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 – dapsone* 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 sulfodoxine, 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); aminopglycosides (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. Michaclis – Menten equation and meanings of Km and Vmax and identification of inhibition patterns via LWB and Eadic	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, soxchlet 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, Bladt & 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 • 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 tabletting, 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

	• 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.	Acrosols- • Definition, advantages & disadvantages, desirable features. • Components – Prepellants-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 • 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 • 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- • 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, immunoflueroscence, 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, dextram, 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, penecillinase.	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 - Oxytocies - 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 LABORATOY 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 glidents
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 Ciocalteau 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

SEMSETER VI

PHARMACEUTICAL MEDICINAL CHEMISTRY – II **3 hrs/ week**

S. No.	Topic	Hours
1.	Steroids – Configuration 5 α and 5 β cholestane, conventional formula and conformational representation. Reactions in ring A & B of steroids – conformation and chemical reactivity, addition, elimination, epoxide opening, relative rates of esterification and oxidation of epimeric alcohols and reduction of ketones, rearrangement reactions, Medicinal chemistry of steroids: Sex hormones (androgens like testosterone and its esters: estrogens like estradiol, ethinyl estradiol and mestranol: progestines like medroxy progesterone acetate, megesterol acetate, norethindrone and norgestrel), anabolic steroids like danazol, stanozolol and androizoxazole: non steroidal estrogens like diethylstilbestrol and cholotrianisene, antiestrogens like tamoxifen and clomiphene, corticoids and steroidal antoflammatory like cortisone, hydrocortisone, prednisolone, dexamethasone, betamethasone and triameinolone.	9
2.	Antihistamines H_1, H_2 receptors. Emphasis to be on the second generation H1 antagonists such as fexofenidine, astemazole, loratidine cetrizine and acrivastine, H2 receptor antagonist like cimetidine*, ranitidine, famotidine, nizatidine, proton pump inhibitors like omeprazole and lansoprazole.	4
3.	Diureties a. Site 1 - Carbonic anhydrate inhibitors acetazolamide*, methazolamide. b. Site 2 - High ceiling or loop diuretics is sulfamoyl anthranilic acids like furosemide*, azosemide and bumetanide in phenoxyacetic acids ethacrynic acid* c. Site 3 - Thiazide and Thiazide like diuretics d. Site 4 - Potassium sparing diuretics such as spironoloactone triamterene and amiloride	5
4.	Local Anesthetics a. Amino esters – procaine, tetracaine, benzocaine b. Amino amides – lidocaine*, mepivacaine, bupivacaine c. Amino ethers – pramoxine d. Alcohols – Benzyl alcohol, eugenol	3
5.	Hypoglycemics (Insulin not to be discussed) 1. Biguanides e.g. metformin b. Sulfonylurea's 1st Generation like tolbutamide *, cholorpropamide, tolazamide and acetohexamide: 2nd Generation like glyburide, glypizide, 3rd Generation like glimepride and repaglimide. 2. Thiazolidinediones such as troglitazone, ciglitazone, rosiglitazone and pioglitazone 3. β – Glycosidase inhibitors like acarbose, voglibose and miglitol.	4

6.	Antiviral agents including HIV – ara-A, indoxuridine*, amantadine*, acyclovir, ganciclovir and ribavirin, HIV agents –both non-nucleosides like nevirapine & delaviridine and nucleosides like AZT and protease inhibitors like indinavir, saqvunavir, ritonavir (only highlights of structure). Combination therapy	4
7.	Antineoplastics a. alkylating agents like mechlorethamine, chlorambucil*, cyclophosphamide*, mitomycin C, busulfan, carmustine, lomustine, dacarbazine and procarbazine. b. Antimetabolites like azaserine, methotrexate*, 5-fluorouracil, ara-C, 6-MP and 6-TG c. Antibiotics like dactinomycin, doxorubicin, bleomycin, and other natural products like vincristine, vinblastine, paclitaxel (only highlights of structure to be discussed) d. Miscellaneous compounds like cis-platin and some newer derivatives e. Combination therapy	7
	* 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 Principals 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. 1: Drug 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, John Wiley.

PHARMACEUTICAL ANALYSIS III — 3 hrs/ week

S. No.	Topic	Hours
1.	**Basic concepts in spectroscopy-** Introduction: Electromagnetic radiation and interaction with matter, electronic spectra, wavelength, wavenumber, frequency, absorbance, transmittance, photometers, spectrophotometers.	2
2.	**UV-Vis absorption spectroscopy-** electronic transitions and UV spectra, chromophores, Auxochromes, bathochromic and hypsochromic shifts, hyperchromism and hypochromism, Beer-Lamberts law (Definition, derivation of mathematical expression, limitations), Applications of Beer's law to single component analysis	15

	and multicomponent analysis (calibration graph, standard absorptivity value, single standardisation, double standardisation, simultaneous equation method, difference spectroscopy, derivative spectroscopy), effect of solvents, Instrumentation- Light sources, Filters, monochromators, cells, detectors, single beam and double beam spectrophotometers, with block and ray diagrams.	
3.	**Fluorescence spectroscopy-** origin of fluorescence and phosphorescence spectra, singlet and triple states, factors affecting fluorescence intensity, Quantitative fluorescence intensity, applications, Instrumentation-light sources, primary and secondary filters, monochromators, detectors.	3
4.	**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 anharmonic 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).	6
5.	**Electrochemical methods-** Theory, Introduction, Instrumentation and Applications of: • Coulometry • Polarography & Pulse polarography • Amperometry • Electrogravimetry	10

Reference Books:

1. Skoog-Principals of Instrumental Analysis, 4th edition, Saunders College Publishing, 1992, USA.
2. Willard H.H.L. L. Merrit & John A. Dean-Instrumental Method of Analysis, 6th edition, 1986, CBS Publishers & Distributors, New Delhi.
3. Ewing Galen W-Instrumental Method of Chemical Analysis, 3rd edition, 1969, Mc Graw Hill Book Company, New York.
4. Beckett & Stenlake-Practical Pharmaceutical Chemistry, 4th edition, 1988, CBS Publishers & Distributors, India.
5. Vogel textbook of Practical Organic Chemistry 4th edition, 1984, Flbs & Longmans, London.
6. James W. Munson-Pharmaceutical Analysis: Modern methods, Marcel Dekker Inc., 1981, USA

PHARMACONOSY II **3 hrs/ week**

Drugs mentioned in bold are for detailed study

S. No.	Topic	Hours
1.	Evaluation and Significance of quality control of drugs of natural origin (DONO) Study of organoleptic, microscopic, physical, chemical and biological methods of evaluation, Physicochemical parameters such as moisture content, ash value, acid insoluble ash, heavy metals content and pesticides residue, microbial bioburden etc. for crude drugs with respect to pharmacopeias. Introduction to W.H.O. guidelines and monographs of drugs of natural origin.	7
2.	Detailed morphology and microscopy of organized drugs and evaluation parameters for unorganized drugs mentioned in bold.	5
3.	Quantitative microscopy, Lycopodium spore method, Leaf constants, camera lucida, diagrams of microscopic objects to the scale with camera lucida.	3
4.	Detailed study of carbohydrates with respect to chemistry, sources preparation and uses. All cellulose derivatives, starches, honey, inulin, alginic acid, gums **(tragacanth, acacia, sterculia, Nanthan, guar)**. Mucilages **(agar,isapghol, linseed) malt and malt extract**, dextram, **pectins,** chitin, hyaluronic acid, Study of sources, constituents and uses of carbohydrate containing herbs i.e. fig, bael, (Cassis latin fistula, tamarkind kernel powder (TKP).	4
5.	Introduction to organic acids, fruits (citrus, tamarind, garcinia, amla).	2
6.	Introduction to Pesticides of natural origin – Introduction study of following with respect to their occurrence, chemistry and applications, **Pyrethrum**, nicotin, **neem**, Red squill.	2
7.	Study of chemistry, classification, extraction, properties, sources and uses of Tannins. Detailed pharmacognostic study and application of **galls, catechu** (pale and black), **Kino**, arjuna, ashoka, harda, behra	2
8.	Study of Lipids (Waxes, fats, fixed oils) their chemistry and classification. Study of following with respect to sources, extraction & composition of lipids and uses: Arachis, castor, sesame, **linseed**, jajoba, olive, almond, mustard, wheatgerm, cottonseed, coconut, safflower, sunflower, croton, neem, rice bran, hydnocarpus, cod halibut and sharkliver oil, Study of kokum butter, coca butter, woolfat, spermaceti wax, beeswax, carnuba wax, lecithin.	5
9.	Hydrocarbons Introduction to composition, properties & sources of alkanes, isoalkanes and anti isoalkanes, alkenes, ethylene, polyacetylenes (stearolic acid, falcarinone, dehydro matricaria esters, thiophenes from tagetes).	2

10.	Study of sources, structure and properties of sulphides from Allium species (A. cepa & A sativum)	2
11.	Study of structure, occurrence and uses of essential amino acids, Study of peptides, proteins, protein hydrolysates, Sources, preparation and uses of gelatin.	2

Reference Books:

1. Trease D. & Evans W.C.: Textbook of Pharmacognosy; W.B. Saunders.
2. Tyler V.E., Brady L.R. & Robbers J.E.: Pharmacognosy; Lea Feibger, USA.
3. Wallis T.E.: Textbook of Pharmacognosy: CBS Publishers, Delhi.
4. Kokate C.K. Purohit A.P. & Gokhale S.B.: Pharmacognosy: Nirali Publications, Pune.
5. Harbone J.B.: Photochemical Methods: A guide to modern techniques of Plant Analysis: Chapman & Hall, London.
6. Bruneton 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 Pharmacopoeia: 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, Bladt & Zgainski: Plant Drug Analysis: Springer Verlag.
14. Khandelwal K.R.: Practical Pharmacognosy Technique and Experiments: Nirali Prakashan, Pune.
15. Vasudevan T.N. Laddha K.S.: Practical Pharmacognosy: New Vrinda Publishing House. Jalgaon.

PHARMACEUTICS V — 3 hrs/ week

S. No.	Topic	Hours
1.	Tablet coating • Need for tablet coating • Sugar coating – Raw materials, steps in detail, coating defects/problems • Film coating – Raw materials, Aqueous film coating, defects/problems • Enteric coating • Coating Equipments – Conventional & modified pans, coating columns (fluidized bed coating), Spray equipment & other accessories. • Q.C. of coated tablets.	12
2.	Microencapsulation • Definition, need/ reasons, concepts of core & coat • Methods with equipments - Wuster process, coacervation-	7

	phase separation, spray drying and related processes, interfacial polymerization, multiorifice centrifugal process, pan coating, solvent evaporation.	
3.	Biological products • Sutures & Ligatures - definition, classification, catgut manufacturing & processing - details, other absorbable sutures (brief), Non absorbable types - silk, linen, polyamides, polyesters, polyolefins, metallic wires, Q.C. testing of sutures & ligatures. • Blood products - Need, problems/ hazards, Blood banking procedures. Whole human blood, Red cell cone, cone of platelets. Plasmapheresis, plasma, serum, Fractionation of plasma, Study of some fractions – clotting factors like Fibrinogen, AHF, Factor IX complex, Prothrombin, Albumin preparations, γ globulin preparations. Q.C. aspects of blood products. • Plasma substitutes (Plasma volume expanders) – need, properties desired, examples-hydrolyzed gelatin based products, HETA starch, Dextran (in detail) Glandular products • Insulin – extraction from pancreas, purification, insulin injections (official) • Thyroid – Processing & product (official) • ACTH preparations • Oxytocin and vasopressin	4 6 3 4

Reference Books:

1. Lachman Leon, Lieberman Herbert A. kanig Joseph L., “The Theory and Practice of Industrial Pharmacy”, 3rd Edition 1987, Varghese Publishing House, Mumbai.
2. Deasy Patrick B., “Microencapsulation and Related Drug Processes”, Volume 20, 1984, Marcel Dekker Inc., New York.
3. Cole G “Pharmaceutical Coating Technology”, Taylor & Francis Ltd. Bristol, PA, 1995.
4. Isaac Ghebre-Sellassie, “Pharmaceutical Pelletization Technology”, Volume 37, 1989, Marcel Dekker Inc., New York.
5. E. A. Rawlins, Ed., Bentley’s Textbook of Pharmaceutics, 8th Edn., Ballierwe Tindall, 1995.
6. S. J. Carter Ed., Tutorial Pharmacy, Cooper & Gunn, 6th Edn., CBS Publishers & distribution, India, 1986.
7. Remington, The science and practice of pharmacy, 21st ed., Vol I & II, B. L., Publications Pvt. Ltd., 2005.

COSMETICOLOGY **3 hrs/ week**

S. No.	Topic	Hours
1.	Definition of cosmetics Historical background Classification of cosmetics and functions	1
2.	Structure of skin, hair, nails and skin appendages and interaction with cosmetics.	2
3.	Toxicology of cosmetics-irritation and sensitization reaction to cosmetics, tests to predict such reactions Microbiological aspects of cosmetics	2
4.	A brief review on perfumes, colors and other raw materials used in cosmetics.	2
5.	Study of following cosmetics with respect to raw materials, formulation, processing and quality control: • Personnel hygiene products- pedicure and manicure preparations, dental care preparations including tooth paste, tooth powder, mouth washes and denture cleaners, antiperspirants and deodorants. • Facial makeup products- skin creams and lotions including cleansing cream, cold cream, vanishing cream, foundation makeup, bleach cream, face powder, roage, lipstick, eye makeup, face packs, and moisturizers. • Protective preparations-hand and body creams and lotions, barrier preparations and emollient preparations, sunscreen and antisunburn preparations, insect repellants. • Hair care preparations- shampoo, women's and men's hair dressing, hair tonics and hair conditioners, hair rinses, hair colorants, hair waving and straightening preparations. • Miscellaneous preparations- Introduction to depilatories shaving preparations, nail products, bath oils, baby cosmetics, antilice preparations, herbal cosmetics. • Schedule S of drug and cosmetics Act in relation to cosmetic manufacture, hygiene, pollution control-ecological concern.	4 9 4 5 6 1

Reference Books:

1. Harry's Cosmetology, 7th Ed., edited by J.B. Wilkinson & R.J. Moore, Longman Singapore, Publishers Pvt. Ltd.

2. Cosmetics- Science and Technology, Vol 1,2 & 3 M.S. Balsam & Edward Sagarin Ed., 2nd edition, Wiley Interscience publications, 1972.
3. Cosmetics-Formulations, Manufacturing & Quality Control by P.P. Sharma – 3rd edition, Vandana Publications Pvt. Ltd., 2005.

PHARMACEUTICAL MANAGEMENT 3 hrs/ week

1. Basic principals and types of viable Business and enterprise. Health care industry - positioning the pharmacist fit in the industry Major players, major brands, Core, auxiliary and allied products and marketing, Major Components of Pharma business

   (Lectures 3)

2. Financial management, Source of funds, basics of balance sheet and profit an loss account.
   Product: DPCO, Costs of inputs in a product, Direct/ indirect, Activity based costing, Taxes, cost benefit analysis of a product, SWOT analysis of a product in competitive market, National budget.

   (Lectures 3)

3. Product Cost, value of a product, Market economics, COST OUTPUT relationship, PROFIT Management, Pricing analysis, Pricing policy Performance management Materials and Inventory management Vendor development, Stock audits.

   (Lecturers 3)

4. Quality management: FDA regulations and approvals, WHO requirements, General awareness of Global requirements of MHRA/ MCA/ TGA/ USFDA/ ISO up gradation. Six sigma concept, Product and process environment Management.

   (Lecturer 3)

5. Market research process. Market forecasting process. Analysis of Volume and growth of Peripheral markets: Nutraceuticals.
   Cosmeceuticals implants.

   (Lecturer 3)

6. Marketing and sales: uniqueness of medical products marketing. Role of retail chemist, distributors, stockist, wholesaler, C & F agents, what is a market, a market share, competitive marketing.
   Change in offing-malls, chain of corporate retails outlets, Brands and Generic market.

   (Lecturer 6)

7. Export market management: market search, preparations and Development, Regulated and unregulated market requirements Continents and Countries for Global market, Hospitals, Govt./ Corporate purchasers, ESIS schemes , NGOs.

   (Lecturer 3)

8. Role of product development and clinical research, Major Diseases and major molecules, Clinical research, patent registration, IPR, PRODUCT and PROMOTIONAL POLICIES.

   (Lecture 4)

9. Other regulatory requirements Factory Act., Pollution Act., Fire-safety and hazard management Hazaop study, (MSDS) safety data sheets.

(Lecturer 3)

10. Leadership, Motivation, Delegation, communication, Conflict management, Shop floor management.

(Lecture 3)

11. Management concepts that help to create value Ps: product, place, price, people, packing, pace, Organization- ZS concept.

(Lecturer 2)

Reference Books:

1) Marketing Management 12th edition by Kotler, Loshy & Jha.
2) Marketing Management 2nd edition by Dr. Rajan Saxena.
3) Introduction to Marketing Management by Adrian Palmer.
4) Financial Management by Prasanna Chandra.
5) Financial Management by I. M. Pandey.
6) Human Resource management by Ashwathapa.
7) Personnel & Human Resource Management by Subba Rao.
8) Production & Operations Management by K. Ashwathapa.
9) Production & Operations Management by S. N. Chary.
10) Production & Operations Management by S. A. Chunawala.
11) Business Logistics/ Supply Chain Management by Ronald Ballon.
12) Introduction to Supply Chain Management by Robert Hanfiels.

PHARMACOLOGY III — 3 hrs/ week

S. No.	Topic	Hours
1.	Autonomic nervous system - Brief introduction to Anatomy and Physiology of ANS - Adrenergic agents (Sympathomimetic agents) - adrenergic blocking agents - Cholinergic drugs (Cholinomimetic agents e.g. Anticholinesterases) - Antochoilinergic drugs a) Muscarrinic drugs b) Nicotinic blockers - Drugs acting at neuromuscular junction (skeletal muscle relaxants) - Drugs acting on autonomic ganglia (stimulants and blockers)	18
2.	Cardiovascular system Drugs used in the treatment of: Hypertension Congestive cardiac failure Angina pectoris Cardiac arrhythmias	14

	Drugs used in the treatment of hyperlipoproteinaemia	
3.	Diuretic drugs	6

Reference Books:

1. Goodman & Gilman's Pharmalogical Basis of Therapeutics – Joel G. Hardman. Lee E. Limbird, Alfred Goodman Gill Man 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 Livingston 2003.
4. Lippincott's Illustrated Review Pharmacology - Lippincott - Raven 3rd Edition Howland & Nyeets 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 and 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.

PHARMACOLOGY LABORATORY I — 4 hrs/ week

S. No.	Topic	Hours
1.	Experiments a) Dose Response Curve (DRC) of any agonist (eg. Ach/ Histamine) using a suitable isolated tissue preparation. b) L V infusion a simulated model using rubber tube mounted on a wooden board (the students are taught to calculate the dose and concentration to be used, actual dilution for preparation of infusion, setting of L V, infusion including cannulation, setting of drop rate, for infusion over a given period of time) * Indian Journal of Pharmacology, Vol 39 (I), Feb. 2007: 57-59. (Free Full text available at www.jip-online.com)	
2.	Demonstration a) effects of drug on isolated frog heart (CD's/ actual) - Adrenaline, Acetylcholine - Atropine Propranolol - Effect of excess of calcium and potassium on isolated heart - Effect of lack of Ca, K on isolated heart - Effect of digitalis on hypodynamic heart b) Stimulated experiment (CD's) Expharm - effect of drug on eye - effect of drug on GI motility c) Demonstration with the help of CD's or Kymograph recordings	

	- Effect Neostigmine on DRC of Ach - Effect of Panecuronium on DRC of Ach **(Give the reading to the students and ask them to plot the graphs and draw the conclusion from the results, eg. Identify type of antagonism existing between two drug by studying the nature of the graph, competitive and non competitive** **Find out the potency of the drugs by studying the DRC by studying IC 50 values)** Calculation of P^A2 value for atropine using Ach as agonist.	
3.	Tutorials Laboratory Animal Handling Care and Ethics in Animal experimentation.	

Reference Books:

1. Kulkarni, S. K. Handbook of Experimental Pharmacology, 3rd Edition Vallbh Prakashan, New Delhi, 2005.
2. Gosh M. N. Fundamentals of Experimental Pharmacology, 3rd Edition, Hilton & Company, Calcutta, 2005.
3. S. B. Kasture. A Handbook of Experiments in Pre-Clinical Pharmacology, 1st Edition, Career Publications, 2006.
4. W. L. M. Perry, Pharmacological Experiments on Isolated Preparations, 2nd Edition, E & S Livingstone, Edinburgh & London, 1970.

Websites:

Indian journal of Pharmaceutical education and research, Vol. 41 (1), Jan-Mar, 2007; 52-61 (www.ipper.org)

PHARMACOGNOSY LABORATORY I — 4 hrs/ week

S. No.	Topic	Hours
1.	Quantitative estimation by lycopodium spore method a) Determination on number of particles (starch grains/ stone cells/ lignified fibers) in given sample of crude drugs. b) Determination of %purity of ginger powder. c) Histochemical identification of starches (maize, rice, wheat, potato)	3
2.	Identification and Measurement of dimensions of different types of starch grains and calcium oxalate crystals, trichomes and stomata.	1
3.	Leaf constants – Stomatal index, stomatal number, palisade ratio, vein islet number, veinlet termination number.	3
4.	Determination of alcohol soluble and water soluble extractives, total ash value and acid insoluble ash and water soluble ash value for any one crude drug as per I.P.	3
5.	Identification of unorganized drugs by chemical tests (agar, acacia, tragacanth, gelatin, sterculia, pale catechu, black catechu and Kino)	1

6.	Detection of adulterants fixed oils	1
7.	Visit to medicinal plant garden	2
	Total	**14**

COSMETICOLOGY LABORATORY 4 hrs/ week

Formulation – Processing, Packaging and Evaluation of cosmetic preparations.

1. Skin cleansers
   - Cleansing milk
   - Clear cleansing gel
2. Skin moisturizers
   - Cold cream
   - Hand and body lotion
   - Moisturizing lotion
3. Suncare products
   - Medicated dusting powder
   - Sunscreen cream
4. Facial cosmetics
   - Vanishing cream
   - Foundation lotion
   - Eye shadow
   - Lipstick
5. Hair care products
   - Clear liquid shampoo
   - Antidandruff shampoo
   - Men's hair dressing preparation
6. Nail care products
   - Nail Lacquer
   - Nail Lacquer remover
7. Shaving preparations
   - Lather shaving cream
   - Brushless shaving cream
   - Aftershave lotion
8. Dental care products
   - Tooth paste
   - Medicated toothpaste
   - Mouthwash
9. Herbal cosmetics
   - Powder face scrub
   - Antiwrinkle cream
   - Antiacne cream