

UNIVERSITY OF MUMBAI

No.UG / 149 of 2008

CIRCULAR :-

A reference is invited to the Ordinances, Regulations and Syllabi relating to the Bachelor of Pharmacy (B.Pharm.) degree course vide pamphlet No. 187 and to this office Circular No.UG/228 of 2002 dated 21st May,2002 and No.UG/175 of 2007 dated 3rd May,2007 and the Director, Mumbai University Institute of Chemical Technology and the Principals of the affiliated colleges in Pharmacy are hereby informed that the recommendation made by the Ad-hoc Board of Studies in Pharmacy at its meeting held on 16th February,2008 has been accepted by the Academic Council at its meeting held on 27th February,2008 vide item No,4.39 and that, in accordance therewith, the syllabus for the Second Year, Third Year and Fourth Year (Sem.III to VIII) of the B.Pharm. degree course is revised as per Appendix and that the same will be brought into force with effect from the academic year 2008-2009 and progressively thereafter.

MUMBAI-400 032

4th April,2008

for I/c. REGISTRAR

To,

The Director, Mumbai University Institute of Chemical Technology and Principals of the affiliated colleges in Pharmacy.

A.C./4.39/27.02.2008

No.UG/ 149 - A of 2008, MUMBAI-400 032

4th April,2008

Copy forwarded with compliments for information to :-

- 1) The Dean, Faculty of Technology
- 2) The Chairman, Ad-hoc Board of Studies in Pharmacy
- 3) The Controller of Examinations,
- 4) The Co-Ordinator, University Computerization Centre,

for I/c. REGISTRAR

Copy to :-

The Director, Board of College and University Development, the Deputy Registrar (Eligibility and Migration Section), the Director of Students Welfare, the Executive Secretary to the Vice-Chancellor, the Pro-Vice-Chancellor, the Registrar and the Assistant Registrar, Administrative sub-center, Ratnagiri for information.

The Controller of Examinations (10 copies), the Finance and Accounts Officer (2 copies), Record Section (5 copies), Publications Section (5 copies), the Deputy Registrar, Enrolment, Eligibility and Migration Section (3 copies), the Deputy Registrar, Statistical Unit (2 copies), the Deputy Registrar (Accounts Section), Vidyanagari (2 copies), the Deputy Registrar, Affiliation Section (2 copies), the Director, Institute of Distance Education, (10 copies) the Director University Computer Center (IDE Building), Vidyanagari, (2 copies) the Deputy Registrar (Special) and the Academic Authorities Unit (2 copies) and the



UNIVERSITY OF MUMBAI



Revised Syllabus
of
(Sem. III, IV, V, VI, VII, & VIII)
of
B.Pharm degree course

**(With effect from the academic year 2008-2009
and progressively thereafter)**

SECOND YEAR B. PHARM SEMESTER III
ANATOMY, PHYSIOLOGY AND PATHOPHYSIOLOGY – III

3 hrs/week

Sr.no.	Topics	Hours
1.	Nervous System Anatomy and physiology of : - Central Nervous System (CNS) - Peripheral Nervous System (PNS) - Autonomic Nervous System (ANS) - Properties of Neurons, Neurotransmitter and neurotransmission - Cranial and spinal nerves - Sensory and Motor pathways	9
2.	Definition and Etiology of following diseases in detail - Epilepsy - Parkinsonism - Alzheimer's Disease - Cerebral Hypoxia - Stroke (Cerebrovascular disease) - Anxiety & Depression - Mania and Schizophrenia	7
3.	Structure and Function of following sensory organs - Eye - Ear - Tongue - Nose - Skin	6
4.	Digestive System - Parts of digestive system, their structure and functions - Digestion and absorption of carbohydrates, proteins and fats - Phases of gastric secretion	8
5.	Definition and Etiology of following diseases in detail - Peptic ulceration - Zollinger – Ellison's Syndrome - Inflammatory Bowel Disease (Ulcerative colitis, Crohn's disease) - Cholecystitis & Cholelithiasis - Jaundice - Hepatitis - Pancreatitis - Achalasia - Reflux esophagitis	6

REFERENCES

1. Ross & Wilson Anatomy & Physiology in Health & Illness. 10th Edition. Anne Waugh. Allison Grant, Churchill Livingstone Elsevier, 2006
2. Tortora & Grabowaski Principles of Anatomy & Physiology. 11th Edition. J Wiley & Sons, 2007
3. Guyton & Hall Textbook of Medical Physiology. 10th Edition. Harcourt Singapore, 2001
4. B. R. Mackenna & R. Callander Illustrated Physiology. 6th Edition. N Y Churchill Livingstone, 1997
5. Kaplan, Jack, Opheim, Toivola, Lyon Clinical Chemistry: Interpretation & Techniques. 4th Edition. Williams & Williams, London 1995.
6. Praful B. Godkar, Darshan P Godkar Textbook of Medical Laboratory Technology. 2nd Edition. Bhalani Mumbai, 2006
7. P. C. Dandiya & P. K. Sharma Biochemistry & Clinical Pathology (Theory & Practical).
8. Russel J. Greene & Norman D. Harris Pathology & Therapeutics for Pharmacists: A Basis for Clinical Pharmacy Practice. 2nd Edition, Pharmpress NY, 2000
9. Ranade & Joshi Manual of Practical Physiology, Pune Vidyarthi Gruha Prakashan.
10. Eric Herfindal, Dick Gourley, Text Book of Therapeutics: Drug and Diseases Management. 7th Edition, Lippincott Williams & Wilkins, A Wolters Kluvers Company.
11. Cotran, Kumar and Collins, Robins- Pathologic Basis of diseases, 6th Edition, W B Saunders Company.
12. The Merck Manual of Medical Information, Home Edition, Merck Research Laboratories, Division of Merck & Co Inc, White House Station, N J, 1997.

ORGANIC CHEMISTRY-III

3 hrs/week

Sr. No	Topic	Hours
1.	Stereochemistry Optical isomerism: representation of molecules by Fischer, Newman and Sawhorse projection formulae R, S and D, L notations, diastereomers and resolution of racemic mixtures. Geometrical isomerism E and Z nomenclature. Conformers of ethane, n-butane and cyclohexanes (mono and disubstituted cyclohexanes to be discussed), aspects of stability and optical activity	16
2.	Name reactions Aldol condensation, Nitroaldol Claisen condensation Michael addition Dieckmann's cyclisation, Stobbe, Reformatsky, Knoevenagel, Perkin, Cannizzaro, Beckmann, Lossen, Curtius, Bayer-Villiger, Favorskii, Hoffman, Wolff, Schmidt, Wittig, Benzilic acid rearrangement, Sommolet, Stevens, Pinacol. Problems based on the transformations to be solved	20

REFERENCES

1. Stereochemistry of Carbon Compounds, E. L. Eliel, Tata McGraw-Hill Publishing Co. Ltd., 1986.
2. Stereochemistry, Conformation and Mechanisms, P. S. Kalsi, 4th Ed., New Age International Publishers, 2001.
3. Strategic Applications of Named reactions in Organic Synthesis, L. Kurti and B. Czako, Elsevier Science & Technology Books, March 2005
4. Organic Chemistry, S. H. Pine, 5th Ed., Tata McGraw Hill Publishing Co. Ltd., 2007.
5. Principles of Organic Synthesis, R. O. Norman, 2nd Ed., Chapman and Hall, 1978.
6. Organic Chemistry, John McMurry, 5th Ed., Brooks/Cole, Thomson Learning, 1999.
7. Organic Chemistry, Francis Carey, 5th Ed. McGraw Hill

PHARMACEUTICAL ANALYSIS II

3hrs/week

Sr. No.	Topic	Hours
1.	Types of errors Concepts of errors: Mean, median, standard deviation, relative standard deviation, Absolute and relative errors, precision, accuracy, significant figures, Determinate and indeterminate errors and the ways to minimize them, Variables in analytical chemistry and scope of pharmaceutical analysis.	4
2.	Solvent extraction Principle, factors affecting liquid-liquid extraction (Solvent, method of extraction, stripping and pH effect, , salting out effect, etc). Soxhlet extraction, Countercurrent Distribution, Batch extraction, Continuous extraction, Multiple extractions, applications (alkaloids, sodium benzoate, pilocarpine nitrate, any one nasal drops)	6
3.	Refractometry Snell's law, Definitions of specific and molar refraction, factors affecting measurement of refractive index (pressure, wavelength, temperature), Principle (Grazing angle of incidence, Critical angle of refraction), different types of refractometers (Abbes, Pulfrich, Dipping type) with construction and working of Abbes refractometer in detail, Applications.	4
4.	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, analyser, Anisotropic crystals, Nicol's prism, Determination of optical	6

activity (Half shade effect), Applications.	
Principles of Gravimetric Analysis Theory: Mass as measurement signal and precipitation equilibria. Unit operations in gravimetric analysis, organic and inorganic precipitants, factors affecting gravimetric analysis, Calculations-Gravimetric factor, Applications: Assay of Nickel by dimethylglyoxime and assay of aluminium by oxine reagent, assay of Ba^{+2} as BaSO_4	6
Miscellaneous- Oxygen flask combustion method- (I.P apparatus, analysis of organically bound halogens, sulphur and phosphorus, assay of di-iodo hydroxy quinoline)	3
Aquametry- Different types of water present in a sample, analysis of water by Karl Fischer titrations, toluene distillation method, oven drying), Karl Fischer titrations- preparation of KFR reagent as per I.P, standardisation of KFR as per I.P, Stability of KFR, application for Ampicillin trihydrate)	4
Kjeldahl's method- (Apparatus, methods of digestion of sample, application-anyone from I.P).	3

REFERENCES

1. Vogel textbook of Practical Organic Chemistry-4th edition, 1984, Elbs & Longmans, London.
2. Beckett & Stenlake-Practical Pharmaceutical Chemistry, 4th edition, 1988, CBS Publishers & Distributors, India.
3. Gary Christian-Analytical Chemistry, 4th edition, 1986, John Wiley & Sons, New York.
4. Takeau Higuchi and Finar Brochmann Hanssen-Pharmaceutical Analysis, 1st edition, 1997, CBS Publishers & Distributors.
5. METTES H.B. of Analytical Chemistry, 1st edition, 1963, Mc Graw Hill Book Company, New York.
6. Grant, Eugene L, Leavenworth, Richard S, -Statistical Quality Control, 4th edition, 1972, Mc Graw Hill Kogakasha Limit, Tokyo.
7. I.P, U.S.P, B.P, European Pharmacopoeia.

Sr. No	Topic	Hours
1.	Carbohydrates Definition, biological roles, aldoses and ketoses, trioses to hexoses, D-L notation, Fischer and Haworth projection formulae (glucose as example), Monosaccharides ranging from trioses to hexoses (Fischer projection, names and abbreviations of common sugars), Reactions of carbohydrates – optical properties, oxidation, reduction, hemiacetal/hemiketal formation, acetate/ketal formation, glycosides, acid catalyzed rearrangement, base catalyzed rearrangement, hydrazone formation, mutarotation, anomeric carbon, Disaccharides and polysaccharides – introduction to structures of simple compounds and their biological role (sucrose, maltose, lactose, cellulose, starch, amylose), Unusual sugars like glucose amine, muramic acid, etc.	10
2.	Proteins Definition, biological roles, amino acids – types, structures, names, three letter abbreviations, one letter codes, unusual amino acids, Reactions of amino acids – acid base behavior, isoelectric pH, optical activity, N-acylation, ninhydrin reaction, reaction with fluorodinitro benzene, dansyl chloride reaction, Edman reaction, Schiff base formation, esterification, side chain reactions, Peptides and proteins, peptide bond and its special properties, introduction to primary, secondary, tertiary and quaternary protein structure and their features in brief.	10
3.	Nucleic acids Definition of DNA and RNA, nitrogenous bases, nucleosides, nucleotides, structure of DNA, shorthand notation of DNA polymers, melting and annealing of DNA, brief introduction to semiconservative replication and information flow via mRNA to proteins, Types of RNA – mRNA, tRNA and rRNA – their structure and their biological role.	6
4.	Lipids Definition, biological roles, fatty acids – saturated, unsaturated, shorthand notation, common fatty acids, Properties of fatty acids – physical properties, formation of esters, triacylglycerols, fats vs oils, acid value, iodine value, ester value, rancidity, hydrolysis of fats, hydrogenation of oils, Compound lipids – phospholipids, sphingolipids, glycolipids, Structure and biological roles of some common compound lipids, Introduction to terpenoids – fat soluble vitamins and cholesterol.	6
5.	Vitamins Detailed description of the mechanisms involved in the biochemical roles of vitamins A, D, E, K, B1, B2, Niacinamide, B6, biotin, folic acid, ascorbic acid, lipoic acid, inositol and pantothenic acid, Biological role of B12 (without structure).	4

REFERENCES

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., Eds. 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.

PHARMACEUTICS III

3hrs/week

Sr. No.	Topics	Hours
1	Biphasic Dispersed Systems: Physicochemical principles – thermodynamic, instability of dispersed systems • Suspensions- definition, advantage & disadvantage, desirable features Theoretical (Preformulation) aspects – wetting phenomena, particle – particle interactions, DLVO theory, flocculated and deflocculated systems, Schulze Hardy Rule, Sedimentation in suspensions, Crystal Factors, Rheology Preparation of suspensions- Precipitation methods and Dispersion method, Formulation Additives, Large scale manufacture with equipments, Q.C. tests including stress testing, Layout, Example formulations- official preparations	12
	• Emulsions – Definition, advantage & disadvantage, Theoretical aspects- interfacial tension, need for emulsion, Theories of emulsification, Droplet stabilization, Mechanism of emulsifiers, selection of emulsifiers – HLB, Davies method, PIT method, cloud point determination, classification of emulsifiers with examples, other additives, Rheology aspects, Manufacturing- large scale with equipments., packaging, stability of emulsions, Q.C. tests& stress tests, layout Examples – Official preparations.	8
2	Semisolids • Introduction • Introduction to anatomy of Skin. • Functions of skin • Percutaneous absorption and penetration, - • Factors influencing percutaneous absorption --- Physiological and physicochemical factors • Methods used to evaluate percutaneous absorption. • Permeation enhancers. • Ointments, Ointment Bases, Pastes, Gels, Poultice,	10

	• Selection of bases – Large scale manufacturing and processing with Equipments. • Q.C. testing, Examples of preparation	
Suppositories	• Definition, advantage & disadvantage, desirable features • Anatomy of Rectum in brief & rectal absorption • Suppository bases- features desired, Classification and selection, Special Bases • Manufacturing and packaging, Q.C. tests • Example- formulations	6

REFERENCES

1. Lachman Leon, Lieberman Herbert A, Kanig Joseph L., "The Theory and Practice of Industrial Pharmacy", 3rd Edition 1987, Varghese Publishing House, Mumbai.
2. Lieberman Herbert A., Rieger, "Pharmaceutical Dosage Forms – Dispersed Systems", Volume 1/2/3, 2nd Edition, 2005, Marcel Dekker Inc, New York..
3. Remington, The science and practice of pharmacy, 21st ed., Vol I and II, B. L. Publications Pvt. Ltd., 2005.
4. Martin A., Physical Pharmacy, 4th Ed., Lea & Febiger, Philadelphia.London, 2006
5. M.E. Aulton, Ed. Pharmaceutics-The Science of Dosage Form Design, Churchill Livingstone Medical Divn. Of Longman Group, UK Ltd., 2002.

PHARMACEUTICAL ENGINEERING II

- Only principles and equipments to be covered
- No mathematical derivations and numerical problems

3hrs/week

Sr. No	Topic	Hours
1	<u>Fluidization</u> • Theory of fluidization	2
2	<u>Extraction</u> : Solid- Liquid and Liquid- Liquid Extraction • Mechanism and method of extraction process and factors affecting extraction process. • Equipments employed in solid- liquid extraction-Soxhlet extractor, Open tank, Agitated tank, Vortical or Turbo extractor, extraction battery and Robert diffusion battery, Rotocel extractor, Bollman extractor, Bonotto extractor, Screw extractor and Hilderbrandt extractor. • Equipments employed for Liquid-Liquid extraction-Mixer settler, Spray columns, Packed columns, Agitated columns, Podbielniak extractor.	6

3	<u>Distillation:</u> • Vapor-Liquid equilibrium • Distillation methods- Equilibrium distillation. Simple distillation Fractional distillation- Theory of batch fractionation, Columns (only construction and working)-Plate columns- bubble cap, sieve plate column, Packed columns. Concept of plate efficiency and HETP (no detailed theories and derivations) Distillation under reduced pressure- Theory of molecular distillation and equipments Falling film and centrifugal molecular distillation still, applications. Azeotropic and Extractive distillation- Theory of azeotropic and extractive distillation, applications such as dehydration of alcohol Steam distillation- Theory of steam distillation and applications of steam distillation such as methods of separation of volatile constituents and preparation of aromatic water, purification of high boiling liquids.	6
4	<u>Crystallization:</u> • Crystal forms and crystal habits • Theory of crystallization-Supersaturation- Mier's theory of supersaturation, Nucleation, Crystal growth • Crystallizers- Classification, Tank crystallizers Agitated tank crystallizers, Swenson Walker crystallizer, Vacuum crystallizer and its modifications such as circulating magma and DTB crystallizer, Krystal or Oslo crystallizer. • Caking of crystals	5
5	<u>Evaporation:</u> • Heat transfer process in boiling liquids in evaporators • Evaporators- Pan evaporators, Horizontal tube evaporator, Short tube vertical evaporator, Multiple effect evaporator, Climbing film evaporator, Falling film evaporator, Forced circulation evaporator, Wiped film evaporator, Evaporator accessories-condensers, vacuum pumps, expansion and bucket traps, Entrainment separators, Vapor recompression, Scale formation.	6
6	<u>Drying:</u> • Mechanism and theory of drying • Dryers- tray dryer, vacuum tray dryer, tunnel dryer, Rotary drum dryer, Spray dryer, Freeze dryer, Fluidised bed dryer	4
7	<u>Pollution from Pharmaceutical Industry:</u> Air pollution and prevention- • wet scrubber, dust collector.	3

	Water pollution • Bulk drug manufacture- dirty water, acids and alkalis, dissolved salts, organic chemicals. • Formulation manufacturing- sterile products, liquid dosage forms, solid dosage form, fermentation products, radiological products. • Waste treatment processes- segregation, neutralization and pretreatment, dissolved salt removal, preacration, biological treatment.	
8	<u>Industrial hazards and safety:</u> • Fire Hazards and extinguishers • Chemical hazards and extinguishers • Mechanical and electrical hazards • Accidents – unsafe action and unsafe condition • Prevention of accidents	4

REFERENCES

1. K. Sambamurthy , Pharmaceutical Engineering, New age international (P) limited publishers, 1998.
2. Dr. A. R. Paradkar , Introduction to Pharmaceutical Engineering, 10th edition, Nirali Prakashan, 2007.
3. James Swarbrick & James C. Boylon, Encyclopedia of Pharmaceutical Technology, Marcel Dekker, INC, New York, 1994.
4. Walter L. Badger & Julius T. Banchero, Introduction to Chemical Engineering, Mc. Graw Hill Inc., 1955.
5. M.E. Aulton, Ed, Pharmaceutics-The Science of Dosage Form Design, Churchill Livingstone Medical Divn. Of Longman Group, UK Ltd., 2002.
6. S.J. Carter , Cooper and Gunn's Tutorial Pharmacy, 6th edition, CBS Publishers & Distributors, New Delhi, 2005.
7. Robert H. Perry, Don W. Green, Perry's Chemical Engineers' Handbook, 7th edition, Don W. Green, Jamess O. Maloney, Mac Graw Hill, 1997.

MATHEMATICS-I

3hrs/week

Sr.No.	Topics	Hours
1	Differential calculus: Successive Derivatives' Leibnitz's rule forth th derivative, Lagrange's and Rolle's mean value theorems (Statements only), Taylor's and Maclaurin's series (without proof) with application curvature	05
2	Partial Differentiation: Functions of two or three variables, change of variables, application to errors, maxima and minima.	03
3	Integral Calculus: Integration by parts, properties of definite integrals and reduction formulae; Determination of length of the curve, area and volume.	08

4	Differential equations: Formation of differential equations, solutions of first order and first degree equations, linear differential equation of higher order with constant coefficients, simple application to chemical reactions and biopharmaceutics.	08
5	Determinants and Matrices: Properties of determinants and applications, solution of simultaneous equations with three variables by Cramers method: Type of matrices, inverse of a matrices, rank of a matrices, eigen values and eigen vectors, Caley Hamilton theorem.	07
6	Numerical Methods: Finite difference operator's (delta and E), interpolation of equal and unequal intervals-Newton's method and Lagrange method: Numerical integration-Trapezoidal rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ rules.	05

REFERENCES

- 1) Mathematics for pharmacy students (Vol.I): Gujar, K.N. Bhavale Ashok 1st Edition, Career publication.
- 2) Differential Calculus: Nareyan, S. 1st Edition, S. chand Publication.
- 3) Applied Mathematics –I, Baphana R.M., 3rd edition, Techmax Publication.
- 4) Textbook of Applied Mathematics VOL.I & II, Wartikar P.N. 7th Edition Pune vidyarthi Griha Prakashan.
- 5) Integral Calculus, Shanti Narayan, 1st Editions, S. Chand Publication
- 6) A Textbook of matrices, Shantinaryan, 10th Edition, S.Chand Publication

PHARMACEUTICAL ANALYSIS LABORATORY-II

4 hrs/week

1. Preparation and standardisation of 0.05M EDTA and 0.1N perchloric acid.
2. Redox titrations- assay of sodium nitrite (KMnO₄ method). Assay of sodium nitrite, assay of methyl paraben/ propyl paraben, determination of sulphur in sulphur ointment, assay of Lugol's solution, assay of hydrogen peroxide, assay of isoniazid.
3. Complexometric titrations- Assay of aluminium hydroxide gel, determination of percentage of calcium and magnesium in a mixture, assay of calcium gluconate powder and injection, assay of zinc sulphate powder.
4. Gravimetric analysis- Al³⁺ as Al-oxinate, Ba²⁺ as BaSO₄, Ni²⁺ as Ni-dimethyl glyoxime.

Demonstration experiments:

1. Non-aqueous titrations- assay of pyridoxine hydrochloride, assay of Norfloxacin/ Metronodazole, assay of chlorpromazine hydrochloride.

PHARMACEUTICS LABORATORY II

4 hrs/week

1. SUSPENSIONS : (a.) Paediatric Kaolin Mixture B.P 1980, (b.) Paediatric Chalk Mixture B.P 1988, (c.) Calamine Lotion I.P'66, (d.) Kaolin Poultice I.P'66, (e.)

- Microscopic evaluation, rheology and sedimentation rate studies for any one of the above suspension
2. EMULSIONS : (a.) Liquid Paraffin Emulsion I.P' 66. (b.) White Liniment B.P.C. (c.) Turpentine Liniment I.P' 1966. (d.) Benzyl Benzoate Application I.P'66. (e.) Microscopy of any one of the above emulsion
 3. OINTMENTS : (a.) Simple Ointment I.P' 66. (b.) Sulphur Ointment I.P'66 (Microscopic evaluation). (c.) Emulsifying Ointment I.P'66. (d.) Benzoic Acid Ointment, Compound B.P.C'68. (e.) Iodine Ointment, Non-staining B.P.C'68. (f.) Iodine Ointment, Non-staining with Methyl Salicylate B.P.C'1968
 4. CREAMS : (a.) Cetrimide Cream B.P 1993.
 5. GELS : (a.) Diclofenac Sodium Gel
 6. PASTES : (a.) Titanium Dioxide Paste.

COMPUTER LABORATORY

4 hrs/week

1.	Computer Devices a. Input and Output devices b. Secondary storage units c. Memory - ROM and RAM, Virtual memory d. ALU, the Control Unit, and CPU e. Classification of Computers - microcomputer, personal computers, laptop computers, minicomputers, mainframes and supercomputers	2
2.	Operating Systems (OS) f. Purpose of the OS g. Management functions of OS h. Services provided by the OS i. Types of OS j. User interfaces - command line and GUI k. Features of the MS-DOS, Windows and Unix OSes	2
3.	Types of Computer Language l. Need for interpreter m. Computer Program n. Interpreter o. Compiler p. Classification of Computer Languages - Conventional, advantages and limitations q. Very brief introduction to C++ language.	3

4.	Introduction to Computer Networks - What is a computer Network - Networking Basics - Common types of Networks – LAN, WAN and their variations - Network topologies – bus, ring, star, mesh - Network protocols - Network components – computers, communications medium, modem, repeater, hubs, switches, bridges, gateways, routers and network interface cards	4
5.	Algorithms and Flowcharts - Algorithm - Characteristics of an algorithm - Writing algorithms - Flowcharts and symbols, drawing a flowchart Divide and conquer strategy	2
6.	Introduction to Data structure - Types of data structures - Arrays - Structures or records - Stack - Queue - Linked lists - Tree	2
7.	Introduction to DBMS and SQL. - Features of DBMS - Introduction to Relational Database Management Systems (DBMS) - Introduction to Ingres DBMS	2
8.	General applications of Computers in Pharmaceutical Sciences.	2

9.	CONCEPTS OF NETWORKING Introduction to Networking, Types of Networking (LAN, MAN, WAN, VWAN), Topologies, Requirements for using Networking, Networking Terminologies (Client, Server, Node, Terminals etc)		4 hrs
10.	WINDOWS		
11.	Sess ion - 1	Introduction to Operating System, Features of Operating systems, types of operating systems, Difference between Dos and Windows Starting and Shutdown of PC, Screen Components. Notepad (File Menu) Notepad Complete with all menus	1
12.	Sess ion - 2	WordPad File and Edit Menu WordPad complete with all menus	1
13.	Sess ion - 3	Paint – all tools , Paint – all menus paint complete	1
14.	Sess ion - 4	Character Map, Control Panel (Date & Time, Keyboard, Mouse, Display) Creation of files and folders, moving files, copying files, Recycle Bin, Run , My Documents, My computer Finding files and folders , doubts clearing	1
15.	MS-OFFICE		
16.	(A):WORD PROCESSING		
17.	Sess ion - 1	Introduction to package, language, MS- office and introduction to word; File and Edit Menu; View menu options	1
18.	Sess ion - 2	Insert menu options: Format font (full) , paragraph and change case Format bullets and numbering, columns, bullets and numbering, borders and shading, tabs	1
19.	Sess ion - 3	Table menu full , Tools – spelling and grammar, thesaurus, mail merge with single filed, multiple fields and queries options	1
20.	Sess ion - 4	Macro , autocorrect, letter wizard Envelopes and labels , window menu options	1
21.	Sess ion - 5	Drawing toolbar options , Drawing toolbar draw option	1

(B): EXCEL		
Session - 1	Introduction to screen , components (database, spreadsheet and chart) , use of excel, auto fill, fill handle features , calculator with '=' sign , sum and average function	1
Session - 2	Edit menu , View menu , Insert menu	1
Session - 3	Format menu , Spelling and grammar, protection, autocorrect, goal seek, macro , options (view and custom lists); Data – sort, forms, subtotals, filters, pivot table	1
Session - 4	Window menu complete, numeric and date and time functions: Numeric functions : ABS, FACT, COUNT, COUNTBLANK, POWER, MOD, PRODUCT, MIN, MAX , QUOTIENT; Date and time functions : NOW, TODAY, TIME	1
Session - 5	Text functions : LOWER, UPPER, PROPER, MID, REPLACE, LEN, TRIM, CONCATENATE, LEFT, RIGHT; Logical functions : AND, OR , NOT , EXACT	1
(C): POWERPOINT		
	Introduction to PowerPoint , creating presentation with auto content wizard Creating presentation with design template, custom animation, slide transition, sounds and songs insertion Creating different types of blank presentations Points to be noted while creating PowerPoint presentations 1. No spelling Mistakes 2. Proper Clipart in each slide 3. Proper Slide Transition Effects 4. Proper Text Animation Effects Proper Timings	1
INTERNET SYLLABUS		
Session - 1	Theory of Internet, basic requirements to run internet, web site, domain name, sub domain, chatting, email, surfing Surfing and creating e- mail ID	1
Session - 2	Inbox, compose, sending and receiving greeting cards, text files , images downloading, search engines (google, yahoo, Lycos, khoj etc) Chatting, yahoo messenger , and other things	1

REFERENCES

1. Basic Electronics and Computer Applications, Rajiv Khanna, New Age International Publishers, 2007.
2. Introduction to Biostatistics & Computer Science, Y. I. Shah, A. R. Paradkar, M.G. Dhayagude, Nirali Prakashan, 3rd Ed., 2004
3. Fundamentals of Computers, V. Rajaraman, Prentice Hall of India Pvt. Ltd., 1986
4. Schaum's Outline Series, Theory & Problems of 'Introduction to Computer Science', by Francis Scheid, McGraw Hill Book Co. , 1983.

SECOND YEAR B. PHARM SEMESTER IV

PHARMACOLOGY - I

Sr.no.	Topics	3 hrs/week	Hours
1	General principles of pharmacology ◆ Introduction to Pharmacology ◆ Routes of drug administration with special reference to their advantages and disadvantages ◆ Drug absorption, distribution, metabolism and excretion ◆ Factors modifying the actions of drugs ◆ Drug toxicity in human - toxic effects of drugs on different systems, organs and tissues		13
2	Mechanisms of drug action: a) Brief introduction of physiological receptors - structural and functional families - cytoplasmic second messengers b) drug-receptor interaction - dose-response relationship - drug antagonism		8
3	Drugs used in the disorders of gastro-intestinal tract ◆ Emetics, antiemetics & prokinetic drugs ◆ Purgatives & antidiarrheals, antispasmodics ◆ Drugs used in the treatment of hyperacidity & peptic ulceration ◆ Inflammatory bowel diseases		8
4	Drugs used in haematological disorders - Antiplatelet agents - Anticoagulants - Thrombolytic agents - Antianaemic drugs		7

REFERENCES

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 NY, 2006
5. Lewis Pharmacology - By Crossland - 5th Edition, Churchill Livingstone
6. Laurence, D. R. & Bennet Clinical Pharmacology- 9th Edition, Elsevier, NY, 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, Hillton & Company, Calcutta, 2005

ORGANIC CHEMISTRY- IV

3 hrs/week

Sr. No.	Topic	Hours
1.	Introduction to free radical chemistry, stability and structure, generation of free radicals (thermal decomposition, photochemical methods, oxidation-reduction, electrolysis), propagation of free radicals, termination of free radicals, Discussion of Birch reduction, Kolbe electrolysis, Hunsdiecker reaction, Sandmeyer reaction.	6
2.	Peptide Chemistry, Chemistry of the peptide bond, methods of forming peptide bond including solid phase peptide synthesis, amino acid protecting agents	6
3.	Organometallic chemistry: Introduction, organomagnesium, organolithium and some mixed organolithiumcuprates, organozinc and organoboranes.	8
4.	Polymer Chemistry: Introduction to polymers, polymer characteristics, properties, methods to determine properties.	5
5.	Heterocyclic aromatics- synthesis and reactions of five and six membered rings with one and two heteroatoms like pyrrole, oxazole, thiophene, furan, imidazole, pyrazole, thiazole, isoxazole, pyridine, pyrimidine, quinoline and isoquinoline, pyrazine and indole.	12

REFERENCES

1. Organic Chemistry, S. H. Pine, 5th Ed., Tata McGraw Hill Publishing Co. Ltd., 2007.
2. Principles of Organic Synthesis, R. O. Norman, 2nd Ed., Chapman and Hall, 1978.
3. Organic Chemistry, John McMurry, 5th Ed., Brooks/Cole, Thomson Learning, 1999.
4. Organic Chemistry, Francis Carey, 5th Ed. McGraw Hill
5. Organic Chemistry, Vols. 1 and 2, I. L. Finar, 5th Ed., Pearson Education, 2005
6. Heterocyclic Chemistry, J. A. Joule and K. Mills, 4th Ed., Blackwell Publishing, 2005

Sr. No.	Topic	Hours
1.	Biochemical Energetics: Concept of free energy, standard free energy vs transformed free energy vs free energy for a reaction. Relationship of standard free energy to reaction equilibrium constant, concepts of enthalpy and entropy, introduction to first and second law of thermodynamics. Standard free energy changes of some important biological reactions. Concept of oxidation-reduction reactions, standard electrode potential, transformed standard electrode potential, standard electrode potentials of some biological important redox couples.	6
2.	Concept of high energy phosphate bond and ATP as a carrier of energy. Concept of oxidation states of carbon in different compounds. Introduction to the terms metabolism, anabolism and catabolism.	3
3.	Digestion of food and absorption of monosaccharides, amino acids and fatty acids into circulation. Fate of absorbed nutrients and relationship with regard to immediate use, storage, re-release and interconversion. Role of different organs in these processes especially liver, kidney, muscle, adipose tissue, brain and rbc's.	3
4.	Carbohydrate metabolism: Discussion of glycolysis, reversal of glycolysis, glycogen synthesis and breakdown, pentose phosphate pathway, TCA cycle, glyoxalate shunt, gluconeogenesis, NADH/NAD ⁺ shuttles, with respect to the location, intermediates, enzymes, energy yield, and regulation. Examples of drugs related to carbohydrate metabolism modulation.	13
5.	Lipid metabolism: Discussion of the oxidation and biosynthesis of saturated and unsaturated fats with respect to location, intermediates, enzymes, energy yields or requirements, and regulation, formation of ketone bodies, acetate mevalonate pathway, biosynthesis of cholesterol. Examples of drugs that are related to lipid metabolism modulation.	4
6.	Electron transport chain: Components of the ETC, oxidative phosphorylation vs substrate level phosphorylation, comparison of this with photosynthesis and photophosphorylation, absorption of light by chlorophyll and energy conservation. Discussion of proton motive force and generation of ATP by use of proton gradients. Examples of some toxins that interfere with ETC.	3
7.	Nucleic acid metabolism: Discussion of biosynthesis of purines and pyrimidines with respect to location, intermediates, enzymes, cofactors, and regulation. Salvage pathways for nucleic acids. Examples of drugs interfering with these pathways.	4

REFERENCES

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., Eds. 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.

DISPENSING PHARMACY

3 hrs/week

Sr. No.	Topics	Hours
1	Definition of Compounding and Dispensing	1
2	Prescription and its parts: Different types of prescriptions, prescription pricing, recording of prescription	4
3	Calculations : various calculations involved in compounding and dispensing such as -- weights and measures, % calculations, dilutions and concentrations, isotonic solutions, HLB value calculations, posology, imperial system of weights and measures	8
4	Basic principles in compounding and dispensing : Types of dosage forms, formulation of dispensed products, storage and stability of products, containers and closures for products, labelling of dispensed products- Preparation of stock solutions: Latin terms and abbreviations	4
5	Compounding and Dispensing aspects of - solutions (for oral use, external use, for body cavities). suspensions. emulsions and creams. ointments, pastes, gels. suppositories, pessaries. powders, granules, lozenges, pastilles, pills, tablets, capsule, tablet triturate, etc Incompatibilities Prepackaging, Dispensing of proprieties	2 2 2 2 2 3 2 1

REFERENCES

1. Cooper and Gunns Dispensing for Pharmaceutical students Twelfth edition Edited by S.J.Carter Indian edition CBS Publishers, Delhi 1987
2. Pharmaceutical Practice Edited by D. M. Collett and M.E.Aulton, Churchill Livingstone ELBS edition, 1991.
3. Pharmaceutical Practice Edited by A.J.Winfield and R.M.E Richards, Second edition, Churchill Livingstone, 1998.

4. Pharmaceutical Practice Edited by A.J.Winfield and R.M.E Richards, Third edition, Churchill Livingstone, 2004.
5. Husa's Pharmaceutical Dispensing, Edited by Eric Martin, Sixth edition, Mack Publishing Company, 1966.
6. Pharmaceutical Calculations – by H.C.Ansel and M.J.Stoklosa, Lippincott Williams and Wilkins, 2006
7. Pharmaceutical Calculations – by Bradley, Gustafson and Stoklosa, Third edition, Lea and Febiger, 1957.

MATHEMATICS-II (FUNDAMENTALS OF STATISTICS)

3hrs/week

SR.NO	TOPICS	HOURS
1.	Measures of central tendency: Arithmetic's mean, median and mode	08
2.	Measures of dispersion: Range, quartile deviation mean deviation and standard deviation, Coefficients of variation, moments, skewness and kurtosis, moments generating, Probability expectations and variance, binomial, Poisson and Normal distributions; Fitting of curve by the method of least square. $\{Y = a + bX; Y = a + bX + cX^2, Y = aX^b, Y = ab^X, Y = ac^{bX}\}$	18
3	Sampling distribution for mean and Proportion: Test of hypothesis for specified values of means and proportion for large samples. Testing equality of two means and proportions, Student's 't' test for single sample and paired observation, F-Test and analysis of variance, testing of attributes, Chi-square distribution	10

REFERENCES

- 1) Fundamentals of statistics: Gupta, S.C. 6th Edition Himalaya publication
- 2) Mathematics for pharmacy students (Vol-I), Gujor K.N.Bhavale Ashok Edition, career publication.
- 3) Measurement, statistics of computation C Cormich D. 1st Edition, John Wiley & Sons.
- 4) Biostatistics in pharmaceutical Industry, Buncher, R.C. 1st Edition, Mateel Decker Inc.
- 5) Vogel's Textbook of Quantitative Chemical Analysis, Mendham, J. R. C. Denney, 6th Edition, Pearson Education Pvt.Ltd.

PSYCHOLOGY AND SOCIOLOGY

3 hrs/week

Note: - All relevant topics can be dealt with special reference to the Pharmaceutical Industry.

Psychology

Sr. No	Topics	Hours
1	Nature, Definition of Psychology-Introduction subfields of Psychology, Industrial Psychology.	2
2	Organizational Behavior –Nature Scope Goals - Personnel Selection	2
3	Occupational Information-uses Personnel Specifications Job analysis Selection techniques:-Application Blanks-Biodata Interviews Psychological tests (Intelligence tests, Aptitude tests, Personality tests) Work Motivation-	4
4	Theories (Maslow's, Herbergs, Vrooms, Equity Theory). Ways to motivate people in organizations. Financial and nonfinancial Incentive, Job satisfaction.	4
5	Leadership- Trait –theory of leader, leadership skills, leadership styles Fiedler's contingency model.	2
6	Team and Team building.	2
7	Accidents-causes Accident prevention-safely measures Organizational change-Resistance. Overcoming resistance.Continuous and episodic change	2

SOCIOLOGY

Sr.No	Topics	Hours
1	Concept of: The relevance of sociology to industry. Social adjustment of workers	3
2	Communication-its levels and types.	3
3	Science, technology, industry and society:-Impact. Role Problems (with special reference to Pharmaceutical Industry)	3
4	Sociology of Medicine in India: - an approach. The best of both the world-bringing traditional medicine up-to-date. Who chooses modern medicine and why? Man, medicine and environment. Allopathic medicine in India. Class composition of medical students. Its relevance to Pharmacy – Pharmaceutical Marketing.	6
5	Industrial Democracy: - Worker participation in management.	3

REFERENCES

1. Sociology by Anthony Giddnes
2. Industrial Relation by P.B.Mammudity
3. Sociology by Harrambus
4. Social Change by Kappu Swami
5. Man, Medicine and Environment-Rene Du Bos (1969)
6. Organizational Behavior-Human Behavior at work -By New Strom and Keith Davis
7. Organizational Behavior-By Suja Nair, Himalaya Publishing Company
8. Industrial Psychology and sociology -By Milind Wagh, Career Publication
9. Industrial Psychology and sociology -By B.V.Pathak,Nirali Prakashan

ANATOMY, PHYSIOLOGY AND PATHOPHYSIOLOGY – IV

3 hrs/week

Sr.no.	Topics	Hours
1.	Cardiovascular System - Functional anatomy of heart - conducting system of heart - cardiac cycle, Electrocardiogram (ECG) - Functional anatomy of blood vessels - Blood pressure and factors regulating blood pressure - Baroreceptors, chemoreceptors vasomotor center - Humoral and neuronal control of blood pressure and circulation - Enterohepatic circulation	12
2.	Definition and Etiology of following diseases in detail - Hypertension - Congestive Cardiac Failure - Cardiac Arrhythmia - Angina Pectoris - Ischemic Heart Disease - Arteriosclerosis / Atherosclerosis - Varicose veins, Hemorrhoids	10

3.	Urinary system - Anatomy and Physiology of Urinary System - Formation of urine - water balance, electrolyte balance & acid – base balance	6
4.	Formation of body fluids and fluid compartments.	4
5.	Definition and Etiology of following diseases in detail - Renal failure - Glomerulonephritis - Renal calculi / kidney stones - Urinary Tract Infections (UTI)	4

REFERENCES

1. Ross & Wilson Anatomy & Physiology in Health & Illness, 10th Edition, Anne Waugh, Allison Grant, Churchill Livingstone Elsevier, 2006
2. Tortora & Grabowaski Principles of Anatomy & Physiology, 11th Edition, J Wiley & Sons, 2007
3. Guyton & Hall Textbook of Medical Physiology, 10th Edition, Harcourt Singapore, 2001
4. B. R. Mackenna & R. Callander Illustrated Physiology, 6th Edition, N Y Churchill Livingstone, 1997
5. Kaplan, Jack, Opheim, Toivola, Lyon Clinical Chemistry: Interpretation & Techniques, 4th Edition, Williams & Williams London 1995.
6. Praful B. Godkar, Darshan P Godkar Textbook of Medical Laboratory Technology, 2nd Edition, Bhalani Mumbai, 2006
7. Russel J. Greene & Norman D. Harris Pathology & Therapeutics for Pharmacists: A Basis for Clinical Pharmacy Practice, 2nd Edition, Pharmpress NY, 2000
8. Ranade & Joshi Manual of Practical Physiology, Pune Vidyarthi Gruha Prakashan.
9. Eric Herfindal, Dick Gourley, Text Book of Therapeutics: Drug and Diseases Management, 7th Edition, Lippincott Williams & Wilkins, A Wolters Kluvers Company.
10. Cotran, Kumar and Collins, Robins- Pathologic Basis of diseases, 6th Edition, W B Saunders Company.
11. The Merck Manual of Medical Information, Home Edition, Merck Research Laboratories, Division of Merck & Co Inc, White House Station, N J, 1997.

ORGANIC CHEMISTRY LABORATORY II

4 hrs/week

Techniques in Organic Chemistry: Quantitative separation of binary organic mixture by physical and chemical methods mixture of different types including compounds with more than one functional group to be given, complete characterization of individual components including physical constants followed by preparation of suitable derivative. Purification techniques solvent selection for recrystallisation, recrystallization techniques, simple distillation, fractional distillation, steam distillation.

DISPENSING PHARMACY LABORATORY

4 hrs/week

1. Solutions	1. Zinc Chloride & Zinc sulphate mouth wash BPC 2. KMnO_4 solution 3. Sodium Bicarbonate Ear Drops BP 4. Pediatric Ferrous Sulphate Solution BP 1988
2. Suspensions	5. Calamine Lotion IP 6. Menthol & Eucalyptus Inhalation
3. Emulsions	7. Arachis Oil Emulsion 8. Calciferol Emulsion 9. Oily Calamine Lotion BP 1980 / Benzoyl Benzoate Application BP 1988 / White liniment
4. Ointment	10. Sulphur ointment BPC / Calamine & Coal Tar Ointment / Whitfield's Ointment
5. Paste	11. Zinc & Coal Tar Paste / Titanium Dioxide paste
6. Gels	12. Lubricating Jelly
7. Cream	13. Medicated Cream
8. Powders	14. Hyoscine HBr Powder 15. Seidlitz Powder
9. Granules	16. Mg Trisilicate Oral Powder BP 1988 / Dusting Powder 17. Effervescent Granules
10. Tablet triturates	18. Isapghul Granules
11. Capsules	19. Boric Acid / Riboflavin 20. Chlordiazepoxide Capsules /
12. Pills	21. Compound Rhubarb Pills BPC 1960 / Potassium Permanganate Pills /
13. Pastilles	22. Mediated Pastilles
14. Lozenges	23. Brompton Cough Lozenge / Bismuth Carbonate Lozenges
15. Suppositories	24. Compound Bismuth Subgallate Suppositories BP1980
16. Incompatibility	25. Eutectic mixture
17. Prepackaging	

BIOCHEMISTRY LABORATORY - I

4 hrs/week

Qualitative test for carbohydrates confirmatory tests by osazone formation

Quantitative estimation of glucose by Willstater's and Lane and Eynon method, estimation of sucrose; Simple colour reactions of proteins and amino acids, precipitation reactions of proteins

Determination of acid value, iodine value and saponification value of lipids

Enzymes: Ptyline activity of saliva

THIRD YEAR B. PHARM SEMESTER V

PHARMACEUTICAL MEDICINAL CHEMISTRY-I

3 hrs/week

Sr. No.	Topic	Hours
1.	Physicochemical properties and drug action	
2.	Metabolism Discussion of the following classes of drugs including, classification, chemical nomenclature, structure including stereochemistry, generic names, chemistry, physicochemical properties, SAR, metabolism, molecular mechanism of action, introduction to rational development if any, of the class of drugs:	4 6
3.	Chemotherapeutic agents – a. Antitubercular agents – PAS*, ethionamide, isoniazid, pyrazinamide, ethambutol*, antitubercular antibiotics (streptomycin, rifampin, viomycin and cycloserine – the first three only highlights of structure to be discussed). Combination therapy. b. Antileprotic drugs – dapson* 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-aminoquinolines eg primaquine*, 4-aminoquinolines eg chloroquine*, 9-aminoacridines eg quinacrine. 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 clotrimazole*, miconazole, ketoconazole, fluconazole, and itraconazole.	4
6.	Antibacterial agents a. Antibiotics – penicillins (natural and semisynthetic penicillins like Penicillin G, Penicillin V, ampicillin*, amoxicillin, cloxacillin*, oxacillin, nafcillin, methicillin and ampicillin prodrugs like bacampicillin and pivampicillin), cephalosporins (cephalexin, cephalothin, cefaxitin, cefuroxime, cefotaxime, cefepime and cefpirome) tetracyclines (tetracycline, chlortetracycline, oxytetracycline, doxycycline and minocycline and its prodrug – rolitetracycline); macrolides (erythromycin, roxithromycin, 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 therapy and for intestinal infections, ulcerative colitis and for reduction of bowel flora. c. Fluoroquinolones like norfloxacin, ciprofloxacin*, sparfloxacin,	10 2

gatifloxacin

d. Oxazolidinediones

*indicates synthesis to be discussed

2

1

REFERENCES

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. 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, Wiley.

BIOCHEMISTRY III

		3 hrs/week
Sr. No.	Topic	Hours
1.	DNA replication: Details of DNA replication, differences between prokaryotes and eukaryotes, telomeres and telomerases, DNA mutations and DNA repair mechanisms, DNA polymorphisms and single nucleotide polymorphisms. Examples of drugs that are used due to role in interaction with DNA or interfering with DNA replication.	8
	Solid phase DNA synthesis, DNA sequencing (Maxim-Gilbert method, Sanger dideoxy method and automation of DNA sequencing)	5
	Protein Biosynthesis: Details of DNA transcription and RNA translation, differences 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.	7
	Solid phase peptide synthesis, Edman reaction based protein sequencing and its automation.	
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. Lineweaver Burke and Eadie Hofstee plotting methods. Enzyme inhibition – competitive, non-competitive and uncompetitive reversible inhibition of enzymes. Effect of these inhibitors on Km and Vmax and Identification of inhibition patterns via LWB and	8

	Eadie Hofstee plots. Examples of drugs that are 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

REFERENCES

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., Eds. 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 L. M., Wiley Liss, USA, 2002.

PHARMACOGNOSY I

3 hrs/week

Sr.no.	Topics	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, cosmetics 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, chemotaxonomical, and pharmacological) and sources of drugs of natural 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 such as starch grains, calcium oxalate crystals, idioblasts etc.	4

9.	Introduction to plant tissue culture and its technique and applications Plant growth regulators and hormones	3
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REFERENCES

- 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 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 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

Sr. No	Topic	Hours
1	Tablets	
	• Definition, Advantages and Limitations Preformulation aspects	2
	• Tablet formulation and Design additives/excipients with examples	3
	• Large scale manufacturing with equipments- for drying, mixing, Direct compression, Granulation, Dry Granulation(Slugging And Roller Compaction)	7
	• Compression -(Single station tablet press and Rotary press), Physics of tablet compression (brief) , Processing problems, in tableting. Layout of tablet section	5
	• Tablet types: Effervescent, Buccal, lozenges, chewable, sublingual, Dispersible, soluble, Orodispesible Q.C. of Tablets	4

Sr. No.	Topics	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: Advantages, disadvantages, 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 parenterals, total parenteral nutrition and intravenous additives	2
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 supplies.	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	Channels 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 : Traits 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 trade 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

REFERENCES

1. "Principles and methods of pharmacy management" Smith, Lea and Febiger.
2. "Drug store and management" Nolen and Maynard, McGraw Hill, 1941.
3. "A Text book of pharmacy management" Tomiski (Kugan page).
4. "Drug Store and Business Management" A.P. Battase, Unique Publication.
5. Battase Unique Publication, 1999.
6. Hospital pharmacy: William E. Hassan, 5th Edition, Lea & Febiger, Philadelphia, 1986.
7. A text book of Hospital Pharmacy: S.H. Merchant and Dr. J.S. Qadry, 4th Edition, B.S. Shah Prakashan, Ahmedabad, 2001.
8. Hospital Pharmacy: Dr. H.P. Tipnis and Dr. Amrita Bajaj, First Edition, Career Publication, Maharashtra, 2007.
9. Giennaro Alfonso R, "Remington : The Science and Practice of Pharmacy", 20th Edition, 2000, Published Lippincott Williams & Wilkins.

PHARMACEUTICAL BIOTECHNOLOGY

3 hrs/week

Sr. No.	Topics	Hours
1	Introduction to Biotechnology, Historical Perspectives, Definitions, Scope, Relevance to Pharma Industry	1
2	Microbial 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 mechanisms- first line of body defence, physiological phenomena-inflammatory response, fever; cellular mediators; soluble (humoral) mediators, phagocytosis • Specific Defence Mechanisms- 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 tests, complement fixation, Tests, immunofluorescence, RIA, ELISA	12

	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	
5	Fermentation Technology- Example of products of fermentation (microbial, animal and plant), types of fermenters, designs 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 restriction endonuclease, SI nuclease, Ligase, Alkaline phosphatase, Vectors (Plasmid, cosmid, YAC), Gene expression (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.	6
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 immobilized enzyme and cell system. Application of enzyme 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, Integration with diagnostic applications.	1

REFERENCES

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 L. Nelson.
9. Pelczar, Chan & Krieg. Microbiology-Concepts and Applications, International Edn., McGraw Hill, Inc., 1993
10. Weir Stewart: Immunology, 8th Edn., Churchill Livingstone, 1997.

Sr.no.	Topics	Hours
1.	Introduction to Chemotherapy Basic principles of chemotherapy Mechanism of action of chemotherapeutics 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 Macrolides	8
3.	Chemotherapy of following diseases Amoebiasis Malaria Helminthiasis d. Tuberculosis & leprosy e. Fungal infection f. Viral diseases g. 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

REFERENCES

- Goodman & Gilman's Pharmacological Basis of Therapeutics – Joel G. Hardman, Lee E. Limbird, Alfred Goodman Gillman 11th Edition, The McGraw- Hill Companies Inc, 2001
- Satoskar, R. S. Bhandarkar S D & Rege N N Pharmacology & Therapeutics – 20th Edition, Popular Prakashan, 2007
- Rang & Dale Pharmacology – 5th Edition, Churchill Livingstone 2003
- Lippincott's Illustrated Reviews: Pharmacology - Lippincott – Raven 3rd Edition Howland & Nycets Publishers NY, 2006
- Lewis Pharmacology - By Crossland - 5th Edition, Churchill Livingstone
- Laurence, D. R. & Bennet Clinical Pharmacology- 9th Edition, Elsevier, NY, 2006
- 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, Hillton & 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-dinitrobenzene)
4. Oxidation (synthesis of benzoic by oxidation of toluene or benzyl alcohol with alkaline potassium permanganate)
5. Sulfonation (synthesis of sodium toluene-p-sulfonate or p-xylenesulfonic 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 ^{11}C .

PHARMACEUTICS 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 tablets-lubricants, glidants
2. Granulation for Soluble aspirin tablets IP and evaluation
3. Granulation, compression and evaluation Riboflavin 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 I.P

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 death time and temperature

Effect of Ultra-Violet exposure on growth of *E. coli*

Demonstration of electrophoresis either by PAGE or Agarose gel electrophoresis

THIRD YEAR B. PHARM SEMESTER VI

PHARMACEUTICAL MEDICINAL CHEMISTRY-II

3 hrs/week

Sr. No.	Topic	Hours
1.	Steroids— Configuration and conformation 5α and 5β cholestane, conventional formula and conformational representation. Reactions in ring A and 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; progestins like medroxy progesterone acetate, megestrol acetate, norethindrone and norgestrel), anabolic steroids like danazol, stanozolol and androxiol; nonsteroidal estrogens like diethylstilbestrol and chlorotrianisene; antiestrogens like tamoxifen and clomiphene, corticoids and steroidal antiinflammatory agents like cortisone, hydrocortisone, prednisolone, dexamethasone, betamethasone and triamcinolone.	9
2.	Antihistaminics H_1 and H_2 receptors. Emphasis to be on the second generation H_1 antagonists such as fexofenidine, astemizole, loratidine, cetirizine and acrivastine. H_2 receptor antagonists like cimetidine*, ranitidine, famotidine, nizatidine; proton pump inhibitors like omeprazole and lansoprazole.	4
3.	Diuretics a. Site 1 — Carbonic anhydrase inhibitors — acetazolamide*, methazolamide b. Site 2 — High ceiling or loop diuretics i) sulfamoyl anthranilic acids like furosemide*, azosemide and bumetanide ii) phenoxyacetic acids — ethacrynic acid* c. Site 3 — Thiazide and Thiazide like diuretics d. Site 4 — Potassium sparing diuretics such as spironolactone, triamterene and amiloride	5
4.	Local Anesthetics a. Amino esters — procaine, tetracaine, benzocaine* b. Amino amides — lidocaine*, mepivacaine, bupivacaine c. Amino ethers — pramoxine d. Amino ketones — dyclonine e. Alcohols — Benzyl alcohol, eugenol	3
	Hypoglycemics (Insulin not to be discussed) 1. Biguanides e.g. metformin b. Sulfonylureas 1 st Generation like tolbutamide*, chlorpropamide, tolazamide and acetohexamide; 2 nd Generation like glyburide, glipizide; 3 rd Generation like glimepiride and repaglinide 2. Thiazolidinediones such as troglitazone, ciglitazone.	4

	rosiglitazone and pioglitazone	
	3. β - Glucosidase inhibitors like acarbose, voglibose and miglitol.	
	Antiviral agents including HIV -ara-A, idoxuridine*, amantadine*, acyclovir, ganciclovir and ribavirin. HIV agents - both non-nucleosides like nevirapine & delaviridine and nucleosides like AZT and protease inhibitors like indinavir, saquinavir, ritonavir (only highlights of structure). Combination therapy.	4
	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	

REFERENCES

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. 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

Sr. 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	15

	(Definition, derivation of mathematical expression, limitations), Applications of Beer's law to single component analysis 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 triplet 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

REFERENCES

1. Skoog-Principles 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, Elbs & Longmans, London.
6. James W. Munson-Pharmaceutical Analysis: Modern methods, Marcel Dekker Inc, 1981, USA.

Drugs mentioned in bold are for detailed study

Sl.no.	Topics	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 , xanthan , guar), mucilages (agar , isapghol , linseed), malt and malt extract , dextran, pectins, chitin, hyaluronic acid. Study of sources, constituents and uses of carbohydrate containing herbs i.e. fig, bacl, <i>Cassia fistula</i> , tamarind 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 , nicotine, 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 <i>Tagetes</i>).	2

10	Study of sources, structure and properties of sulphides from Allium species (<i>A. cepa</i> & <i>A. sativum</i>)	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

REFERENCES

- 1) Trease D. & Evans W.C.: Text Book of Pharmacognosy; W.B. Saunders.
- 2) Tyler V.E., Brady L.R. & Robbers J.H.: Pharmacognosy; Lea Febiger, U.S.A.
- 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 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 Techniques and Experiments, Nirali Prakashan, Pune
- 15) Vasudevan T.N., Laddha K.S.: Practical Pharmacognosy; New Vrinda Publishing House, Jalgaon.

PHARMACEUTICS V

3hrs/week

Sr. No.	Topics	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 equipments & other accessories	12

	• Q.C. of coated tablets	
2	Microencapsulation • Definition, need/reasons, concepts of core & coat • Methods with equipments – Wuster process, coacervation-phase separation, spray drying and related processes, interfacial polymerization, multiorifice centrifugal process, pan coating, solvent evaporation.	7
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 conc., conc. 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 & products(official) • Liver extract • ACTH preparations • Oxytocin and vasopressin	4 6 3 4

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 & distributors, India, 1986.
7. Remington, The science and practice of pharmacy, 21st ed., Vol I and II, B. L. Publications Pvt. Ltd., 2005.

COSMETICOLOGY

3 hrs/week

Sr. 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, formulations, processing and quality control: • Personnel hygiene products- pedicure and manicure preparations, dental care preparations including tooth paste, tooth powder, mouth washes and denture cleansers, antiperspirants and deodorants. • Facial makeup products- skin creams and lotions including cleansing cream, cold cream, vanishing cream, foundation makeup, bleach cream, face powder, rouge, 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- shampoos, women's and men's hair dressings, 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

- 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.



PHARMACEUTICAL MANAGEMENT

3 hrs/week

1. Basic principles and types of viable Business and enterprise.
Health care industry –Positioning the pharmacist fit in the industry.
Major players, major brands, Core, auxillary and allied products
And marketing, Major Components of Pharma business.
(Lectures 3)
2. Financial management, Source of funds, basics of balance sheet and profit and 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.
(Lectures 3)
4. Quality management: FDA regulations and approvals., WHO requirements, General awareness of Global requirements of MHRA/MCA/IGA/USFDA, ISO up gradation, Six sigma concept, Product and process environment Management.
(Lectures 3)
5. Market research process, Market forecasting process, Analysis of Volume and growth of Peripheral markets: Nutraceuticals, Cosmeceuticals implants.
(Lectures 3)
6. Marketing and sales: uniqueness of medicinal products marketing, Role of retail chemist, distributors, stockist, wholesaler, C&F agents, what is a market, a market share, competitive marketing.
Changes in offing- malls, chain of corporate retails outlets, Brands and Generic market.
(Lectures 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.

(Lectures 3)

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

(Lectures 4)

- 9 Other regulatory requirements Factory Act, Labor Act, Pollution Act, Fire- safety and Hazard management Hazop study, (MSDS) Safety data sheets.

(Lectures 3)

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

(Lectures 3)

- 11 Management concepts that help to create value, Ps : product, place, price , people , packing, pace, Organization- 7 S concept.

(Lectures 2)

REFERENCES

- 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

Sr.no.	Topics	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) - Anticholinergic drugs a) Muscarinic blockers b) Nicotinic blockers	18

	- Drugs acting at neuromuscular junction (skeletal muscle relaxants)	
	- Drugs acting on autonomic ganglia (stimulants and blockers)	
2.	Cardiovascular system Drugs used in the treatment of: Hypertension Congestive cardiac failure Angina pectoris Cardiac arrhythmias Drugs used in the treatment of hyperlipoproteinaemia	14
3	Diuretic drugs	6

REFERENCES

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 NY, 2006
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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, Hillton & Company, Calcutta, 2005

PHARMACOLOGY LABORATORY I

4 hrs/week

Sr.no.	Topics
1.	Experiments a) Dose Response Curve (DRC) of any agonist (eg. Ach, Histamine) using a suitable isolated tissue preparation. b) I.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 I.V. infusion including cannulation, setting of drop rate, for infusion over a given period of time)* Indian Journal of Pharmacology Vol 39 (1), Feb 2007: 57- 59. (Free Full text available at www.ijp-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) simulated experiment (CD's) Expharm

- effect of drugs on eye
- effect of drug on GI motility

c) Demonstration with the help of CD's or Kymograph recordings

- Effect of Neostigmine on DRC of Ach
- Effect of Pancuronium on DRC of Ach

(Give the readings 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 drugs by studying the nature of the graph, competitive and non competitive)

Find out the potency of the drugs by studying the DRC by studying IC₅₀ values)

- Calculation of P₅₀ value for atropine using Ach as an agonist.

3. Tutorials

Laboratory Animal Handling

Care and Ethics in Animal experimentation.

REFERENCES

Kulkarni, S. K. Handbook of Experimental Pharmacology 3rd Edition Vallabh Prakashan New Delhi, 2005

Gosh M N. Fundamentals of Experimental Pharmacology, 3rd Edition. Hillton & Company, Calcutta, 2005

S B kasture. A Handbook of Experiments in Pre- Clinical Pharmacology- 1st Edition, Career Publications, 2006.

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.ippcr.org)

PHARMACOGNOSY LABORATORY I

4 hrs/week

Sr.no.	Topics	Hours
1	Quantitative estimation by iycopodium 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 of fixed oils	1
7	Visit to medicinal plant garden	
	Total	14

COSMETICOLOGY LABORATORY

4 hrs week

Formulation - Processing, Packing 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

FINAL YEAR B. PHARM SEMESTER VII

PHARMACEUTICAL MEDICINAL CHEMISTRY - III

3 hrs/week

Sr. No.	Topic	Hours
	Discussion of the following classes of drugs including classification, chemical nomenclature, structure including stereochemistry, generic names, chemistry, physicochemical properties, SAR, metabolism, molecular mechanism of action, and synthesis, introduction to rational development if any of the class of drugs:	
1.	Cholinergic Drugs (i) cholinergic agonists (methocholine, carbachol*, bethanechol, pilocarpine) (ii) Ach esterase inhibitors (physostigmine, neostigmine*, tacrine*, ambenonium chloride, isofluorophate, pralidoxime) (iii) cholinergic antagonists (atropine, scopolamine, homatropine hydrobromide, ipratropium bromide); synthetic cholinergic antagonists (cyclopentolate*, dicyclomine*, benzotropine mesylate, procyclidine hydrochloride, isopropanide iodide, tropicamide) (iv) ganglion blocking agents (trimethaphan, camsylate, mecamylamine) (v) neuromuscular blocking agents (tubocurarine, gallamine triethiodide, succinyl choline chloride)	9
2.	Adrenergic Drugs (i) α -adrenergic agonists (phenylephrine, naphazoline, xylometazoline, oxymetazoline, methyldopa, clonidine*, guanabenz, guanfacine) (ii) β -adrenergic agonists (isoproterenol, terbutaline*, albuterol, salmeterol, isoxxsuprine, ritodrine) (iii) α -adrenergic antagonists (tolazoline, phentolamine, phenoxymetazoline, prazosin, doxazosin) (iv) β -adrenergic antagonists (propranolol*, atenolol, metoprolol, acebutalol, alprenolol, timolol, labetalol*) Other adrenergic agents (amphetamine, pseudoephedrine, ephedrine, guanethidine*, propylhexedrine, reserpine).	9
3.	CVS Drugs (i) antianginal agents (amyl nitrite, isosorbide dinitrate, pentaerythritol tetranitrate, verapamil, bepridil, diltiazem, nifedipine*, amlodipine, nimodipine, dipyridamole) (ii) antiarrhythmic agents (quinidine, procainamide*, disopyramide, lidocaine, tocainide, mexilitine, encainide, amiodarone, propafenone, verapamil, diltiazem, propranolol,	4 4

sotalol*	
(iii).antihypertensive agents (a) review of adrenergic agents (b) review of Ca channel blockers (c) ACE inhibitors (captopril*, enalapril, benazepril, ramipril) (d) angiotensin II receptor antagonists (losartan, valsartan*, candesartan)	6
(iv) vasodilators and K-channel agonists (diazoxide, minoxidil)	1
(v) antihyperlipidemic agents (clofibrate*, gemfibrozil, niacin, lovastatin, atorvastatin)	3
*indicates synthesis to be discussed	

REFERENCES

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., L. F. 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. I: Drug Synthesis, Eds. H. J. Roth, A. Kleeman, and T. Beissewenger, Ellis Horwood Ltd., 1988.
6. The Organic Chemistry of Drug Synthesis, Daniel Lednicher, Vols 1 to 7, Wiley.

PHARMACEUTICAL ANALYSIS IV

3 hrs/week

Sr. No.	Topic	Hours
1.	Chromatography Principles , terminology-stationary phase, mobile phase, classification of chromatographic methods, migration rate of species (partition coefficient, retention time, adjusted retention time), Rate of solute migration (capacity factor, selectivity factor), Column efficiency and band broadening (shape of peak-Gaussian, plate height, number of theoretical plates, van Deemeter equation), Optimisation of column performance (Column resolution, capacity factor, selectivity factor, tailing factor, peak width), Qualitative analysis, Quantitative analysis (Peak height, peak areas, calibration and internal standard, external standard, area normalization).	3
2.	Gas chromatography (GSC & GLC) Introduction, Principle, Instrumentation-carrier gas, columns, injection system, detectors (advantages, disadvantages, applications of Thermal conductivity , electron capture, thermionic, flame ionisation, nitrogen phosphorus, photoionisation), head space analysis, applications.	5
3.	HPLC Introduction, Principle, Instrumentation-mobile phase reservoir, pumps (reciprocating, displacement, pneumatic, isocratic elution,	5

	gradient elution). solvent treatment system. Injection systems (Rheodyne injector in detail, direct sample introduction, sampling loops.), columns and fittings (for reverse and normal phase, analytical and guard columns, thermostats, column packing), detectors-advantages, disadvantages.(UV-single wavelength, variable wavelength, photodiode array), fluorescence, refractive index, electrochemical.	
4.	Ion exchange chromatography Principle, ion exchange resins, mobile phases, applications.	2
5.	Ion pair chromatography Principle, applications	1
6.	Size exclusion chromatography Principle for gel permeation and gel filtration method, support media, mobile phases, applications.	1
7.	Paper chromatography Introduction, choice of filter papers, solvents, chromatographic chambers, development techniques (descending, ascending, radial, multiple chromatography, two-dimensional chromatography), qualitative analysis-location of spots, Quantitative analysis (direct and elution method), factors affecting retention factor, applications.	3
8.	Thin layer chromatography Introduction, Principle, different adsorbents, different methods for preparation of plates, solvents, development techniques (ascending, descending, horizontal, multiple development, two dimensional development), preparative TLC, Qualitative evaluation-visualisation of spots, Quantitative evaluation (Area, weight, densitometry, elution), factors affecting Rf, applications.	3
9.	High performance thin layer chromatography Introduction, principle, preparation of plates, development techniques, Qualitative evaluation, Quantitative evaluation, Instrumentation (adsorbents, solvents, sample application, scanning and documentation), applications.	2
10.	Validation of analytical methods as per U.S.P.	1
11.	Statistics & statistical Quality control Normal distribution, t-test, F-test, linear regression, correlation coefficient, confidence limits.	3
12.	Sampling procedures Objectives, different kinds of samples, sampling plan, sampling schemes, sampling equipments, methods of statistical analysis as applied to sampling and interpretation of results	2
13.	Thermal methods of analysis Theory, introduction, instrumentation, factors affecting analysis, pharmaceutical applications of: Thermogravimetry (TG), Differential thermal analysis (DTA), Differential Scanning Calorimetry (DSC).	5

REFERENCES

1. Skoog-Principles of Instrumental Analysis. 4th edition, Saunders College Publishing, 1992, USA.
2. Browning- Chromatography, 1969, Mc Graw Hill, London.
3. Willard H.H, L.L. Merrit & John A. Dean-Instrumental Method of Analysis, 6th edition, 1986, CBS Publishers & Distributors, New Delhi.
4. Beckett & Stenlake-Practical Pharmaceutical Chemistry, 4th edition, 1988, CBS Publishers & Distributors, India.
5. I.P, U.S.P, B.P, European Pharmacopoeia.
6. James W. Munson-Pharmaceutical Analysis: Modern methods, Marcel Dekker Inc, 1981, USA.

PHARMACOGNOSY III

3 hrs/week

Drugs mentioned in bold are for detailed study

Sr.no.	Topics	Hours
1.	Alkaloids: Chemistry, classification and occurrence of alkaloid in general. Detailed study of the following plants containing alkaloids Ephedra , colchicum, cocoa & tea , coffee, lobelia, tobacco, belladonna, datuna stramonium, hyoseyamus, cinchona , opium , ashwagandha, ipecae , rauwolfia , vinca, nux vomica , vasaka , aconite, kurchi , pilocarpus, cola, coca, pepper, curare alkaloids, ergot.	12
	Biosynthesis of lysergic acid, opium alkaloids, tropane alkaloids, colchicine, emetine, quinine	3
2.	Occurrence, structure and applications of following Glycosides a) Anthroquinone - Rubia, cochineal, aloes, hypericum, cascara, andira, senna , rhubarb . b) Isothiocyanate - Brassica c) Cyanogenetic - Almonds, wild cherry d) Napthoquinone - Plumbago, alkanna, henna , walnut	6
	Biosynthesis of aloe emodin, amygdalin, juglone	2
3.	Brief introduction to Plant allergens Definition, classification (inhalant, injectant, infestants etc.) with examples. Plants causing hay fever & dermatitis, mould causing allergy.	2
4.	Sources, preparation and uses of following enzymes: Papain, bromelain, malt extract, serratiopeptidase, urokinase, streptokinase, pepsin. Study of lectins and snake venom. Preparation of polyvalent antivenins	3
5.	Study of following herbs as health food (Neutraceuticals):	3

	Alfaalfa, arnica, apricot pits, bran, chamomile, chicory, cucumber, fenugreek, onion, garlic, gentian, hydrocotyle, hibiscus, hops, honey, marigold, amla, ginseng, ashwagandha, ginko biloba, spirulina, gymnema, momordica, tinospora.	
6.	Study of preparation, composition and uses of fibres of plant, animal & mineral origin (cotton, jute, asbestos, glass wool, silk, wool, rayon and other regenerated fibres, nylon).	3
7.	Occurrence, composition, preparation and uses of following drugs of mineral origin: Diatomite, chalk, bentonite, tale. Study of sulphur containing naturally occurring compounds (sulphides, thiophenes)	2

REFERENCES

- 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 Febiger, 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 of Plant Analysis; Chapman & Hall, London
- 6) Brunton 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 I.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.

Sr. No.	Topics	Hours
1	Introduction to sterile dosage forms Parenteral products Various routes of parenteral administration, pyrogens, vehicle- WFI preparation, purity, storage and distribution, vehicles other than WFI, additives in parenteral products, types of formulations, freeze drying, containers- glass and plastics-types and evaluation, concept of FFS, rubber closures and testing, personnel, facilities- layout, environmental control cleanliness classes, air handling (HVAC systems), HEPA filters, laminar flow, production procedures, QA & QC-sterility test, pyrogen/endotoxin test, particulate evaluation, leaker test.	12
2	Ophthalmic products - Anatomy and physiology of eye - lachrymal system, tears, precorneal tear film, cornea, ocular bioavailability, types of ophthalmic products- solutions, suspensions, ophthalmic ointments and gels, preservatives and efficacy test, additives, QA and QC sterility test, clarity, particle size for suspension, tests on ointments and collapsible tubes, packaging. - Contact lens solutions: types of lenses- cleaning solution, disinfection solutions, lubricants, multipurpose solutions and packages.	8
3	Oral sustained and controlled release systems Advantages of SR systems, biopharmaceutical consideration and dose calculation of drug, properties of drug with reference to the design of oral SR systems, matrix and reservoir type of systems, dissolution controlled systems, diffusion controlled systems, ion exchange controlled systems.	8
4	Stability studies Kinetic principles, Arrhenius equation and derivation of shelf life based on Arrhenius equation, limitations and advantages of Arrhenius equation, degradation pathways- hydrolysis, oxidation, photolytic degradation, methods to enhance stability of drugs, interactions with containers and closures, accelerated stability studies, introduction to ICH guidelines.	8

REFERENCES

1. Pharmaceutical dosage forms: Parenteral medications, Vol. I, II, III, ed. by Kenneth A. Avis, Leon Lachman and H. A. Liberman, Marcel Dekker INC., 1986.
2. Pharmaceutics The science of dosage form design ed. by M. E. Aulton, 2nd ed., Churchill Livingstone, 2002.
3. Modern Pharmaceutics, 4th ed. Revised and Expanded, ed. by Gilbert S. Banker and Christopher T. Rhodes, Marcel Dekker INC., 2002
4. The theory and practice of industrial pharmacy, ed. by Leon Lachman, H. A. Liberman, J. L. Kanig, 3rd ed., Verghese Publishing house, 1987.

5. Remington, The science and practice of pharmacy, 21st ed., Vol I and II, B. L. Publications Pvt. Ltd., 2005.
6. Ophthalmic drug delivery, ed. by Ashim K. Mitra, 1993, Marcel Dekker INC.
7. Turco and Kings, Sterile Dosage forms, 3rd Edn., Lea & Febiger, Philadelphia, 1985.
8. Michael J. Akers, Quality Control of Parenterals, Marcel Dekker
9. "Controlled drug delivery- Fundamentals and Applications", Robinson Joseph R., Lee Vincent H., Vol 29, Marcel Dekker Inc.

BIOPHARMACEUTICS AND PHARMACOKINETICS

3 hrs/week

Topics	Hours
Introduction to the subject of biopharmaceutics and pharmacokinetics. Emphasis on the importance in drug discovery, development and clinical pharmacy.	1
Definitions, different mechanisms of drug transport, physiology of cell membrane and passage of drugs across cell membrane	2
Modified pH partition theory and its limitations Zero & first order transport.	2
Rate limiting steps in drug absorption, Theories of dissolution Physicochemical factors affecting the bioavailability of drugs	2
Physiology of GIT and oral bioavailability Formulation dosage form related factors and physiological factors affecting oral bioavailability.	2
Different routes of drug administration as alternative to oral route. Factors affecting bioavailability of drugs from parenteral routes e.g. insulin zinc suspension	2
Dissolution rate and methods of enhancing dissolution rate. Official and unofficial methods of dissolution Application to different dosage forms	2
<i>In-vitro in-vivo</i> correlation and its significance	1
Distribution Definition, relationship of drug transport to distribution process, perfusion limitation permeability limitation plasma protein and tissue protein binding, introduction to the concept of volume of distribution and factors affecting distribution	3
Elimination: Definition, introduction to elimination via metabolism and excretion Hepatic clearance, hepatic extraction ratio, intrinsic clearance, high to low clearance drugs, first pass effect and dependence of hepatic extraction ratio. Introduction to renal clearance and factors affecting renal clearance.	3
Pharmacokinetics: Introduction to compartmental and physiological models. Introduction to the one compartmental open model and its assumptions.	1
Mathematical treatment of pharmacokinetics upon IV bolus dosing and extravascular dosing Importance of volume of distribution, Clearance, elimination rate constant, half life, absorption rate constant, bioavailability. Introduction of the concept of area under the curve, the trapezoidal rule and the method of residuals.	9
Introduction to the rate method and sigma minus method for urine analysis for IV.	
Introduction to method for estimating bioavailability and bioequivalence.	2

Discussion of linear and nonlinear kinetics and description of factors resulting in non linear kinetics
Application of PK principles through simple problems.

2
2

REFERENCES

1. Brahmankar, D. M., Jaiswal, Sunil B., "Biopharmaceutics and Pharmacokinetics: a treatise," 1st Edition, 1995, Vallabh Prakashan, Delhi.
2. Banakar, Umesh, "Pharmaceutical Dissolution Testing", Volume 49, Marcel Dekker Inc., New York, 1992.
3. Malcom Rowland, Thomas Tozer, "Clinical Pharmacokinetics: Concept and Application", 3rd Edition, 1996, A Lea-Febiger book, B. I. Beverly Books Pvt. Ltd. USA.
4. Robert E. Notari, "Biopharmaceutics and Pharmacokinetics An Introduction", 1971, 4th Edition, Marcel Dekker Inc., New York.
5. Leon Shargel, Susanna Wu-Pong, Andrew B.C. Yu, "Applied Biopharmaceutics & Pharmacokinetics" 5th Edition, 2005 Singapore
6. Milo Gibaldi, "Biopharmaceutics and Clinical Pharmacokinetics" 4th Edition, 1991, USA.

PHARMACOLOGY IV

3 hrs/week

Sr.no.	Topics	Hours
1.	Drugs acting on central nervous system ◆ Aliphatic alcohols ◆ General anaesthetics ◆ Local anaesthetics ◆ Sedative-hypnotics & anxiolytic agents ◆ Antiepileptic drugs ◆ Antidepressants ◆ Antipsychotics ◆ Drugs used in Neurodegenerative disorders - Antiparkinsons - Drugs used in Alzheimer's disease ◆ Analgesics, antipyretic and anti-inflammatory drugs ◆ CNS stimulants & Psychotomimetic Drugs (Convulsions and respiratory stimulants, Psychomotor stimulants and Psychotomimetic drugs)	18
2.	Autocoids - Histamine, Antihistaminics - 5 HT and Antagonists - Kinins, Ecosonides, Cytokines, PAF	6
3.	Pharmacotherapy of Bronchial asthma	2
4.	Immunology- Regulation of Immune system physiological and pathological states, Signaling Pathways for activation and inhibition, Immunology of diseases like HIV and Cancer and their modulation &	6

	Immunomodulators.	
5.	Principles of toxicology - Heavy metal poisoning and its treatment - Pesticide poisoning and its treatment - Opium alkaloid poisoning and its treatment	4

REFERENCES:

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 NY, 2006
5. Lewis Pharmacology - By Crossland - 5th Edition, Churchill Livingstone
6. Laurence, D. R. & Bennet Clinical Pharmacology- 9th Edition, Elsevier, NY, 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, Hillton & Company, Calcutta, 2005

PHARMACOLOGY LABORATORY II

4 hrs/week

Sr.no.	Topics
1.	Experiments Bioassay of - Acetylcholine - Histamine
2	Demonstration - bioassay of oxytocin - bioassay of pancuronium (With Graph or Actual)
3	Demonstration / Simulated C D's - To study the CNS depressant activity of chlorpromazine on locomotor activity of mice using actophotometer - To study the effect of diazepam on the muscle grip strength of mice using rota-rod apparatus - Analgesic effect of aspirin using analgesiometer. - To study phenothiazine induced catatonia in rats and to study antiepileptic (antiparkinsons) effect of scopolamine - To study the anticonvulsant property of diazepam on pentylenetetrazole induced convulsions in mice or anticonvulsant effect of phenytoin against maximal electroshock induced convulsion in mice.
4.	Toxicity studies (CPCSEA, OCED guideline)

REFERENCES

1. Kulkarni, S. K. Handbook of Experimental Pharmacology – 3rd Edition Vallabh Prakashan New Delhi, 2005
2. Gosh M N. Fundamentals of Experimental Pharmacology, 3rd Edition. Hillton & 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.
5. Websites: Indian journal of Pharmaceutical education and research, Vol. 41 (1). Jan- Mar, 2007 52- 61 (www.ipper.org)

PHARMACEUTICAL CHEMISTRY LABORATORY-II

4 hrs/week

1. Synthesis of heterocycles a) Benzimidazole from o-phenylenediamine. b) 4-methyl carbostyrl from Acetoacetanilide
2. Perkin reaction: Cinnamic acid from benzaldehyde.
3. Claisen Aldol Condensation Chalcone
4. Benzilic acid rearrangement. Benzilic acid from benzil.
5. Hofmann rearrangement Anthranilic acid from Phthalimide.
6. Reduction reaction: PABA from p nitrobenzoic acid.
8. Esterification: Benzocaine from PABA
9. Condensation: Phenytoin
10. Multistep reaction: Sulfanilamide from acetanilide

PHARMACOGENOSY LABORATORY II

4 hrs/week

Sl. no.	Topics	Hours
1.	Morphology, microscopy and chemical test for identification of cinchona, vasaka, ephedra, kurchi, datura, nux vomica, senna, rauwolfia, ipecac	8
2.	TLC analysis Extraction and TLC 1) Alkaloids of nux vomica/cinchona 2) Glycosides of senna/aloe	2
3.	Morphological identification of drugs covered in theory (alkaloids and glycosides) any 20 samples	2
	Total	12

1. Preparation and monographic testing of WFI (IP)
2. Processing & testing of glass containers & rubber closures (as per IP)
3. Preparation and documentation of following :
 - A) Injections (official) –
 - Sodium chloride and Dextrose injection
 - Calcium gluconate injection
 - Ascorbic acid injection
 - One injection with oily vehicle
 - One suspension injection
 - B) Ophthalmic preparations
 - Sulphacetamide eye drops
 - One Antibiotic eye ointment
 - Contact lens solution
4. Calculation of Pharmacokinetic parameters (plasma samples provided)

FINAL YEAR B. PHARM SEMESTER VIII
PHARMACEUTICAL MEDICINAL CHEMISTRY-IV

3 hrs/week

Sr. No.	Topic	Hours
	Discussion of the following classes of drugs including, classification, chemical nomenclature, structure including stereochemistry, generic names, chemistry, physicochemical properties, SAR, Metabolism, molecular mechanism of action, and synthesis, introduction to rational development if any of the class of drugs:	
1.	CNS Drugs	
	(i) sedatives and hypnotics (mephobarbital, Phenobarbital*, pentobarbital, secobarbital, diazepam, nitrazepam*, oxazepam, alprazolam, midazolam, chlorodiazepoxide, choral hydrate, glutethimide*, zolpidem, zopiclone)	5
	(ii) anticonvulsants (Phenobarbital, chlordiazepoxide, diazepam, clonazepam*, phenytoin, trimethadione, paramethadione, ethosuximide*, phenosuximide, primidone, sodium valproate, carbamazepine*, progabide, lamotrigine, vigabatrin)	5
	(iii) antipsychotics (chlorpromazine*, triflupromazine, thioridazine, fluphenazine, chlorprothixene, loxapine, clozapine, haloperidol*, droperidol, risperidone*, pimozide, molindone)	5
	(iv) anti-anxiety agents (meprobamate, tybamate, hydroxyzine, buspirone)	1
	(v) antidepressants (imipramine, chlorimipramine, amitriptyline, nortriptyline, doxepine*, fluoxetine*, paroxetine, trazodone, iproniazid, pargline, isocarboxazide, tranylecypromine)	5
	(vi) antiparkinsons (carbidopa*, levodopa, selegiline, amantadine, bromocriptine, benzotropine*, procyclidine, trihexyphenidyl, orphenadrine)	2
	(vii) analgesics (opioids) (morphine, codeine, levophanol, dextromethorphan, phenazocine, pentazocine, meperidine*, α - and β -prodine, pheniridine, anileridine, fentanyl, methadone*, phenadoxone, racemoramide, dextropropoxyphene*, nalorphine, naloxone, naltrexone)	7
2.	NSAID's (aspirin, paracetamol, phenylbutazone*, oxyphenbutazone, indomethacin, sulindac, mefenamic acid, ibuprofen, naproxen*, ketoprofen, nabumetone, diclofenac*, nimesulide, celecoxib, rofecoxib, piroxicam*, colchicines, sulfapyrazole, allopurinol)	6
	*indicates synthesis to be discussed	

REFERENCES

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. 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, Wiley.

PHARMACEUTICAL ANALYSIS V

3 hrs/week

Sr. No.	Topic	Hours
1	Atomic absorption and Emission spectroscopy Principle, differences between atomic absorption spectroscopy and flame emission spectroscopy. Instrumentation- Radiation sources, Flame atomization (types of flames, flame structure, flame atomizers), single and double beam spectrophotometers, advantages and disadvantages, Pharmaceutical applications.	3
2	Nuclear Magnetic Resonance Spectroscopy Introduction, Phenomenon (Spinning nucleus, effect of an external magnetic field, precessional motion, precessional frequency, energy transitions), theory, Chemical shift and its measurement (factors influencing chemical shift-shielding, deshielding, Vander Waals deshielding, anisotropic effect, eg: alkanes, alkenes, carbonyl, aromatic and cyclohexane), Solvents used in NMR (Choice of solvents, solvent shifts-concentration, temperature, hydrogen bonding effects), Spin-spin coupling and splitting (splitting of NMR signals, theory, coupling constants, multiplicities of signal, chemical and magnetic equivalence), spin-spin decoupling, Instrumentation (Magnets, magnetic field sweep, radiofrequency oscillator, receiver, recorder and integrators, applications.	6
3	Mass spectrometry Introduction, Basic principles, Instrumentation (single focusing and double focusing mass spectrometer, quadrupole mass spectrometer, GC-MS, HPLC-MS), Electron impact, chemical ionisation, Field ionisation mass spectrometry, fast atom bombardment spectrometry), base peak, Molecular ion, metastable ions, Fragmentation processes, Applications.	6

4	Radiochemistry and Radiopharmaceuticals Fundamentals of radioactivity (radionuclide, Isotopes, radioactive decay, half-life of radionuclide, specific activity, Becquerel, Curie). Properties of radiation, Radiation protection, measurement of radioactivity (Geiger-Muller counter, liquid scintillating counting, gamma scintillation detector), Radiopharmaceuticals (Properties of radionuclide, pharmaceutical properties, chemical properties), ^{99m} Tc generator, Quality control of radiopharmaceuticals (Physical, chemical and sterility control, radionuclidic purity and radiochemical purity), Isotope dilution analysis.	5
5	Near IR spectroscopy- Introduction, Principles, Advantages, Qualitative measurements- NIR overtone bands of organic functional groups, Quantitative absorption- Absorbance measurements, diffuse reflectance measurements, Instrumentation- Radiation source, Wavelength selection, Detectors, Sample interface, Sample preparation, pharmaceutical applications of NIR.	3
6	X-Ray methods- Introduction, Instrumentation, identification of crystalline compound, X-ray powder diffraction, Bragg reflections, diffraction methods, Pharmaceutical analytical applications.	3
7	Structural elucidation problems based on UV, IR, NMR, Mass spectroscopy (simple problems with molecular formula given).	8
8	Hyphenated Techniques-GC-MS, LC-MS (Interfaces and Applications only).	2

REFERENCES

1. Skoog-Principles of Instrumental Analysis, 4th edition, Saunders College Publishing, 1992, USA.
2. Browning- Chromatography, 1969, Mc Graw Hill, London.
3. Willard H.H, L.L. Meritt & John Dean-Instrumental Method of Analysis, 6th edition, 1986, CBS Publishers & Distributors, New Delhi.
4. Beckett & Stenlake-Practical Pharmaceutical Chemistry, 4th edition, 1988, CBS Publishers & Distributors, India.
5. I.P, U.S.P, B.P, European Pharmacopoeia.
6. William Kemp-Organic Spectroscopy, 3rd edition, Reprinted 2005, Palgrave Publishers Ltd, New York.
7. Clive Whiston-Analytical Chemistry by open learning, 1987, John Wiley & Sons, New York, Toronto.

Study of Occurrence, chemistry and applications of following crude drugs with detailed pharmacognosy for the drugs mentioned in bold

Sr.no.	Topics	Hours
1.	Glycosides Saponin glycosides (liquorice , quillaia, asparagus , ginseng, dioscorea, agave, fenugreek, bacopa, hydrocotyle, alpina, smilax <i>Acacia concinna</i> , sapiandus) Cardiac (digitalis , strophanthus, squill, nerium, thevetia) Biosynthesis of steroidal glycoside molecule.	6
2.	Volatile oils: with respect to sources, composition & preparation of volatile oils and uses. Umbelliferous fruits (anise, caraway, dill , ajowan, fennel , coriander), clove , cardamom , cinnamon , <i>Saussurea lappa</i> , eucalyptus , sandalwood, star anise, patchouli oil, lemongrass, winter green, palmrosa, rose, abolmescus, rasana, nutmeg, lemon peel oil, orange peel oil, spearmint oil and peppermint oil, jatamansi, valerian, artemesia, vetiver.	9
3.	Resins turpentine , cannabis hops, Colophony , myrrh, shellac, benzoin, balsams (tolu, Peru), turmeric , guggulu, ginger , colocynth, guaiacum, asafetida, capsicum	4
4.	Flavonoids Quercetin, Rutin, hesperidin & flavonoids from orange peel powder.	2
5.	Phenylpropanoids & Lignans podophyllum, psoralea, Ammi majus, phyllanthus	2
6.	Polyketides - male fern, podophyllum	1
7.	Terpenoids & iridoids (Structure, occurrence, and uses) Quassia, piccerhiza, tinospora, Artemisia, taxus, carrot, gentian, chirata, andrographs.	4
8.	Biosynthesis of terpenoids (mono, sesqui, di and triterpenoids) (skeleton only)	2
9.	Phytotoxins <i>Abrus precatorius</i> , aconite, <i>Belighia sapida</i> , curare, datura, lily of the valley, ergot, poison hemlock, poison ivy, yew, mushrooms, psoralea.	2
10.	Introduction to marine Drugs Cytotoxins with any two examples.	2
11.	Special aspects of preparation of Ayurvedic formulations and herbal formulations. Preparation and Evaluation of plant extracts and formulations with respect to phytoconstituents.	2

REFERENCES

- 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 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 Techniques and Experiments; Nirali Prakashan, Pune
- 15) Vasudevan T.N., Laddha K.S.: Practical Pharmacognosy; New Vrinda Publishing House, Jalgaon.

PHARMACEUTICS VII

3 hrs/week

Note: References to latest amendments of Schedule M and Schedule U of Drugs and Cosmetics Act 1940 to be made wherever it is appropriate

Sr. No.	Topic	Hours
1.	Quality assurance (discuss specimen documents) Raw material control, actives and inactives, in process control, sanitization, environmental and microbiological control, packaging and labelling control, finished product control, standard operating procedures, cGMP, Q.C standards of identity, purity, quality and potency, Q.C. charts, sampling & sampling plans.	8
2.	Documentation – need/importance, batch manufacturing records, SOPs, Maintenance & Retrieval of Documents	3
3.	Pilot plant scale up techniques – group's responsibilities, facilities, example of scaling up of manufacturing of tablets, liquids and semisolids.	5
4.	Validation – Definition, Types, Qualification Process Validation – steps & documentation (Brief). Examples – Raw Materials, mixing and granulation, mixer, granulator. Validation of sterilization process and equipment- microbial death kinetic terms, F	5

5.	value applications, steps for validating steam sterilization method. Production management Pharma industry- current scenario Site selection and development – factors to be considered in designing a facility, layout of manufacturing facilities, environmental aspects, materials of construction, equipment selection, handling of components and containers, vendor audit, warehousing, maintenance and service aspects. Personnel - qualifications, selection, responsibilities & training Materials management, sales forecasting, inventory control, production planning, elements of cost & cost controls.	8
6.	Factory Layout – considerations/steps. Examples of Typical layout schemes for Tablets, capsules, liquids, sterile formulations manufacturing areas.	4

REFERENCES

1. The theory and practice of industrial pharmacy, ed. by Leon Lachman, H. A. Liberman, J. L. Kanig, 3rd ed., Verghese Publishing house, 1987.
2. The science and practice of pharmacy, 21st ed., Remington, Vol I and II, B. I. Publications Pvt. Ltd., 2005.
3. Cole, Graham. "Pharmaceutical Production Facilities : Design and Applications" 1990.
4. Pharmaceutical Process Validation, 2nd Edition, Nash Robert A., Berry Ira R., Volume 57, 1992, Marcel Dekker Inc., New York.
5. Pharmaceutical dosage forms: Parenteral medications, Vol. I, II, III, ed. by Kenneth A. Avis, Leon Lachman and H. A. Liberman, Marcel Dekker INC., 1986.

NOVEL DRUG DELIVERY SYSTEMS

3 hrs/week

S. No.	Topic	No of lectures
1.	<u>Oral Controlled Drug Delivery Systems-</u> a) Multiparticulate drug delivery systems (Pellets)- need and significance of pelletization, techniques- pan coating, extrusion and spheronization, equipments, evaluation b) Osmotic Systems- Basic principles, classification, oral osmotic pumps, applications & evaluation c) Gastroretentive drug delivery systems (GRDDS)- Regional variability in intestinal absorption and concept of absorption window. Design of GRDDS technologies- low density (Floating systems), Swelling and expanding systems, Mucoadhesive systems, high density systems. Evaluation of GRDDS.	3
2.	<u>Mucoadhesive drug delivery systems</u> Mucoadhesion and theories, factors influencing mucoadhesion, <i>in vitro-in vivo</i> methods to study mucoadhesion, bioadhesive polymers and systems.	4

3.	<u>Ocular drug delivery systems</u> Limitations of conventional systems, ophthalmic inserts- nonerodible and erodible inserts, pilocarpine ocular insert, Lacrisert, SODI, Minidisc, NODS, polymers, particulates, enhancers, intraocular solutions, ocular iontophoresis, evaluation.	6
4.	<u>Transdermal drug delivery systems (TDDS)</u> Skin and skin permeation, modes of percutaneous penetration, components of TDDS, different types of TDDS and release control mechanisms, production, evaluation of PSA and TDDS - <i>in vitro</i> , <i>in vivo</i> .	6
5.	<u>Introduction to targeting. Passive and active targeting</u> a) Targeting to lymphatic systems Anatomy of lymphatic system, lymphatics in intestine, factors enhancing intestinal drug uptake, approaches, prodrug and delivery systems examples, parenteral drug administration for lymphatic transport. b) Liposomes Structural components and classification, methods of preparation, size reduction, characterization, stability, applications c) Drug targeting to brain The blood brain barrier, transport through blood brain barrier, factors affecting drug permeation through BBB, strategies for brain drug delivery d) Nanoparticles Preparation techniques, characterization, biodistribution, evaluation and applications. e) Colonic targeting- Physiology of colon, difficulties in colonic targeting, approaches- prodrug, pH sensitive polymers, polysaccharides, time release systems, osmotic systems, azo polymers, evaluation.	1

REFERENCES

1. Advances in controlled and novel drug delivery, ed. by N. K. Jain, CBS publishers and distributors, 2001.
2. Modern Pharmaceutics, 4th ed. Revised and Expanded, ed. by Gilbert S. Banker and Christopher T. Rhodes, Marcel Dekker INC., 2002
3. Targetted and controlled drug delivery, Novel carrier systems, S. P. Vyas and R. K. Khar, CBS publishers and distributors, 2002.
4. Controlled and novel drug delivery, ed. by N. K. Jain, CBS publishers and distributors, 1997.
5. Controlled drug delivery, concepts and advances, S. P. Vyas and R. K. Khar, Vallabh Publishers, 2002.
6. The theory and practice of industrial pharmacy, ed. by Leon Lachman, H. A. Liberman, J. L. Kanig, 3rd ed., Verghese Publishing house, 1987.
7. The science and practice of pharmacy, 21st ed., Remington, Vol I and II, B. I., Publications Pvt. Ltd., 2005.
8. Bioadhesive Drug Delivery Systems - Fundamentals, Novel Approaches, and Development, Mathiowitz Edith, Chickering III, Donald E., Lehr Claus-Michael, Volume 98, Marcel Dekker Inc., New York, 1995.

9. Nanoparticulate Drug Delivery Systems, Thassu Deepak, Dellers Michael, Pathak Yashwant, Volume 166, Marcel Dekker Inc., New York, 2007.
10. Microencapsulation – Methods and Industrial Applications”, Benita Simon, 2nd Edition, Marcel Dekker Inc., New York, 2006.
11. Controlled and Novel Drug Delivery, Jain N. K., 1st Edition, CBS Publishers and Distributors, New Delhi, 2004.
12. Targeted and Controlled Drug Delivery- Novel Carrier Systems”, Vyas S. P., Khar R. K., 1st Edition, CBS Publishers and Distributors, New Delhi, 2002.
13. Ophthalmic Drug Delivery Systems, Mitra, Ashim K., Volume 58, Marcel Dekker Inc., New York, 1993.
14. Encyclopedia of Pharmaceutical Technology, Swabrick, Boylan, Volumes 1,6,8,9,10,12,13,14,15,16,17,18,19,20, Marcel Dekker Inc., New York.
15. Oral Mucosal Drug Delivery, Rathbone Michael J., Volume 74, 1996 Marcel Dekker Inc., New York, 1996.

FORENSIC PHARMACY AND JURISPRUDENCE

3 hrs/week

S. No.	Topics	Hours
1	Historical perspectives including details of Chopra Committee and Hathi Committee	1
2	An objective study of the following Acts incorporating the latest amendments Pharmacy Act 1948 • Definitions • PCI and State Councils Composition and Function • Preparation of Registers and qualifications for entry into registers • Educational Regulations and Approval of Courses and Institutions • Offences and Penalties	14
3	Drugs and Cosmetics Act 1945 • Definitions. • Advisory bodies: DTAB and DCC: Composition and Function • Drug Control Laboratories and Government Analysts • Drug inspectors, Licensing Authorities, Controlling Authorities and Customs Collectors. • Provisions Governing Import, Manufacture and Sale of Drugs • Labeling and Packaging of Drugs. • Provisions applicable to Manufacture and Sale of Ayurvedic Drugs • Provisions Governing Import, Manufacture and Sale of Homeopathic Drugs. • Provisions Governing Import, Manufacture and Sale of Cosmetics • Various offences and corresponding Penalties • Broad content of various Schedules of the Drugs and Cosmetics Act and Rules	14

1	Drugs and Magic Remedies (Objectionable Advertisements) Act 1954	2
	• Definitions, Prohibited Advertisements, Savings	
2	Narcotic Drugs and Psychotropic Substances Act	2
	• Definitions	
	• Narcotics Commissioner and other officers	
	• Illicit Traffic and measures to prevent illicit traffic of opium	
	• Offences and corresponding penalties	
3	Drug price Control Order 1995 and New Drug Policy	2
4	Medicinal and Toilet Preparations (Excise Duties) Act.	2
	• Definitions, restricted and unrestricted preparations	
	• Manufacturing in bond and outside bond	
5	Prevention of Food Adulteration Act 1954	2
	• Definitions	
	• Central board of food standards, central food laboratory, compositions and functions	
	• Public analysts and food inspectors	
6	Indian Patents Act 1975	2
7	Bombay Shops and Establishments Act	1
	• Definitions and Provisions	
8	Factories Act 1954	1
	• Definitions and Provisions	
9	Indian Penal Code and Code of Criminal Procedures	1
	• Provisions pertaining to different Courts, jurisdiction and power.	
	• Provisions governing entry, search, arrest, bailable and non-bailable offences, Cognizable and non-cognizable offences	
10	Insecticides Act	1
	• Definitions	
	• Procedure for licensing and registration of insecticides	
	• Savings	

REFERENCES

1. "Forensic Pharmacy", Kuchekar and Kadtare and Itkar, Nirali Prakashan, 5th edition, 2005.
2. "Text book of Forensic Pharmacy" N.K.Jain, Vallabhprakashan, 4th edition, 1999
3. D&C Acts, 1940 and Rules, 1945, S.W.Deshpande, and Nilesh Gandhi, Summit Publishers 2006, Mumbai.
4. Govt of India Publication of above Acts and Rules.

Sr.No.	Topics	Hours
1.	Concept of clinical pharmacy, community pharmacy and hospital pharmacy (definition, scope and objectives)	6
2.	Concept of therapeutic drug monitoring and patient compliance	6
3.	Role of pharmacist as a patient counselor	3
4.	Rational use of drugs	16
	- Drug - drug interactions possible mechanisms and examples - Drug interaction with food, alcohol, tobacco - Adverse drug reactions - Types and examples - Detection and prevention of ADR - Drugs used in geriatrics, pediatrics and pregnancy - Irrational drug combination - Dose adjustment in renal and hepatic dysfunction	
5.	General Introduction to drug discovery and development Pre- Clinical Stages Clinical development - phases of clinical trials Commercial Aspects	5

REFERENCES

- 1) Clinical Pharmacy - Dr. Tipnis, Dr. Bajaj, 1st Edition, Career Publications, 2003
- 2) Clinical Pharmacology- P. N. Bennett, M. J. Brown, 9th Edition, Churchill Livingstone, 2006
- 3) Text Book of Clinical Pharmacy Practice- G. Parthsartathi, Karin Nyfort Hansen, Milap C. Nahata, Orientlongman, 2004.
- 4) Clinical Pharmacy and Therapeutics- Roger Walker, Clive Edwards, 3rd Edition, Churchill Livingstone, 2003.

PHARMACEUTICS LABORATORY V

4 hrs/week

1. S.R. oral tablets - use of hydrophobic and hydrophilic matrix materials (monolithic and reservoir) - preparation and *in vitro* release evaluation.
2. Dissolution testing - Marketed formulations of conventional tablets- soluble drug & poorly soluble drug (selection of medium)
3. Ophthalmic DDS- Mucoadhesive gel and evaluation.
4. Accelerated stability testing of any suitable drug/ formulation
5. Demonstration of sugar and film coating of tablets.
6. Microencapsulation by coacervation phase separation technique of a liquid (volatile oil) & a solid (Charcoal/ Paracetamol), evaluation of the products.
7. SR suppositories- PEG base and Hydrogel base- evaluation of *in vitro* release.

PHARMACOGNOSY LABORATORY III

4 hrs/week

Sr.no.	Topics	Hours
1.	Macroscopy, microscopy of liquorice, clove, fennel, dill, cardamom, cinnamon, coriander, quassia, kalmegh, picrorrhiza, asparagus.	8
2.	Extraction and detection of phytoconstituents of following classes (Any two examples of each class). Flavonoids, glycosides (liquorice), volatile oils (clove, fennel, anise, dill)	2
3.	Qualitative analysis of unorganized drugs as covered in theory (asafetida, myrrh, benzoin, guggul, and aloes).	2
4.	Microscopic evaluation of Ayurvedic churna formulation & analysis of total tannins from Triphala churna.	1
5.	Morphological identification of drugs covered in theory (volatile oils and glycosides) any 20 samples.	1
	Total	14

PHARMACEUTICAL ANALYSIS LABORATORY III

4 hrs/week

1. Determination of pK_{a1} and pK_{a2} of phosphoric acid.
2. Determination of HCl and phosphoric acid in a given mixture potentiometrically.
3. Assay of paracetamol tablets, propranolol tablets, albendazole tablets, Rifampicin capsules as per I.P.
4. Assay of quinine sulphate by fluorimetry.
5. Study of quenching effects of iodide ions on fluorescence of quinine sulphate
6. Assay of phenylephrine hydrochloride ophthalmic solution by difference spectroscopy.
7. Assay of caffeine and sodium benzoate injection by simultaneous equation method and absorbance ratio method.
8. Assay of trimethoprim in cotrimoxazole tablets as per I.P.
9. Assay of nifedipine and atenolol tablets by UV.
10. Determination of streptomycin base colorimetrically from injection.
11. Identification of sample by TLC.

Demonstration experiments:

1. Assay of sample by HPLC/ HPTLC/ GC.
2. Qualitative analysis by I.R.
3. Determination of K^+ from KCl by flame photometry.
4. Selection of mobile phase for TLC.
5. Identification of amino acids by paper chromatography.

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