

SYLLABUS COPY FOR THIRD YEAR B. PHARM

SEMSETER V

PHARMACEUTICAL MEDICINAL CHEMISTRY – I

3 hrs/ week

S. No.	Topic	Hours
1.	Physiochemical properties and drug action	4
2.	Metabolism Discussion of the following classes of drugs including, classification, chemical nomenclature, structure including stereochemistry, generic names, chemistry, physiochemical properties, SAR, metabolism, molecular mechanism of action, introduction to rational development if any, of the class of drugs.	6
3.	Chemotherapeutic agents – a. Antitubercular agents – PAS*, ethonamide, isonamide, pyrazinamide, ethambutol*, antitubercular antibiotics (streptomycin, rifampin, viomycin and cycloserine – the first three only highlights of structure to be discussed). Combination therapy. b. Antileprotic drugs – dapsons* and clofazimine	6
4.	Antimalarials – Natural products like cinchona alkaloids (with stereochemistry and drug action) and artemisinin and its derivatives like artether and artemether and artesunate. Synthetic antimalarials such as 8-aminoquiacridines eg. Primaquine, Quinoline methanols eg mefloquine: misc, like halofantrine and lumefantrine: DHFR inhibitors like pyrimethamine* and cycloguanil and sulfonamides like sulfadoxine, sulfadiazine*, and sulfalene. Combination therapy.	5
5.	Antifungal agents – Natural products like griseofulvin, amphotericin B and nystatin (later two only general aspects of structure related to activity) and the antifungal azoles like clotrinazole, ketoconazole, fluconazole and itraconazole.	4
6.	Antibacterial agents a. Antibiotics – penicillins (natural and semisynthetic penicillins like Penicillin G, PenicillinV, ampicillin*, amoxicilline*, oxacillin, nafcillin, methacillin and ampicillin prodrugs like bacampicillin and pivampicillin), cephalosporins (cephalexin, cephalothin, cefaxitin, cefuroxime, cefotaxime, cefepine and cefpirome) tetracycline, chlortetracycline, oxytetracycline, doxycycline and miocycline and its prodrug – rolitetracycline); macrolides (erythromycin, rocithromycin, azithromycin – only highlights of structure to be discussed); aminoglycosides (gentamicins and neomycins – only highlights of structure to be discussed); Chloramphenicol. b. Sulfonamides – Short, intermediate and long acting sulfonamides, sulfonamides for ophthalmic infections, for burn	10

	therapy and for intestinal infections, ulcerative colitis and for reduction of bowel flora. c. Fluroquinolones like norfloxacin, ciprofloxacin*, sparfloxacin, gatifloxacin d. Oxazolidinediones	2
		1
	* indicates synthesis to be discussed	

Reference Books:

1. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, 11th Ed., Eds. John H Block and John M Beale, Lippincott Williams & Wilkins, 2004.
2. Foye's Principles of Medicinal Chemistry, Eds., T. L. Lemke and D. A. Williams, Williams & Wilkins, Baltimore, 2002.
3. Medicinal Chemistry, Ashutosh Kar, 4th Edition, New Age International Publishers, 2007.
4. The Art of drug Synthesis, Eds. Douglas S Johnson and Jie Jack Li, Wiley Interscience, 2007.
5. Pharmaceutical Chemistry, Vol. EDrug Synthesis Eds. H. J. Roth, A. Kleeman and T. Beissewenger, Ellis Horwood Ltd., 1988/
6. The Organic Chemistry of Drug Synthesis, Daniel Lednicer, Vols. 1 to 7, Wiley.

BIOCHEMISTRY III

3 hrs/ week

S. No.	Topic	Hours
1.	DNA replicator: Details of DNA replication, difference between prokaryotes and eukaryotes, telomeres and telomerases DNA polymorphisms and single nucleotide polymorphism. Examples with DNA or interfering with DNA replication. Solid phase DNA synthesis, DNA sequence (Maxim-Gilbert method, Sanger dideoxy method and automation of DNA sequencing)	8 5
2.	Protein Biosynthesis: Details of DNA transcription and RNA Protein, difference between prokaryote and eukaryotes, concepts of introns and exons and intron splicing, concept of posttranslational modifications (examples of glycosylated proteins, conjugated proteins, insulin). Examples of protein synthesis inhibitors used as drugs. Solid phase peptide synthesis, Edman reaction based protein sequencing and its automation.	7
3.	Enzyme kinetics: Classification of enzymes. Effects of enzyme concentration, substrate concentration, temperature, pH on enzyme reactions. General mechanisms of enzyme catalysis acid base catalysis, oxidation-reductions, proximity effects, transition state theory, etc. Michaelis – Menten equation and meanings of Km and Vmax and identification of inhibition patterns via LWB and Eadie	8

	Hofstee plots. Examples of drugs that enzyme inhibitors.	
4.	Metabolic regulation: Brief description of the following: Enzyme compartmentalization, kinetic factors, modification of enzymes for regulation, cascade systems, repression and induction of enzymes and their regulation via modulation of transcription and translation.	8

Reference Books:

1. Lehninger, Principles of Biochemistry, 4th Ed., Eds. Nelson D. L and Cox M. M. Replika Press Pvt. Ltd., India, 2007.
2. Biochemistry, Stryer L., 3rd Ed., W. H. Freeman & Co., 1988.
3. Harper's Biochemistry, 25th Ed., Murray R. K., Granner D. K., Mayes P. A. and Rodwell V. W., Appleton and Lange, USA, 2000.
4. Outlines of Biochemistry, 5th Ed., Eds. Conn E. Stumpf P. K., Bruening G and Doi Roy H. John Wiley & Sons, USA, 1987.
5. Textbook of Biochemistry with Clinical Correlations, 5th Ed., Ed. Devlin T. M., Wiley Liss, USA, 2002.

PHARMACOGNOSY I

3 hrs/ week

S. No.	Topic	Hours
1.	Origin, scope and history of Pharmacognosy	2
2.	Literature and information about official and related text available about herbals and drugs of natural origin concept of authentication of crude drugs	2
3.	Role of Pharmacognosy in allopathy and traditional systems of medicine, namely, ayurveda, unani, siddha, Chinese etc. and nutraceuticals, cosmetic etc.	3
4.	Introduction to medicinal botany with respect to barks, wood, root, fruit, seed, flower, leaves etc. Methods of classification and their significance in the study of drugs of natural origin (alphabetical, biological, chemical, taxonomical, chemataxonomical, and pharmacological) and sources of drugs of nature origin (Plant, animal, mineral and marine with one example of each class).	6
5.	Pharmacognosy of crude drugs Cultivation, collection, preparation, drying, storage, and quality control of drugs of natural origin. Commerce and trade of drugs of natural origin.	6
6.	Methods of extraction (percolation, maceration, soxhlet etc.) of different classes of phytochemicals from crude drugs. Introduction to newer techniques of extraction.	4
7.	Primary and secondary metabolites and their biosynthetic pathways. Study of terpenoids, fixed oils, shikimic acid pathway, acetate hypothesis and polyketides with one example of each class.	6
8.	Plant cell structure with respect to cell organelles and cell contents	4

	such as starch grains, calcium oxalate crystals, idoblasts etc.	
9.	Introduction to plant tissue culture and its technique and applications plant growth regulators and hormones.	3

Reference Books:

1. Trease D. & Evans W. C.: Text Book of Pharmacognosy: W. B. Saunders.
2. Tyler V. E. Brady L. R. & Robbers J. E.: Pharmacognosy; Lea Feibger, USA.
3. Wallis T. E.; Text Book of Pharmacognosy; CBS Publishers, Delhi.
4. Kokate C. K., Purohit A. P. & Gokhale S. B.: Pharmacognosy; Nirali Publications, Pune.
5. Harbone J. B.: Phytochemical Methods: A guide to modern techniques Analysis: Chapman & Hall, London.
6. Bruncton J.: Pharmacognosy, Phytochemistry, Medicinal Plants: Intercept Limited.
7. Vasudevan T. N. & Laddha K.S.: A Textbook of Pharmacognosy, Vrinda Publication House, Jalgaon.
8. The Indian Pharmacopeia: The Controller of Publication; Delhi.
9. Brain K.R. & Turner T. D.: The Practical Evaluation of Phytopharmaceuticals: Wright, Scientica, Bristol.
10. Iyenger M.A. & Nayak S. G.: Anatomy of Crude Drugs: Manipal Power Press Manipal.
11. Iyenger M. A. : Pharmacognosy of Powdered Drugs; Manipal Power Press, Manipal.
12. Kokate C.K.: Practical Pharmacognosy; Vallabh Prakashan.
13. Wagner, Blatt & Zgainski; plant Drug Analysis; Springer Verlag.
14. Khandelwal K. R.: Practical Pharmacognosy Techniques and Experiments; Nirali Prakashan, Pune.
15. Vasudevan T. N. Laddha K. S.: Practical Pharmacognosy; New Vrinda Publishing House, Jalgaon.

PHARMACEUTICS IV

3 hrs/ week

S. No.	Topic	Hours
1.	Tablets <ul style="list-style-type: none"> • Definition Advantages and Limitations Preformulation aspects • Tablet formulation and design additives excipients with examples • Large scale manufacturing with equipments-for drying, mixing, Direct compression, Granulation, Dry Granulation (Slugging And Roller Compaction) • Compression – (Single station tablet press and Rotary press), Physics of tablet compression (brief), Processing problems, in tableting, Layout of tablet section. • Tablet types: Effervescent, Buccal, lozenges, chewable, sublingual, Dispersible, soluble, Orodispesible Q. C. of Tablets. 	2 3 7 5 4
2.	Capsules	6

	<ul style="list-style-type: none"> • Hard capsules – Raw materials, gelatin manufacturing (brief), manufacturing of hard capsule shells, size, sealing, storage, Mention of gelatin substitute – vegetarian capsules, Hard capsule fill formulation aspects, Large scale manufacturing filling of hard capsule shells, filling equipments with examples (stress or principle of equipments), Packaging – strip & Blister packaging equipments. Q. C. tests, Layout of capsule section. • Soft Gelatin Capsules- Raw material Gelatin- desirable properties, Soft Capsule- properties, nature of shell & contents, Large scale manufacturing- Rotary Die Process Packaging Q.C. tests. 	
3.	<p>Acrosols-</p> <ul style="list-style-type: none"> • Definition, advantages & disadvantages, desirable features. • Components – Propellants-types, selection, two phase & three phase systems. Containers – Tin Plate, Aluminum, Glass, Plastics, Valve, & Actuator Standard valve (detail) & specialized valves (in brief), Product concentrate Different formulation systems- solution, Dispersions, Foams Powders. 	5

Reference Books:

1. Aulton Michael E., "Pharmaceutics The Science of Dosage Form Design", 2nd Edition, 2002, Churchill Livingstone Publishers.
2. Lieberman Herbert A., Lachman Leon, Schwartz/ Joseph B., "Pharmaceutical Dosage Forms - Tablets", Volume 1/2/3, 3rd Edition, 2005, Marcel Dekker Inc., New York.
3. Lachman Leon, Lieberman Herbert A, Kanig Joseph L., "The Theory and Practice of Industrial Pharmacy", 3rd Edition 1987, Varghese Publishing House, Mumbai.
4. E. A. Rawlins, Ed., Bentley's Textbook of Pharmaceutics, 8th Edn, Ballierwe Tindall, 1995.
5. Ridgways K., Hard capsules- Development & Technology, Pharmaceutical Press London, 1987.

HOSPITAL PHARMACY AND DRUG STORE MANAGEMENT

3 hrs/ week

S. No.	Topic	Hours
1.	Hospital pharmacy – history and development, Duties and responsibilities of hospital pharmacist.	1
2.	Hospitals, classification, organization, Administration and functions.	1
3.	Pharmacy and therapeutics committee: Objective, composition and function	2
4.	Hospital formulary: Advantage, disadvantage, preparation, contents a few examples.	2
5.	Purchasing procedure, storage and inventory control	2
6.	Dispensing of controlled substances: Hospital control procedures	1
7.	Prepackaging, manufacturing and bulk compounding of large volume	2

	parenterals, total parenteral nutrition and intravenous additives.	
8.	Central sterile service: Advantages, plan, location, Sterilization and disposal of surgical materials. Sterilization of rubber gloves, syringes, needles, catheters, surgical instruments, powders and other materials.	2
9.	Medical gases: Therapeutic use of gases; colour coding of cylinders, care of cylinders and accessories.	1
10.	Health accessories: Wheel chairs, canes, crutches, bedpans, vaporizers, syringes, needles, clinical thermometers, first aid suppliers.	1
11.	Clinical applications of radiopharmaceuticals: Introduction to particulate radiation, half life, therapeutic and diagnostic radiopharmaceuticals, and facilities required protection of operators.	2
12.	Use of computers in hospitals	1
13.	Introduction to Pharmacy Practice <ul style="list-style-type: none"> • Pharmacy Trade or Profession • Reorientation from Product to Patient Focus 	1
14.	Code of Ethics for a Pharmacist	1
15.	Community Pharmacy :Scope in India and Abroad	2
16.	Channel's of distribution <ul style="list-style-type: none"> • Wholesalers & Retailers and Their role. Classification, Functions and Services. 	2
17.	Forms of business Organization (in brief) Hindu Undivided family, Sole proprietorship, Partnership, Company and Co-operative Society.	2
18.	Entrepreneurship: Trails of Entrepreneur and Development as an Entrepreneur	1
19.	Location analysis	1
20.	Layout Design (Exterior and Interior)	1
21.	Purchasing and inventory Control (Methods, restricted to retail only viz., Want Book, Systematic Want Book, Open to Buy Budgeting, ABC, VED and EOQ Analysis. Use of computers for inventory control)	2
22.	Sales Promotion	1
23.	Risk Management & Insurance Policies for Shopkeeper	1
24.	Frauds in Retail Practice: How to prevent them	1

Reference Books:

1. "Principles and methods of pharmacy management" Smith, Lea and Febiger.
2. "Drug store and management" Nolen and maynard, Mcgraw Hill, 1941.
3. "A Textbook of pharmacy management" Tomiski (Kugan page).
4. "Drug Store and Business Management" A. P. Battase, Unique Publication. Battase Unique Publication, 1999.
5. Hospital pharmacy: William E. Hassan, 5th Edition, Lea & Febiger, Philadelphia.

6. A textbook of Hospital: S. H. Merchant and Dr. J. S. Quadry, 4th Edition, B. S. Shah Prakakshan, Ahmadabad, 2001.
7. Hospital Pharmacy: Dr. H. P. Tipnis and Dr. Amrita Bajaj, First Edition, Career Publication, Maharashtra, 2007.
8. Gennaro Alfonso R., "Remington: The Science and Practice of Pharmacy", 20th Edition, 2000, Published Lippincott Williams & Wilkins.

PHARMACEUTICAL BIOTECHNOLOGY

3 hrs/ week

S. No.	Topic	Hours
1.	Introduction to Biotechnology, Historical Perspectives, Definitions, Scope, Relevance to Pharma Industry	1
2.	Microbiological Limit tests-Need, Standards for raw materials of natural origin (pharmacopoeial with some examples)	1
3.	Microbiological assays- Basic principles, some examples.	2
4.	Immunology- <ul style="list-style-type: none"> • Host-microbe interactions, Introduction to terms-infection, infestation, pathogen, resistance, susceptibility etc. • Factors affecting pathogenicity and infection, organization of immune system-organs & cells involved. • Innate defence mechanism – first line of body defence, physiological phenomena-inflammatory response, fever, cellular, mediators; soluble (humoral) mediators, phagocytosis. • Specific Defence Mechanism – Characteristics, Antigen, Cell-mediated immunity, Humoral immunity-antibody structure and types, Pathways of immune response, Clonal selection theory • Hypersensitivity & Allergy • Immunodeficiency states- Primary & acquired, Autoimmunity. • Introduction to diagnostic markers. • Serology-precipitin tests, agglutinin, complement fixation. Tests, immunofluorescence, RIA, ELISA • Immunological products-Vaccines & Sera- Definitions and Classification, Outline of general method of preparation of bacterial & viral vaccines, Typical Examples of each type, Q. C. aspects, Recent trends in vaccines. 	12
5.	Fermentation Technology- Example of products of fermentation (microbial, animal and plant), types of fermenters, design of fermenter, factors affecting fermentation and down stream process, Production of penicillin, dextran, amylase, Introduction to single cell protein, biological oxygen demand.	4
6.	Introduction to rDNA technology- Details of restrictions endonuclease, SI nuclease, Ligase, Alkaline phosphatase, Vectors (Plasmid, cosmid, YAC), Gene expression	6

	(Bacterial expression system, Yeast expression system, animal expression system, Plant expression system) Application of rDNA technology for production of Pharmaceutical products e.g. Insulin, human growth hormone, interferon	
7.	Techniques used in molecular biology- Introduction to polymerase chain reaction, DNA sequencing, cDNA library, genomic library, blotting techniques, electrophoresis.	4
8.	Introduction to gene therapy, transgenic animal and transgenic plants, Site directed mutagenesis.	2
9.	Definition of enzyme and cell immobilization, methods for enzyme immobilization (adsorption, covalent binding, entrapment, matrices with example), example of immobilization, introduction to biosensor with immobilized enzyme e.g. glucose oxidase, penicillinase.	3
10.	Introduction to Hybridoma technology – Production and application of monoclonal antibody, animal cell culture with diagnostic applications	1

Reference Books:

1. A textbook of biotechnology by R. C. Dubey.
2. Biotechnology by B. D. Singh.
3. Pharmaceutical Biotechnology by S. P. Vyas and dixit
4. Pharmaceutical Biotechnology by S. S. Kori.
5. Biotechnology by H. D. Kumar.
6. A textbook of microbiology by Ananthnarayan.
7. Pharmaceutical Microbiology by W. B. Hugo and A. D. Russell.
8. Lehninger principle of Biochemistry by David, Nelson.
9. Pelezar, Chan & Krieg, Microbiology-Concepts and Applications, International Edn., McGraw Hill, Inc., 1993.
10. Weir Stewart: Immunology, 8th Edn., Churchill Livingstone, 1997.

PHARMACOLOGY II

3 hrs/ week

S. No.	Topic	Hours
1.	Introduction to Chemotherapy Basic principles of chemotherapy Mechanism of action of chemotherapy agents Mechanism of resistance to chemotherapeutic agents	6
2.	Antibacterial drugs Sulfonamides and Trimethoprim Quinolones & Fluoroquinolones Penicillins, cephalosporins & cefamycins & other β lactum antibiotics Tetracyclines Chloramphenicol Aminoglycosides Erythromycin	8

	Macrolides	
3.	Chemotherapy of following diseases Amoebiasis Malaria Helminthiasis e. Tuberculosis & leprosy f. Fungal infection g. Viral disease h. Cancer	12
4.	Drugs used in endocrine disorders - Antidiabetic agents - Antithyroid agents - Oxytocics - Oral contraceptives - Bone Metabolism & Drugs used in Osteoporosis (Bone Structure & Composition, Bone Remodeling, disorders of Bone and Drugs used in Treatments)	10

Reference Books:

1. Goodman & Gilman's Pharmacological Basis of Therapeutics- Joel G. Hardman, Lee E. Limbird, Alfred Goodman GillMan 11th Edition, The McGraw – Hill Companies Inc., 2001.
2. Satoskar, R. S. Bhandarkar S. D. & Rege N. N. Pharmacology & Therapeutics – 20th Edition, Popular Prakashan, 2007.
3. Rang & Dale Pharmacology, 5th Edition, Churchill Livingstone, 2003.
4. Lippincott's Illustrated Reviews: Pharmacology – Lippincott – Raven 3rd Edition Howland & Nycets Publishers N Y, 2006.
5. Lewis Pharmacology – By Crossland – 5th Edition, Churchill Livingstone
6. Laurence, D. R. & Bennet Clinical Pharmacology- 9th Edition, Elsevier, N. Y., 2006.
7. Kulkarni, S. K. Handbook of Experimental Pharmacology – 3rd Edition Vallabh Prakashan New Delhi, 2005.
8. B. G. Katzung – Basic and Clinical Pharmacology, 9th Edition Appleton and Lange publication, 2004.
9. Gosh M. N. – Fundamentals of Experimental Pharmacology, 3rd Edition, Hilton & Company, Calcutta, 2005.

PHARMACEUTICAL CHEMISTRY LABORATORY – I

4 hrs/ week

Introduction/ transformation of functional groups in molecules

1. Acetylation (synthesis of aspirin & acetanilide or benzanilide)
2. Bromination (synthesis of p-bromoacetanilide or p-nitrobromobenzene)
3. Nitration (synthesis of p-nitroacetanilide or m-dinitrobromobenzene)
4. Oxidation (synthesis of benzoic by oxidation of toluene or benzyl alcohol with alkaline potassium permanganate)
5. Bromination (synthesis of sodium toluene-p-sulfonate or p-Nylenesulfonate acid)

6. Reduction (Ketones, synthesis of benzhydrol by reduction of benzophenone with zinc and sodium hydroxide) **or** synthesis of m-nitroaniline by partial reduction of m-dinitrobenzene with sodium polysulfide.
7. Esterification (synthesis of n-butylacetate from n-butanol and acetic acid)
Demonstration of reaction monitoring by TLC.

PHARMACUTICS LABORATORY III

4 hrs/ week

- 1.A) Evaluation of excipients-bulking agent, directly compressible diluents, conventional Bulk density, flow properties, compressibility and discussion of observations
- B) Evaluation of excipients – disintegrating agents
Swelling index determination and discussion of observations.
- C) Evaluation of excipients of tablet-Lubricants glidants
2. Granulation for Soluble aspirin tablets IP and evaluation
3. Granulation compression and evaluation Riboflavin in tablet IP 96
4. Granulation, compression and evaluation of Chewable antacid tablets.
5. Granulation and Compression of Ascorbic acid tablets IP 96
6. Granulation, compression and evaluation of Paracetamol tablets IP 96
7. Dissolution test for paracetamol tablets IP.
8. Evaluation of Capsule shells, filling of ampicillin trihydrate capsules and their evaluation.

BIOCHEMISTRY LABORATORY II

4 hrs/ week

Colorimetric estimation of blood sugar, blood cholesterol
 Estimation of protein by Biuret method and Folin Ciocalteu method
 Estimation of RNA
 Estimation of Vitamin E and Vitamin C
 Extraction of enzymes, Partial purification by alcohol, acetone precipitation, ammonium sulphate precipitation, Study of factors affecting rate of an enzymatic reactions: Effect of activators, inhibitors, or rate of enzymatic reaction, Determination of K_m of any one enzyme, Assay of alkaline phosphatase, α -amylase, protease, polyphenol, oxidase, lipase
 Chromatographic separation of amino acids.

PHARMACEUTICAL BIOTECHNOLOGY LABORATORY

4 hrs/ week

Air Microbiology by solid and liquid impingement methods

Coliform Count of water by MPN technique

Test for Sterility as per IP

Microbial Limit test on Excipients as per I.P. – Hard Gelatin Capsule Shells, Tragacanth, Starch, Lactose

Studies on selective media: McConkey Agar, Cetrimide Agar, Vogel Johnson and Medium for *S typhi*

Antibiotic Sensitivity test by disc method

Widals test tube agglutination method

Biochemical Tests (Catalase, Oxidase, Urease, Nitratase, Protease, Amylase and IMVIC)

Antimicrobial assay of antibiotic, introduction to zone of inhibition and calculation

Immobilization of enzymes and cells by calcium alginate, gelatin and agar

Isolation of DNA

Selection and isolation of bacteria by replica plating

Determination of thermal of bacteria b replica plating

Effect of Ultra-Violet exposure on growth of E coli

Demonstration of electrophoresis either by PAGE or Agarosegel electrophoresis