannins: Black Catechu, Pale Catechu, Myrobalan, Bahera
   Lipids: Castor oil, Cod liver oil, Shark liver oil, Bees wax
   Volatile Oils: Fennel, Cassia, Clove, Cardamom, Mentha piperata, Musk.
   Natural pesticides: Neem, Pyrethrum, Tobacco
   Natural fibers: Cotton, Silk, Jute.

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2. Indian Herbal Pharmacopoeia, IDMA Publication
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4. Text Book of Pharmacognosy: T E Wallis
5. Text Book of Pharmacognosy: Trease & Evans
6. Text Book of Pharmacognosy: Kokate & Purohit.
7. Practical Pharmacognosy: C K Kokate
8. Practical Pharmacognosy: M.A Iyengar
9. Practical Evaluation of Phytopharmaceuticals: Brain & Turner
10. Harborne J.B Phytochemical Methods: A guide to Modern techniques.

3.6.10 Pharmacognosy-II

1. Quantitative microscopy
   Determination of stomatal index
   Determination of stomatal Number
   Determination of Vein islet Number
   Determination of Vein termination Number

2. Morphology, Microscopy (only T.S) and chemical tests of the following drugs:
   Ginger
   Fennel
   Cassia
   Clove

3. Systematic chemical analysis of following drugs
   Agar
   Acacia
   Benzoin
   Black catechu
   Pale catechu

4. Group Experiment
   Isolation and estimation of volatile oil contents