SHAHEED BENAZIR BHUTTO UNIVERSITY SHERINGAL PHARM-D CURRICULUM

Department of Pharmacy

Doctor of Pharmacy (PharmD) Curriculum – Term System

This curriculum is adopted in full compliance with the guidelines of the Higher Education Commission (HEC) and the Pharmacy Council of Pakistan.

Sessions 2009–2014, 2010–2015, 2011–2016, 2012–2017

SHAHEED BENAZIR BHUTTTO UNIVERSITY SHERINGAL
Dir Upper Pakistan -18050

SCHEME OF COURSES FOR PHARM-D
FOR TERM SYSTEM

1st Professional Pharm-D

1st Term			2nd Term		
Course No.	Subject	Cr. Hr.	Course No.	Subject	Cr. Hr.
301	Pharmaceutical Chemistry-I (Organic-I) [Th.]	3	302	Pharmaceutical Chemistry-II (Organic-II) [Th.]	3
303	Pharmaceutical Chemistry-I (Organic-I) [Lab.]	1	304	Pharmaceutical Chemistry-II (Organic-II) [Lab.]	1
305	Pharmaceutical Biochemistry-I [Th.]	3	306	Pharmaceutical Biochemistry-II [Th.]	3
307	Pharmaceutical Biochemistry-I [Lab.]	1	308	Pharmaceutical Biochemistry-II [Lab.]	1
309	Pharmaceutics-I (Physical Pharmacy-1) [Th.]	3	310	Pharmaceutics-II (Physical Pharmacy-I1) [Th.]	3
311	Pharmaceutics-I (Physical Pharmacy-1) [Lab.]	1	312	Pharmaceutics-II (Physical Pharmacy-I1) [Lab]	1
313	Physiology & Histology-I [Th.]	3	314	Physiology & Histology -II [Th.]	3
315	Physiology & Histology-I [Lab.]	1	316	Physiology & Histology -II [Lab.]	
317	Anotomy	3	318	Biostatistics	1
319	Pharmaceutical Mathematics	2			4
	Total Cr. Hr.	21		Total Cr.Hr.	20

2nd Professional Pharm-D

3rd Term			4th Term		
Course No.	Subject	Cr. Hr.	Course No.	Subject	Cr. Hr.
401	Pharmaceutics-III (Pharmaceutical Preparations-I) [Th.]	3	402	Pharmaceutics-IV (Pharmaceutical Preparations-II) [Th.]	3
403	Pharmaceutics-III (Pharmaceutical Preparations-I) [Lab.]	1	404	Pharmaceutics-IV (Pharmaceutical Preparations-II) [Lab.]	1
405	Pharmacology & Therapeutics-I (General-I) [Th.]	3	406	Pharmacology & Therapeutics-II (General-II) [Th.]	3
407	Pharmacology & Therapeutics-I (General-I) [Lab.]	1	408	Pharmacology & Therapeutics-II (General-II) [Lab.]	1
409	Pharmacognosy-I [Th.]	3	410	Pharmacognosy-II [Th.]	
411	Pharmacognosy-I [Lab.]	1	412	Pharmacognosy-II [Lab.]	3
413	Pharmaceutical Microbiology-I [Th.]	3	414	Pharmaceutical Microbiology-II [Th.]	1 3
415	Pharmaceutical Microbiology-I [Lab.]	1	416	Pharmaceutical Microbiology-II [Lab.]	1
417	Pakistan Studies	3	418	Islamiyat	3
	Total Cr. Hr.	19		Total Cr.Hr.	19

3rd Professional Pharm-D

5th Term			6th Term		
Course No.	Subject	Cr. Hr.	Course No.	Subject	Cr. Hr.
501	Pathology [Th.]	3	502	Computer and its Applications in Pharmacy [Th.]	3
503	Pathology [Lab.]	1	504	Computer and its Applications in Pharmacy [Lab.]	1
505	Pharmacology & Therapeutics-III (Systemic Pharmacology-I) [Th.]	3	506	Pharmacology & Therapeutics-IV (Systemic Pharmacology-II) [Th.]	3
507	Pharmacology & Therapeutics-III (Systemic Pharmacology-I) [Lab.]	1	508	Pharmacology & Therapeutics-IV (Systemic Pharmacology-II) [Lab.]	1
509	Pharmacognosy-III [Th.]	3	510	Pharmacognosy-IV [Th.]	3
511	Pharmacognosy-III [Lab.]	1	512	Pharmacognosy-IV [Lab.]	1
513	Pharmaceutical Chemistry-III (Instrumentation-I) [Th.]	3	514	Pharmaceutical Chemistry-IV (Instrumentation-II) [Th.]	3
515	Pharmaceutical Chemistry-III (Instrumentation-I) [Lab.]	1	516	Pharmaceutical Chemistry-IV (Instrumentation-II) [Lab.]	1
517	Pharmaceutics-V (Dispensing Pharmacy) [Th.]	2	518	Pharmaceutics-VI (Community Pharmacy) [Th]	4
519	Pharmaceutics-V (Dispensing Pharmacy) [Lab.]	1			
	Total Cr. Hr.	19		Total Cr. Hr.	20

Fourth Professional Pharm-D

7th Term			8th Term		
Course No.	Subject	Cr. Hr.	Course No.	Subject	Cr. Hr.
601	Pharmaceutics-VII (Hospital Pharmacy-I) [Th.]	3	602	Pharmaceutics-VII (Hospital Pharmacy-II) [Th.]	3
603	Pharmaceutics-VIII (Clinical Pharmacy-I) [Th.]	3	604	Pharmaceutics-VIII (Clinical Pharmacy-II) [Th.]	3
605	Pharmaceutics-VIII (Clinical Pharmacy-I) [Lab.]	1	606	Pharmaceutics-VIII (Clinical Pharmacy-II) [Lab.]	1
607	Pharmaceutics-IX (Industrial Pharmacy-I) [Th.]	3	608	Pharmaceutics-IX (Industrial Pharmacy-II) [Th.]	3
609	Pharmaceutics-IX (Industrial Pharmacy-I) [Lab.]	1	610	Pharmaceutics-IX (Industrial Pharmacy-II) [Lab.]	1
611	Pharmaceutics-X (Bio-pharmaceutics-I) [Th.]	3	612	Pharmaceutics-X (Bio-pharmaceutics-II) [Th.]	3
613	Pharmaceutics-X (Bio-pharmaceutics-I) [Lab.]	1	614	Pharmaceutics-X (Bio-pharmaceutics-II) [Lab.]	1
615	Pharmaceutics-XI (Pharmaceutical Quality Management-I) [Th.]	3	616	Pharmaceutics-XI (Pharmaceutical Quality Management-II) [Th.]	3
617	Pharmaceutics-XI (Pharmaceutical Quality Management-I) [Lab.]	1	618	Pharmaceutics-XI (Pharmaceutical Quality Management-II) [Lab.]	1
		19			19

Final (Fifth) Professional Pharm-D

9th Term			10th Term		
Course No.	Subject	Cr. Hr.	Course No.	Subject	Cr. Hr.
701	Pharmaceutical Chemistry-V (Medicinal-I) [Th.]	3	702	Pharmaceutical Chemistry-V (Medicinal-II) [Th.]	3
703	Pharmaceutical Chemistry-V (Medicinal-I) [Lab.]	1	704	Pharmaceutical Chemistry-V (Medicinal-II) [Lab.]	1
705	Pharmaceutics-XVII (Clinical Pharmacy-III) [Th.]	3	706	Pharmaceutics-XVII (Clinical Pharmacy-IV) [Th.]	3
707	Pharmaceutics-XVII (Clinical Pharmacy-III) [Lab.]	1	708	Pharmaceutics-XVII (Clinical Pharmacy-IV) [Lab.]	1
709	Pharmaceutics-XVIII (Pharmaceutical Technology-I) [Th.]	3 1	710	Pharmaceutics-XVIII (Pharmaceutical Technology-II) [Th.]	3 1
711	Pharmaceutics-XVIII (Pharmaceutical Technology-I [Lab.]	3	712	Pharmaceutics-XVIII (Pharmaceutical Technology-II) [Lab.]	3
713	Pharmaceutics-XIX (Forensic Pharmacy-I) [Th.]	3	714	Pharmaceutics-XIX (Forensic Pharmacy-II) [Th.]	3
715	Pharmaceutics-XX(Pharmaceutical Management & Marketing-I) [Th]		716	Pharmaceutics-XX (Pharmaceutical Management & Marketing-II) [Th]	
	Total Cr. Hr.	18		Total Cr. Hr.	18

NOTE:

1. Two credit hours of mathematics will be equal to 40 marks. Four credit hours for Biostatistics will be equal to 60 marks.
2. Two credit hours of dispensing will be equal to 40 marks while one credit hour of practical will be equal to 60 marks.
3. In general, three credit hours of theory will be equal to 50 marks. One credit hour of practical will also be equal to 50 marks.
   Moreover, four credit hours will be equal to 100 marks.
4. One credit hour of practical means that there will be one practical class in a week and one practical class will not be less than 3hours.

Pharm-D	Term cr. Hrs.	Term cr. Hrs.	Total cr. Hrs.
1st Prof.	21	20	41
2nd Prof.	19	19	38
3rd Prof.	19	20	39
4th Prof.	19	19	38
Final Prof.	18	18	36
Total	98	98	192

DETAILS OF COURSES FOR PHARM-D (TERM SYSTEM)

FIRST PROFESSIONAL

1st TERM

301 PHARMACEUTICAL CHEMISTRY-I (ORGANIC-I)
[Theory] Cr. Hr. 03

Note: The topics will be taught with special reference to their Pharmaceutical Applications.

1. BASIC CONCEPTS: Conjugation, hyperconjugation, steric effect, inductive effect, mesomeric effect, hydrogen bonding, Theory of resonance. Effect of structure on reactivity of compounds. Tautomerism of carbonyl compounds.

2. NUCLEOPHILIC AND ELECTROPHILIC SUBSTITUTION REACTION IN ALIPHATIC AND AROMATIC SYSTEMS.

3. ORIENTATION IN ELECTROPHILIC SUBSTITUTION REACTIONS ON BENZENE RING.

4. ORGANIC REACTIONS: Baeyer-Villiger oxidation; Diels Alder reaction; Grignard's reaction, Metal hydride reduction and Wolf Krishner reduction, Friedel Craft's reaction, Perkin reaction, Cannizzaro reaction, Wolf Kishner reduction.

5. CARBONIUM ION REARRANGEMENTS & THEIR STABILITY: Pinacol-pinacolone, Wagner-Meerwein, Wolf, Hofmann and Beckmann rearrangements.

6. CARBANIONS & THEIR STABILITY: Condensation reaction (Aldol condensation; Favorskii rearrangement; Witting reaction).

303 PHARMACEUTICAL CHEMISTRY-I (ORGANIC-I)
[Laboratory] Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Organic analysis: Identification of unknown simple organic compounds.

Recommended Books

1. Peter Sykes, **A Guide Book to Mechanism in Organic Chemistry**, Longman, New York, 1st Ed., 1991.
2. E L Eliel, **Stereochemistry of Carbon Compounds**, Tata MacGraw-Hill, New Delhi, 1992.
3. Rehman and M Younis, **Organic Chemistry for B.Sc. students**, Ilmi Kitab Khana, Lahore, 1997.
4. L Finar, **Organic Chemistry** Vol I, Person Education Asia, 6th Ed., New Delhi, 2001.
5. Raj K Bansel, **Organic Reaction Mechanism**, Tata MacGraw-Hill, New Delhi, 1992.
6. Furaiss Brian, **Practical Organic Chemistry**, 5th Ed., ELBS, London.
7. Sykes A P, **Guide Book to Mechanism in Organic Chemistry**, 5th Ed., Lonsmen Co, UK, 1970.
8. Roberts J D and Caserio M C, **Basic Principles of Organic Chemistry**, 1990.
9. Naser-ud-Din, **Introduction to Stereochemistry**, Ghafoor Stationary Mart, Peshwar, 1994.
10. Bhal B S, **Text Book of Organic Chemistry**, S Chand & Co. New Delhi, 14th Ed., 1995.

305 PHARMACEUTICAL BIOCHEMISTRY-I (Theory) Cr. Hr. 03

1. GENERAL INTRODUCTION AND BASIC BIOCHEMICAL PRINCIPLES
   Role of pharmaceutical biochemistry in the health profession. Nature of biochemical reactions.

2. BASIC CHEMISTRY OF BIOMOLECULES (Nature, Classification etc.)
   (a) Carbohydrates: Chemistry, Classification, Reactions of Carbo-hydrates, Optical activity, Biological and pharmaceutical importance of carbohydrates.
   (b) Lipids: Chemistry of Fatty acids and Lipids, Classification (Saponifiable and non-saponifiable lipids, Simple, Complex and

derived lipids), Reactions of Fatty acids and other Lipids, Essential fatty acids, Biological and pharmaceutical importance of lipids.

(c) Proteins and Amino acids: Chemistry, Classification of proteins and amino acids, Reactions of proteins and amino acids, Organizational levels, Macromolecular nature of proteins, Biological and pharmaceutical importance of proteins and amino acids.

(d) Nucleic acids: Chemistry, Types (DNA, RNA, mRNA, tRNA, rRNA), Purine and Pyrimidine bases, Nucelosides, Nucelotides, Structures of nucleic acids, Biological and pharmaceutical importance of nucleic acids.

(e) Vitamins: Chemistry, Classification (Fat-soluble and water-soluble vitamins), Biological and pharmaceutical importance of vitamins.

(f) Hormones: Chemistry, Classification (Proteinous and non-proteinous hormones, amino acid derivatives, steroids), Biological and pharmaceutical importance of hormones.

(g) Enzymes: Chemistry, Classification, Mode of action, Kinetics (Michaelis Menten Equation and some modifications), Inhibition, Activation, Specificity, Allosteric enzymes, Factors affecting the rate of an enzyme-catalyzed reaction, Biological and pharmaceutical importance, Mechanism of action of some important enzymes (Chymotrypsin, Ribonuclease).

307 PHARMACEUTICAL BIOCHEMISTRY-I (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. **Qualitative analysis of:** Carbohydrates, Amino acids, Peptides and Proteins, Lipids and Sterols (Cholesterol) Bile salts and billirubin, Blood analysis – Sugar, Uric acid, Billirubin, Cholesterol and Creatinine.

Recommended Books

1. M N Chaterjea, **Medical Biochemistry,** Jaypee Brothers Medical Publishers, New Delhi, 2003.
2. Roberk Murray, Daryl K, Granner, Peter A Mayes, Victor W Rodwell **Harper's Biochemistry,** Appleton and Lange, Lange Medical Publications, NewYork, 2000.
3. Albert L Lehninger **Principles of Biochemistry,** CBS Publisher, Delhi, 1993.
4. Lubert Stryer, **Biochemistry,** W H Freeman and Company, 2002.
5. Pamela C Champe, Richard A Harvey, **Illustrated Biochemistry,** J Lippincot Company, 1994.
6. **Harper's Biochemistry**, Print-Hall, New Jersey, 1996.
7. M Rafiq, **Biochemistry**, The Carvan Book House, Lahore, 1st Ed.
8. Montogomary, **Clinical Chemistry**, The C V Mosby Company, 5th Ed.

9. Conn and Stumpf, **Outlines of Biochemistry**, John Willey & Sons, New York, 5th Ed., 1999.
10. Lehninger, **Biochemistry**, Worth Publishers Co, New York.
11. Ahmed M **Essentials of Medical Biochemistry,** Merit Pub, Fasilabad, 1991
12. West E S, Todd R W and Van Bruggen T J, Text Book of Biochemistry, The MacMillan Co, 1996.

309 PHARMACEUTICS-I (PHYSICAL PHARMACY-I) (Theory) Cr. Hr. 03

1. PHARMACY ORIENTATION:
   Introduction and orientation to the Professional of pharmacy in relation to Hospital Pharmacy, Retail pharmacy, Industrial pharmacy, Forensic pharmacy, Pharmaceutical education and research etc.

2. HISTORY AND LITERATURE OF PHARMACY:
   (a) A survey of the history of pharmacy through ancient, Greek and Arab periods with special reference to contribution of Muslim scientists to pharmacy and allied sciences.
   (b) An introduction of various official books.

3. PHYSIOCHEMICAL PROCESSES:
   (a) Precipitation: Process of precipitation and its applications in Pharmacy.
   (b) Crystallization: Types of crystals, Mechanism and methods of crystallization and its applications in Pharmacy.
   (c) Distillation: Simple, fractional, steam distillation, vacuum distillation, destructive distillation and their applications in Pharmacy.
   (d) Miscellaneous Processes: Efflorescence, deliquescence, lyophilliza-tion, elutrition, exiccation, ignition, sublimation, fusion, calcination, adsorption, decantation, evaporation, vaporization, centrifugation, dessication, levigation and trituration.

4. PHYSICO-CHEMICAL PRINCIPLES:
   (a) Solutions: Introduction, types, concentration expressions, ideal and real solution, colligative properties, their mathematical derivations and applications in pharmacy, molecular weight determinations, distribution co-efficient and its applications in pharmacy.
   (b) Solubilization: Solubility, factors affecting solubility, surfactants, their properties and types. Micelles, their formulation and types.
   (c) Ionization, pH, pH indicators, pka, buffers, buffer's equation, isotonic solutions and their applications in pharmacy.

(d) Hydrolysis, types and protection of drugs against hydrolysis.
(e) Micromeritics: Particle size and shapes, distribution of particles methods of determination of particle size and importance of particle size in Pharmacy.

311 PHARMACEUTICS-I (PHYSICAL PHARMACY-I) (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Experiments to demonstrate some of the physico-chemical processes like simple distillation, steam distillation, crystallization and dialysis. Determination of particle size. Preparation of buffer solutions and isotonic solutions.

Recommended Books

1. Martin, **Physical Pharmacy**, B I Waverly PVT, Delhi, 4th Ed., 1994.
2. Cooper and Gunns, **Tutorial Pharmacy**, CBS Publishers & Distributors, New Delhi, 1986.
3. **Bentley's Pharmaceutics**, All India Traveler Book Seller, New Delhi, 1996.
4. Martin P, Bustamante P and Chun, **Physical & Chemical Principles of Pharmaceutical Science**, AHC, 4th Ed., (1999), New York.
5. Martin AMN, Banker G S and Chun AHC **Advances in Pharmaceutical Sciences.** Academic Press, London, 1985.
6. Mill C C Casson, N, **Rehology of dispress systems.** Pergamon Press, New York, 1975.
7. Rienger M and Scott-Blair G W, **Rehology.** Academic Press, London, 1990.
8. Barry B W **Advances in Pharmaceutical Sciences**, Academic Press, London, 1990.
9. Sherman P, **Emulsion Science**, Academic Press, London, 1972.
10. Martin A, Swarbrick J and Cammatra A, **Physical Pharmacy**, 3rd Ed. Lee & Febiger, Philadelphia, 1983.
11. Attwood D and Flocence A T, **Surfactant Systems**. Chapman and Hall Ltd, London, 1982.

313 PHYSIOLOGY & Histology-I (Theory) Cr. Hr. 03

Physiology

1. BLOOD: Composition of blood (RBC, WBC and Platelets), Functions and Genesis of the formed elements, Fate of Red Blood cells, Jaundice, Reaction of Blood, Blood groups, Rh factors, ESR Blood volume,

Functions of Spleen, Blood coagulation, Hemophilia. Anaemias — classification.

2. CIRCULATORY SYSTEM: Properties of the cardiac muscle. Origin and conduction of the heart beat. Cardiac cycle. ECG. Heart sounds. Cardiac output. Stroke volume and heart rate. Nerve supply of the Heart. Coronary, Pulmonary, and skin circulation. Blood pressure, vasomotor system. Arterial pulse. Venous pulse, capillary circulation. Axon reflex, Triple response. Haemorrhage. Circulatory changes in exercise. Composition and circulate of lymph. Haemorrhage & Shock.

3. RESPIRATORY SYSTEM: Mechanics of respiration. Intrathoracic, intrapulmonary pressure, pulmonary ventilation. Lungs volume and capacities. Composition of Inspired air, expired air and alveolar air, carriage of O_2 and CO_2 by the blood. Regulation of breathing (Nervous & Chemical control). Respiratory changes in exercise, pneumonias, emphysema and bronchial asthma.

4. DIGESTIVE SYSTEM: Mastication, Deglutation, Digestive juices-saliva, Gastric juice, Pancreatic juice. Bile and intestinal juices; their composition, Functions and mechanism of secreation, Movements of the stomach and intestines. Functions of large intestine. Defecation. Functions of liver and gall bladder.

5. URINARY SYSTEM: Urine formation — composition of urine — GFR Urea clearance. Formation of concentrated and diluted urine.

Histology

1. Introductin of cell: General structure of tissues in different systems of Body.
2. Basic Tissues: Epthelium (classification, shape, distribution and function). Supporting/connective tissue including bones and cartilage. (Classification, Distribution and Function) Muscular Tissue. (Types, distribution and function) Nervous Tissue (neuron and its types Neuroglia — classification and distribution).
3. Gastrointestinal tract: GIT including exocrine organs: Liver, pancreas and Gall Bladder.
4. Respiratory system: Respiratory system including Nasal cavity, Larynx, Trachea, Lung.
5. Cardio vascular System: Heart, Artery, Vein, Lymphatic.

315 PHYSIOLOGY & HISTOLOGY-I (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities.

Physiology

1. Blood: Determination of Haemoglobin (Hb), ESR, RBC Count, WBC Count, DLC (Differential Leucocyte Count), Bleeding Time, Coagulation Time and Determination of blood groups.
2. Respiration: Estimation of vital capacity and its relation to posture and standard vital capacity. Determination of tidal volume. Demonstration of artificial respiration.
3. CVS: Recording of Arterial Pulse, Recording of Arterial Blood Pressure and Electro-cardiogram.

Histology

1. Demonstration of preparation and staining of slides. Histological examination of slides, epithelium, connective tissues, muscle tissues, Organ system – Lung, appendix, Gall bladder, Stomach, Intestine, Heart, Artery, Vein, Lymphatic, etc.

Recommended Books

Physiology

1. Arthur C Guyton, M D, **Text Books of Medical Physiology**, W B Saunders Company, 9th Ed., 1996.
2. William F Ganong, **Review of Medical Physiology**, Prentice Hgall international Inc, 17th Ed., 1995.
3. Chandi Charan Chatterjee, **Human Physiology**, Medical allied agency, 1994.
4. Samson Wright's Applied Physiology. Revised by Cyril A Keele and Eric Neil.
5. Spence A P and Mason E B, **Human Anatomy and Physiology**, Beajamin/Cumming Publishing Inc Clifornia, 3rd Ed.
6. Snell R S, Clinical Anatomy for Medical Students, Litle Brown & Co Inc USA, 1992.

Histology

1. Bradbury S, Hewer's Text Book of Histology, ELBS, London, 1984.
2. Reference Book: Tissues of the body by Legros Clerks. Publisher Oxford at the Clarendon Press, London.
3. Cormack H D, **Essential Histology**, J B Lippincott Co Philadelphia, 1993.
4. Hammersen F, **Histology; color Atlas Of Microscopic Anatomy**, Lee & Febijer Co, Pennsylvania, 1985.

317 **ANATOMY (Theory)** **Cr. Hr. 03**

1. Introduction: Anatomical Terminology: Definition. Cell, tissue, organ system.

2. Cardiovascular System:
   (a) Heart: Structure of Heart, Location of Heart, Blood Supply to Heart.
   (c) Blood Vessels**:** Main blood vessels arising & entering the heart. Types of blood vessels with examples.

3. Respiratory System: Name and structures of different parts of respiratory system and their inter-relationship.

4. Elementary System: Name and structure of different parts of elementary system and their inter-relationship.

5. Urinary System: Name and structure of organs of urinarysystem and their inter-relationship.

6. Reproductive System: Male ande Female reproductive systems. Name, structure and association of the organs.

7. Endocrine System:
   (a) Pituitary gland, structure and relation to hypothalamus.
   (b) Thyroid gland, structure.
   (c) Adrenal gland, structure.

8. Nervous System:
   Introduction: Cells of Nervous System (Neuron), Accessory cells of NS Organisation of Nervous System:
   (a) Central Nervous System: Brain — Meninges (Cerebrum — cerebral Lobes, Ventricals, Cerebellum — Anatomy of Cerebellum, Brain Stem — Mid-Brain, Pons, Medulla Oblongata, Diencephalon, Thalamus, Hypothelamus, Cranial Nerves, Spinal Cord — Meninges. CSF Internal Structure. Sensory and Motor Pathway. Spinal Reflexes. Peripheral Spinal Nerves).
   (b) Autonomic Nervous System: Sympathetic Nervous System and Parasympathetic Nervous System.

Recommended Books

1. Romanes, G J, **Cunningham's Manual of Practical Anatomy**. Humphary Kalfom, Oxford, Oxford University Press, London, 3 volumes, 1996.

2. Gray's Anatomy, **Descriptive and Applied**. Longman's Green and Co, London, 1996.
3. J G Romanes, London, **Cunningham's Textbook of Anatomy**. Oxford University Press, 1996.
4. Snell, R.S**. Clinical Anatomy**, Boston, Little, Brown and Company, 1996.
5. Keith L More and TVN Persaud, Philadelphia, **Clinically Oriented Human Anatomy.** W B Saunders, 1996.
6. B Grant, **A Method of Anatomy,** Bailliere Tinal and Co, Ltd, London.
7. W J Hamilton, **A textbook of Anatomy**, Macmillan and Co, London.
8. R J Last, **Anatomy, Regional and Applied,** J and A Churchill Ltd, London.

319 PHARMACEUTICAL MATHEMATICS (Theory) Cr. Hr. 02

1. ALGEBRA:
   (a) Sets and Functions: Elementary concepts of sets. Concept of Functions, Domain and Range of a Function. Different types of Functions. Graphical representation of a function. Some applications of Functions.
   (b) Solution of Linear and Quadratic Equations. Equations reducible to Quadratic Form. Solution of simultaneous Equations.
   (c) Arithmetic, Geometric and Harmonic Progressions. Arithmetic, Geometric and Harmonic Means.
   (d) Permutations and combinations.
   (e) Binomial Theorem: Simple application.

2. TRIGONOMETRY: Measurement of Angles in Radian and degrees. Definitions of circular functions. Derivation of circular function for simple cases.

3. ANALYTICAL GEOMETRY: Coordinates on point in a plane. Distance between two points in a plane. Locus, Equations of straight line, Equation of Parabola, Circle and Ellips.

4. DIFFERENTIAL CALCULUS: Concept of Derivations. Rules of Differentiation. Examples on the evaluation of Derivations. Derivatives of Exponential and Logarithmic Functions, Partial Derivations. Higher Order Derivatives. Maxima & Minima points of Inflections.

5. INTEGRAL CALCULUS: Concept of Integration. Rules of Integrations. Integrations of Algebric and Trignomatric functions by using different techniques.

Recommended Books

1. C H Edvards Jr and David E Penney, **Calculus and Analytic Geometry**, Prentice-Hall, Inc, A division of Sinon & Schustor Englewood Gliffs, New Jersey 07632, USA, 1995.
2. Ahmed B and Khan M, **Mathmactics for Pharmacists**, Arsalan Paper Mart, Multan, 1993.

2nd TERM

302 PHARMACEUTICAL CHEMISTRY (Organic-II) (Theory) Cr. Hr. 03

Note: The topics will be taught with special reference to their Pharmaceutical Applications.

1. Stereochemistry: Stereoisomerism, optical isomerism; Molecules with more than one chiral center. Geometrical isomerism, Resolution of racemic mixture. Conformational analysis.
2. Free radicals: Introduction, structure and stability, preparation and properties.
3. General methods of preparations, properties, identification test and pharmaceutical applications of the following classes and their analogues: Alcohols, Phenols, Ethers, Aldehydes, Ketones, Acids, esters, Amines and Aniline, Lactones, Lactams, Amides, Imides, Diazonium salts.
4. Preparation and properties of medicinally important heterocyclic compounds such as: Pyrrol, Furan, Thiophene, Pyridine, Pyrimidine and Pyrazine.
5. Preparation and properties of heterocyclic compounds in which benzo-ring is fused with five and six membered ring containing one heteroatom; Indole, Quinoline and Isoquinoline.

304 PHARMACEUTICAL CHEMISTRY (Organic-II) (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Organic Preparations like Benzoic acid, Aspirin, Acetanilide, Iodoform, Nitrophenol, 3-nitrophthalic acid, Benzhydrol, 2, 4-Dinitro-chlorobenzene.

Recommended Books

1. Peter Sykes, **A guide Book to Mechanism in Organic Chemistry**, Longman, New York, 1st Ed., 1991.
2. E L Eliel, **Stereochemistry of Carbon Compounds**, Tata McGraw-Hill, New Delhi, 1992.
3. Rehman and M. Younis, **Organic Chemistry for B.Sc. students**, Ilmi Kitab Khana, Lahore, 1997.
4. L Finar, **Organic Chemistry** Vol I, Person Education Asia, 6th Ed., New Delhi, 2001.
5. Raj K Bansel, **Organic Reaction Mechanism**, Tata McGraw-Hill, New Delhi, 1992.
6. Furaiss Brian, **Practical Organic Chemistry**, 5th Ed., ELBS, London.
7. Sykes A P, **Guide Book to Mechanism in Organic Chemistry**, 5th Ed., Lonsmen Co, UK, 1970.
8. Roberts J D and Caserio M C, **Basic Principles of organic Chemistry**, 1990.
9. Naser-ud-Din, **Introduction to Stereochemistry**, Ghafoor Stationery Mart, Peshawar, 1994.
10. Bhal B S, **Text Book of Organic Chemistry**, S Chand & Co, New Delhi, 14th Ed., 1995.

306 PHARMACEUTICAL BIOCHEMISTRY-II (Theory) Cr. Hr. 03

1. Metabolic fate of Biomolecules (Anabolism and Catabolism)
   (a) Carbohydrates: Introduction to metabolism, Brief introduction to the digestion and absorption of carbohydrates, Aerobic and anaerobic breakdown of Glucose, Glycolysis, Pentose Phosphate Pathway, Glycogenolysis, Glycogenesis, Gluconeogenesis, Citric acid cycle, Energetics of various metabolic processes.
   (b) Lipids: Brief introduction to the digestion and absorption of lipids, Oxidation of fatty acids through B-oxidation, Biosynthesis of fatty acids, neutral lipids and cholesterol.

(c) Proteins and Amino acids: Brief introduction to the digestion and absorption of proteins and amino acids, Metabolism of essential and non-essential amino acids, Biosynthesis and catabolism of Haemins and porphyrin compounds.

(d) Bioenergetics: Principles of bioenergetics. Electron transport chain and oxidative phosphorylation.

2. Regulation of Metabolic Processes

(a) Role of Vitamins: Physiological role of Fat-soluble (A, D, E and K) and Water-soluble (Thiamin, Riboflavin, Pantothenic acid, Niacin, Pyridoxal phosphate, Biotin Folic acid, Cyanocobalamin – members of B-complex family – and Ascorbic acid), Coenzymes and their role in the regulation of metabolic processes.

(b) Receptor mediated regulation (Hormones): Mechanism of action of hormones, Physiological roles of various hormones, Site of synthesis and target sites of hormones.

(c) Secondary Messengers: Role of cAMP, Calcium ions and phosphoinositol in the regulation of metabolic processes.

(d) Gene Expression: Replication, Transcription and Translation (Gene expression) Introduction to Biotechnology and Genetic Engineering, Basic principles of Recombinant DNA technology, Pharmaceutical applications. Balance of Catabolic, Anabolic and Amphibolic processes in human metabolism, Acid-Base and Electrolyte Balance in Human body.

308 PHARMACEUTICAL BIOCHEMISTRY-II (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the requirements, e.g. **Quantitative analysis of:** Carbohydrates – Glucose (reducing sugar) and any other carbohydrate using Benedict and Anthrone method. Amino acids, Peptides and Proteins using Biuret and Ninhydrin (Spectrophotometric) method. Analysis of normal and abnormal components of Urine including Sugar, Uric acid, Bilirubin, Cholesterol and Creatinine.

Recommended Books

1. M N Chaterjea, **Medical Biochemistry,** Jaypee Brothers Medical Publishers, New Delhi, 2003.
2. Roberk Murray, Daryl K, Granner, Peter A Mayes, Victor W Rodwell **Harper's Biochemistry,** Appleton and Lange, Lange Medical Publications, NewYork, 2000.

3. Albert L Lehninger, **Principles of Biochemistry,** CBS Publisher, Delhi, 1993.
4. Lubert Stryer, **Biochemistry,** W H Freeman and Company, 2002.
5. Pamela C Champe, Richard A Harvey, **Illustrated Biochemistry,** J Lippincot Company, 1994.
6. **Harper's Biochemistry**, Print-Hall, New Jersey, 1996.
7. M Rafiq, **Biochemistry**, The Caravan Book House, Lahore, 1st Ed.
8. Montogomary, **Clinical Chemistry**, The C V Mosby Company, 5th Ed.
9. Conn and Stumpf, **Outlines of Biochemistry**, John Willey & Sons, New York, 5th Ed., 1999.
10. Lehninger, **Biochemistry**, Worth Publishers Co, New York.
11. Ahmed M **Essentials of Medical Biochemistry,** Merit Pub Faisalabad, 1991.
12. West E S, Todd R W and Van Bruggen T J, Text Book of Biochemistry, The MacMillan Co, 1996.

310 PHARMACEUTICS-II (PHYSICAL PHARMACY-II) (Theory) Cr. Hr. 03

1. DISPERSED SYSTEM:

(a) Colloids: Types, methods of preparation, properties (optional, kinetic, electrical) Dialysis and artificial kidney, stability of colloids, protection and sensitization phenomenon and application of colloids in Pharmacy.

(b) Emulsions: Types, theories of emulsification. Emulsifying agents, their classification and stability of emulsion.

(c) Suspensions: Type, Methods of Preparation, Properties, Suspending agents, their classification and stability.

(d) Adsorption Techniques: Adsorption techniques and processes of adsorption in detail.

2. RHEOLOGY:
   (a) Definition and Fundamental concept.
   (b) Properties contributing to rheological behaviour.
   (c) Graphic presentation of rheological data.

3. RATE and ORDER OF REACTIONS.

4. KINETIC PRINCIPLES AND STABILITY TESTING: THEORETIC CONSIDERATIONS: Degradation:
   (a) Physical Factors: Influence of pH, temperature, ionic strength, acid-base catalysis, U.V. light.
   (b) Chemical Factors: Complex chemical reactions. Oxidation-reduction, hydrolysis.

312 PHARMACEUTICS-II (PHYSICAL PHARMACY-II) (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Determination of Emulsion systems. Determination of %age composition of solutions by specific gravity method. Determination of Partition-coefficient, surface tension, viscosity.

Recommended Books

1. Martin, **Physical Pharmacy**, B I Waverly PVT, Delhi, 4th Ed., 1994.
2. Cooper and Gunns **Tutorial Pharmacy**, CBS Publishers & Distributors, New Delhi, 1986.
3. **Bentley's Pharmaceutics**, All India Traveler Book Seller, New Delhi, 1996.
4. Martin P, Bustamante, P and Chun, **Physical & Chemical Principles of Pharmaceutical Science**, AHC, 4th Ed., (1999), New York.
5. Martin AMN, Banker G S and Chun AHC **Advances in Pharmaceutical Sciences.** Academic Press, London, 1985.
6. Mill C C, Casson N, **Rehology of dispress systems.** Pergamon Press, New York, 1975.
7. Rienger M and Scott-Blair G W, **Rehology.** Academic Press, London, 1990.
8. Barry B W, **Advances in Pharmaceutical Sciences**, Academic Press, London, 1990.
9. Sherman P. **Emulsion Science**, Academic Press, London, 1972.
10. Martin A, Swarbrick J and Cammatra A **Physical Pharmacy**, 3rd Ed., Lee & Febiger, Philadelphia, 1983.
11. Attwood D and Flocence A T, **Surfactant Systems**. Chapman and Hall Ltd, London, 1982.

314 PHYSIOLOGY & HISTOLOGY-II (Theory) Cr. Hr. 03

Physiology

1. PHYSIOLOGY OF NERVE AND MUSCLE: Chemical change in Muscle on contraction. Action Potential.

2. NERVOUS SYSTEM: Spinal reflexes. Reflex regulation of movement and posture. Cerbral cortex functions. Voluntary movements. Descending tracts of spinal cord. Basal ganglia, Cerbellum. Autonomic Nervous system. Thalamus. CSF.

3. SKIN: Structure, Functions of skin, Temperature regulation by Skin.

4. SPECIAL SENSE: Elementary knowledge of structure and function of the special senses.

5. ENDOCRINOLOGY: Definition of Hormone. Nature of different types of hormone. Mechanism of action of hormone.
   (a) Pituitary hormones: Growth Hormone, Prolactin, ACTH, TSH, ADH, Oxytocin. Acromegaly, Giantism, PanHypopituitrism.
   (b) Thyriod Gland: Thyroxin, Tri-iodothyronin, Format and functions of thyroid hormones. Hyperthroidism, Myxodema.
   (c) Para thyriod Hormone:
   (d) Pancreatic Hormone: Insulin, Glucagon, Diabetes mellitis.
   (e) Adrenal Glands: Mineralocorticoids, Glucocorticoids, Anabolic Steroids, Adrenalin, Nor-adrenalin, Cushing syndrome, Addison disease.
   (f) Sex Hormones: Female Sex Hormone: Structure and function. Male Development of secondary sex characteristics, spermato-genesis. Composition of semen. Female Development of secondary characters. Menstruation, (Ovarian cycle). Oogenesis. (Dysmanorrhea, etc.).

Histology

1. Skin: Types of skin, Derivatives of skin including Nail, sebaceous glands, sweat glands and Hair follicles.
2. Lymphoid Tissue: General structure of Lymphoid organs: Lymph node, spleen, palatine tonsil and thymus.
3. Excretory system including Kidney, Ureter, and Urinary bladder.
4. Reproductive system: Male reproductive organs, (Testes, Genital tract). Female reproductive organs, (Ovary, and female genital tract).
5. Endocrine system: Pituitary gland, Adrenal gland, Thyroid gland, Parathyroid gland, Endocrine part of pancreas.

316 PHYSIOLOGY & HISTOLOGY-II (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities.

Physiology

1. Eye: Visual activity, far vision and near vision. Field of vision (Perimetry).
2. CNS: Nerve Muscle Preparation in frog. Effect of Temperature on muscle. Demonstration of spinal reflexes.

Histology

Demosntration of preparation and staining of slides. Histological examination of slides. Organ system – Skin, Spleen, Tonsil, thymus, Reproductive system, Endocrine system, etc.

Recommended Books

Physiology

1. Arthur C Guyton, M D, **Text Books of Medical Physiology**, W B Saunders Company, 9th Ed., 1996.
2. William F Ganong, **Review of Medical Physiology**, Prentice Hall International Inc, 17th Ed., 1995.
3. Chandi Charan Chatterjee, **Human Physiology**, Medical allied agency, 1994.
4. Samson Wright's Applied Physiology. Revised by Cyril A Keele and Eric Neil.
5. Spence A P and Mason E B, **Human Anatomy and Physiology**, Beajamin/Cumming Publishing Inc, Clifornia, 3rd Ed.
6. Snell R S, Clinical Anatomy for Medical Students, Little Brown & Co Inc, USA. 1992.

Histology

1. Bradbury S, Hewer's TextBook of Histology, ELBS, London, 1984.
2. Reference Book: Tissues of the body by Legros Clerks. Publisher Oxford at the Clarendon Press, London.
3. Cormack H D, **Essential Histology**, J B Lippincott Co. Philadelphia, 1993.
4. Hammersen F, **Histology; colour atlas of microscopic anatomy**, Lee & Febijer Co, Pennsylvania, 1985.

318 BIOSTATISTICS (Theory) Cr. Hr. 04

1. DESCRIPTION OF STATISTICS: Descriptive Statistics: What is Statistics? Importance of Statistics. What is Biostatistics? Application of Statistics in Biological and Pharmaceutical Sciences. How samples are selected?

2. ORGANIZING and DISPLAYING DATA: Vriables, Quantitative and Qualitative Variables, Univariate Data, Bivariate Data, Random Variables, Frequency Table, Diagrams, Pictograms, Simple Bar Charts, Multiple Bar Charts, Histograms.

3. SUNNARIZING DATA and VARIATION: The Mean, The Median, The Mode, The Mean Deviatiobn, The Variance and Standard Deviation, Coefficient of Variation.

4. CURVE FITTING: Fitting a Straight Line. Fitting of Parabolic or High Degree Curve.

5. PROBABILITY: Definitions, Probability Rules,Probability Distributions (Binomial & Normal Distributions).

6. SIMPLE REGRESSION AND COORELATION: Introduction. Simple Linear Regression Model. Correlation co-efficient.

7. TEST OF HYPOTHESIS AND SIGNIFICANCE: Statistical Hypothesis. Level of Significance. Test of Significance. Confidence Intervals, Test involving Binomial and Normal Distributions.

8. STUDENT "t", "F" and Chi-Square Distributions: Test of Significance based on "t", "F" and Square Distributions.

9. ANALYSIS OF VARIANCE: One-way Classification, Two-way Classification, Partitioning of Sum of Squares and Degrees of Freedom, Multiple Ccompression Tests such as LSD, The analysis of Variance Models.

Recommended Books

1. Daniel W W, **Bio-Statistics, Foundation for Analysis in Health Science**. 3rd Ed., 1983.
2. Zar J H, **Bio-Statistical analysis,** Francis Hall, N J, USA.
3. Nilton J S, and Tsokos J D, **Statistical Methods in Biological and Health Sciences**, McGrew-Hill. 1983.
4. Chaudhry S A and Kamal S, **Introduction to Statistical Theory**, Part-I and Part-II, Ilmi Kitab Khana, Urdu Bazar, Lahore, 1996.
5. Samuels M, **Statistics for the life sciences**, Dellen Pub Co, S F, USA, 1991.
6. Walpole R E, **Introdution to Statistics**, Macmillam Pub Co, N Y, 1982.

SECOND PROFESSIONAL

3rd TERM

401 PHARMACEUTICS-III (Pharmaceutical Preparations-I) (Theory) Cr. Hr. 03

1. Introduction: Dosage form. Ingredients

2. Pharmaceutical Calculations: Some Fundamentals of Measurements and Calculations. The Metric System. The Common Systems. Conversions. Calculation of Doses. Reducing and Enlarging Formulas. Density, Specific Gravity & Specific Volume. Weights and Volumes of Liquids. Percentage Preparations. Isotonic Solutions. HLB Values. Industrial Calculations. Some calculations involving Hydrogen-ion concentration.

3. Galenical Preparations: Infusions. Decoctions. Extracts. Fluid extracts. Tinctures. Aromatic Waters.

4. Extraction Processes: Maceration: Purpose and process. Percolation: Purpose and Process. Liquid-Liquid extraction. Large scale extraction.

5. Solvents used in Pharmaceutical Preparations.

6. Oral Solutions, Syrups, Elixirs and Spirits: Solutions and their preparation, dry mixtures for solution, oral rehydrate solutions, oral colonic leverage solution. Syrup: components and preparation of Syrups. Elixirs: Preparation of elixirs, medicated and non-medicated elixirs.

7. Oral Suspensions, Emulsions, Magma and Gels: Preparations, Examples, and Importance.

403 PHARMACEUTICS-III (Pharmaceutical Preparations-I) (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Prepartion of simple syrup, Orange syrup, Ferrous sulphate syrup, Cod Liver oil Emulsion, Liquid paraffin Emulsion, Throat paint (Mandle's paint), Boroglycerine glycerite, Tannic acid glycerine, Spirit ammonia aromatic, Spirit of Ethyl nitrite.
(A minimum of 10n practicals will be conducted)

Recommended Books

1. Michel E Aulton, **Pharmaceutics**, ELBS/Churchill Livingstone, London, 1998.
2. **Bentley's Book of Pharmaceutics**, CBS Publishers & Distributors, New Delhi, 1986.
3. **Pharmaceutics, the Science of Dosage Form Design**. 2nd Ed., HawCourt Publisher, 2002.
4. E A Rawlins, Berdley's **Textbook of Pharmaceutics**, edited by 8th (or recent edition) 1977. Macmillan Publishing Co Inc, New York.
5. Sprowl's (Dittert L W, Eds.), **American Pharmacy**, 7th Ed, J B Lippincott Co, 1990.

405 PHARMACOLOGY & THERAPEUTICS-I (General-I) (Theory) Cr. Hr. 03

1. GENERAL PHARMACOLOGY

   (a) Introduction: History, Pharmacology and its classification and Drugs and their sources
   (b) Routes of drugs administration: Advantages and disadvantages of Enteral Routes, Advantages and disadvantages of Parentral Routes and Advantages and disadvantages of Topical Routes.
   (c) Pharmacokinetics: Drug solubility and passage of drugs across the body membranes, Plasma concentration of drugs and various factors affecting it (Absorption and factors influencing the rate of absorption (GIT and other routes) of drugs, Distribution and factors influencing the rate of distribution of drugs, Biotransformation and factors influencing the rate of biotransformation of drugs, Excretion, channels of excretion and factors influencing the rate of excretion of drugs), Definition of (Bioabvailability & Bioequivalence, Therapeutic Index, Plasma Half Life ($t_{½}$), Dose-Response Curve, Area Under Curve, Volume of Distribution.
   (d) Pharmacodynamics: Drug receptors and theories, Mechanisms of drug action, Specificity of drug action and Factors modifying the action & dosage of drugs.

2. DRUGS ACTING ON AUTONOMIC NERVOUS SYSTEM (ANS)
   (a) Organization of ANS its subdivisions and innervations.
   (b) Neurotransmitters in ANS, their synthesis, release and fate.
   (c) Sympathetic agonist drugs: Catecholamines and Non-catecholamines.
   (d) Sympathetic antagonist drugs: Adrenergics Nerve Blockers, Adrenoceptor antagonists (Alpha-adrenergic blockers and Beta-adrenergic blockers).

(e) Parasympathetic (Cholinergic) agonists and Anticholinestrase inhibitors.
(f) Parasympathetic antagonists.
(g) Drugs acting on Ganglia (Ganglian stimulants and Ganglion blockers).
(h) Neuromuscular blocking drugs.

3. DRUGS ACTING ON GASTROINTESTINAL TRACT:
(a) Emetic.
(b) Anti-emetics.
(c) Purgatives: Bulk forming purgatives, Lubricant purgatives, Irritant purgatives and Saline Purgatives.
(d) Anti-diarrheal Agents.
(e) Treatment of Peptic & Dudenal Ulcers: Antiacids, H_2-Receptor Antagonists, Antimuscarinic Agents, Proton Pump Inhibitors, Gastrin Receptor Antagonist and Cytoprotective agents.
(f) Drug treatment of chronic inflammatory diseases of bowel.
(g) Drugs affecting bile flow and Cholelithiasis.

Note:

1. Only an introduction will be given of the banned and obsolete drug products.
2. While dealing with Pharmacology stress should be laid to the group actions of related drugs and only important differences should be discussed of the individual drugs placed in same group.
3. Newly introducted drugs should be included in the syllabus while drugs with no clinical and therapeutic values ought to be excluded from syllabus at any time.
4. The prototype drugs in each group from the latest edition of the recommended books.

407 PHARMACOLOGY & THERAPEUTICS-I (General-I) (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Preparation of standard solution. Ringer solution. Tyrode solution. Kreb solution. Normal saline solution. To demonstrate the effects of sympathomimetic (Adrenaline) & sympatholytic drugs (Propranolol) on Frog's heart. To demonstrate the effects of parasympathomimetic (Acetylcholine) and parasympatholytic (Atropine) drugs on Frog's heart. To demonstrate the effects

of an unknown drug on Frog's heart. Routes of Administration of drugs.
(Note: A minimum of 10 practicals will be conducted)

Recommended Books

1. Goodman Gillman, **Pharmacological basis of therapeutics**. McGraw-Hill Book Company, New York, 1996.
2. Winguard and Brody, **Human Pharmacology**, Mosby Year Book, Boston, 1991.
3. James M Ritter and Lionel De Levis, **A Text book of Clinical Pharmacology**, Oxford University Press, New York, 1995.
4. R S Satorkar and S D Bhandarkar, **Pharmacology and Pharmacotherapeutics**, Popular Prakashan, Bomby, 1993.
5. J D Tripathy, **Essential of Medical Pharmacology**, Japees Brother, New Delhi, 4th Ed., 2000.
6. D R Laurance, **Clinical Pharmacology,** ELBS, London, 6th Ed., 1987.
7. Katzung B G, **Basic and Clinical Pharmacology**, McGraw-Hill Medical Publishers, New York, 8th Ed., 2001
8. Lipponcott, **Pharmacology**, Lippincot William & Willkin, USA, 2001.
9. Manuchair Edabi, **Pharmacology**, Little Brown & Company, London, 1993.
10. Qayum A, **Fundamentals of Experimental Pharmacology**. Ghandhara University, Peshawar.
11. Bertram G K, **Basic and Clinical Pharmacology**, Paramount Publishing Business & Professional Group, USA, 6th Ed., 1995.
12. William F, Ganong W F, **Review of Medical physiology**, Prentice Hall International Inc, New Jersey.

409 PHARMACOGNOSY-I (Theory) Cr. Hr. 03

1. GENERAL INTRODUCTION: Historical Development and Scope of Pharmacognosy. Traditional system of Medicine/medicinal plants. Evolution of Modern system of Medicine (History of Modern System of Medicine). Classification of Crude Drugs with Special Emphasis to Chemical and Therapeutical System of Classification. Terminology Used in Pharmacognosy. Preparation of Crude Drugs for Commercial Market, Methods of Cultivation, Drying, Storage. Preservation, Packing, Deterioration and Adulteration of Crude Drugs. Evaluation of Crude Drugs I E. Organoleptic, Microscopic, Physical, Chemical and Biological.

2. THE STUDY OF THE CRUDE DRUGS BELONGING TO VARIOUS FAMILIES OF MEDICINAL IMPORTANCE

Families	Crude Drugs

a. Ranunculanceae Aconitum, Larkspur, Pulsatilla, Hydrastis.
b. Papaveraaceae Papaver Somniferum, Sanguinaria, Canadensis.
c. Leguminosae Acacia, Glycyrrhiza, Senna, Cassia, Tamarind.
d. Umbelliferae Fennel, Carum, Coriander, Conium, Asafoetida.
e. Apocynaceae Rauwolfia, Catharanthus.
f. Solanaceae Belladonna, Hycscyamus, Stramonium Capsicum.
g. Scrophulariaceae Digitalis, Verbascum (Mullien).
h. Labiatae Peppermint, Thyme, Spearmint, Salvia, Ocimum.
i. Liliaceae Garlic, Colchicum, Aloe.
j. Zingiberaceae Ginger, Curcuma.

3. GROWTH REGULATORS: General account with special reference to Auxins, Gibberellins Abscisic acid, Cytokinins and Ethylene.

411 PHARMACOGNOSY -I (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Introduction of the entire and broken parts of the plant drugs (Macro and organoleptic characters).
(Note: A minimum of 10 practicals will be conducted)

Recommended Books

1. V E Tyler, L R Brady and J E Robbers, **Pharmacognosy,** 9th Ed., Lea and Febiger, Philadelphia, 1988.
2. G E Trease and W C Evans, **Pharmacognosy,** W B Saunders, Philadelphia, Toronto, 2002.
3. K Usmanghani, **Topics in Pharmacognosy,** University Grants Commission Monograph Series, Islamabad, pp74, 1985.
4. T E Wellis, **Text book of Pharmacognosy**, CBS Publishers & Distributors, New Delhi, 1986.
5. Varro E Taylor, **Pharmacognosy**, Lee Febiger Philadelphia, 9th Ed.
6. Mohammad Ali, **Introduction to Pharmacognosy**, CBS Publishers & Distributors, New Delhi, 1986.
7. K Usmanghani, **Chemical Pharmacognosy**, University Grants Commission, Islamabad, 1985.
8. Youngkin H W, **Text Book of Pharmacognosy**, The Blakiston Co, Toronto, 6th Ed., 1948.

413 PHARMACEUTICAL MICROBIOLOGY-I (Theory) Cr. Hr. 03

Note:- The topics will be taught with special reference to their Pharmaceutical Applications.

1. GENERAL MICROBIOLOGY: Historical Introduction, Scope of Microbiology with special reference to Pharmaceutical Sciences. Nomenclature and classification of Micro-organisms.

2. ORGANISMS:
   The Bacteria: General and cellular Morphology, structure and function. Classification of Bacteria. Growth curve, growth factors and growth characteristics. Nutrition, Requirements and Nutrition factors affecting growth. Culture Media, Bacterial cultures and staining Methods.
   The Viruses: Introduction, Classification (and detail of at least one species from every group), cultivation, and replication.

3. THE FUNGI/YEAST/MOLDS.

4. THE PROTOZOA.

5. The NORMAL FLORA: Microbiology of air, water and soil (General introduction and normal inhibitants of air, water, and soil).

413 PHARMACEUTICAL MICROBIOLOGY-I (Theory) Cr. Hr. 03

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Preparation of general and selective media and culturing of micro-organisms. Total and viable counts of microorganism. Morphological and selective biochemical characteriz-ation of some specimen. Staining of Bacteria: Gram method, Acid fast, Giemasas staining, Capsule staining, Flagella staining and Spore staining. Microbiological analysis of air, water and soil.

Recommended Books

1. Jawetiz, **Medical Microbiology and Immunology**, 5th Ed., Churchill Livingstone, London, 1998.
2. W B Hugo & A D Russell, **Pharmaceutical Microbiology**, Black Well Science Ltd, London, 6th Ed., 1998.
3. Lippincot. **Microbiology by Lipponcott.** William & Willkin, USA, 2001.
4. Alcamo. **Introduction to Microbiology.** John Bartlett Publishers, 6th Ed., 2003.
5. Collin and Lynes, **Microbiological Methods**, Vutterworth Heineman, Oxford, 1995.
6. M Mekallee, **Microbiology: Essentials and Application**, McGraw-Hill Inc, 2nd Ed.
7. Singleton and Sainsbury, **Dictionary of Microbiology and Molecular biology**, John Willey & Sons, New York, 2000.
8. Pelczar, **Microbiology**, McGraw-Hill Inc, 1996.
9. Prescott, Harley, **Microbiology**, 2nd Ed., Klein Wm C Brown Publishers, 2001.

417 PAKISTAN STUDIES (Theory) Cr. Hr. 03

As per syllabi of B.A/B.Sc. classes, approved by the respective University.

4th TERM

402 Pharmaceutics-IV (Pharmaceutical Preparations-II) (Theory) Cr. Hr. 03

1. TRANSDERMAL DRUG DELIVERY SYSTEMS: Introduction of Ointments, Creams, Pastes, Poultice, Plasters, Lotions, Liniments, Topical gels, Topical Tinctures, Collodions, Topical solutions, Topical Powders, Percutaneous absorption, Transdermal systems in use.

2. OPHTHALMIC, NASAL AND OTIC PREPARATIONS: Ophthalmic solutions, suspensions, ointment, inserts, contact lens solutions. Nasal decongestant solutions, Decongestant inhalers. Ear preparations: Anti-infective, anti-inflammatory and analgesic.

3. SUPPOSITORIES AND VAGINAL SUPPOSITORIES: Semi-solid Preparations, Suppositories bases, preparation, packaging and storage, Solutions/Anemas.

4. AEROSOLS, INHALATIONS AND SPRAYS: Aerosol: Principle, container and valve assembly, Propellants, filling, testing, packaging, labeling and storage.

5. POWDERS, CAPSULES, TABLET DOSAGE FORMS: Preparation of Powders, mixing of powders, uses and packaging of powders, granules, effervescent, granulated salts. Hard gelatin capsules, capsule sizes, preparation of filled hard gelatin capsules, soft gelatin capsules, preparation and its application. Tablets, their types, characteristics and methods of preparation.

6. INTRODUCTION TO PARENTERALS: Official types of injections, solvents and vehicles for injections, added substances.

7. A brief introduction to oral hygiene products.

404 Pharmaceutics-IV (Pharmaceutical Preparations-II) (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Prepartion of Methyl salicylate ointment, Sulpher ointment, Calamine lotion, Iodine tincture, Preparations of oral hygiene products, Poultice of Kaolin, Effervescent granules, Distilled Water for injections.
(A minimum of 10n practicals will be conducted)

Recommended Books

1. Michel E Aulton, **Pharmaceutics**, ELBS/Churchill Livingstone, London, 1998.
2. **Bentley's Book of Pharmaceutics**, CBS Publishers & Distributors, New Delhi, 1986.
3. Pharmaceutics, **The Science of Dosage Form Design**. 2nd Ed., HawCourt Publisher, 2002.
4. E A Rawlins, Berdley's **Textbook of Pharmaceutics**, edited by 8th time (or recent edition) 1977. Macmillan Publishing Co Inc, New York.
5. Sprowl's (Dittert L W; Ed.), American Pharmacy, 7th Ed., J B Lippincott Co, 1990.

406 PHARMACOLOGY & THERAPEUTICS-II (General-II)
(Theory) Cr. Hr. 03

1. AUTACOIDS AND THEIR ANTAGONISTS:
   Histamine and Antihistamines, Serotonin and Serotonin Antagonists and Other Autocoids

2. DRUGS ACTING ON RESPIRATORY SYSTEM:
   (a) Drugs used for cough (Antitussives, Expectorants and Mucolytic Agents).
   (b) Drug treatment of Bronchial Asthma (Bronchodilators, Cromoglycate, Nedocromil, Cortecosteroids & other Anti-inflammatory drugs and Muscarinic receptor antagonists)

3. DRUGS ACTING ON CARDIO-VESCULAR SYSTEM:
   (a) Angina pectorus and its drug treatment.
   (b) Congestive heart failure & its treatment.
   (c) Antiarrhythmic drugs.
   (d) Agents used in Hyperlipidemia.
   (e) Coagulants and Anticoagulants.
   (f) Antihypertensives.
   (g) Diuretics.

4. DRUGS ACTING ON GENITOURINARY SYSTEM:
   Oxytoxic drugs, Ergot alkaloids and uterine relaxants.

5. ANTI-ANAEMIC DRUGS.

Note:

1. Only an introduction will be given of the banned and obsolete drug products.
2. While dealing with Pharmacology stress should be laid to the group actions of related drugs and only important differences should be discussed of the individual drugs placed in same group.
3. Newly introducted drugs should be included in the syllabus while drugs with no clinical and therapeutic values ought to be excluded from syllabus at any time.
4. The prototype drugs in each group from the latest edition of the recommended books.

408 PHARMACOLOGY & THERAPEUTICS-II
(General-II) (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. To demonstate the effects of vasconstrictor drugs on Frog's blood vessels. To demonstrate the effects of stimulant drugs on Rabbit's intestine (Acetyl choline, Barium chloride). To demonstrate the effects of depressant drugs on Rabbit's intestine (Atropine). To differentiate the effects of an unknown drug on Rabbit's intestine and identify the (unknown) drug. To study the effects of Adrenaline on Rabbit's Eyes. To study the effects of Homatropine on Rabbit's Eyes. To study the effects of Pilocarpine on Rabbit's Eyes. To study the effects of Local Anaesthetic drug (e.g. Cocaine) on Rabbit's Eyes. To identify the unknown drug & differentiate its effects on Rabbit's Eyes. (Note: A minimum of 10 practicals will be conducted)

Recommended Books

1. Goodman Gillman, **Pharmacological basis of therapeutics**. McGraw-Hill Book Company, New York, 1996.
2. Winguard and Brody, **Human Pharmacology**, Mosby Year Book, Boston, 1991.
3. James M Ritter and Lionel De Levis, **A Text book of Clinical Pharmacology**, Oxford University Press, New York, 1995.
4. R S Satorkar and S D Bhandarkar, **Pharmacology and Pharmaco-therapeutics**, Popular Prakashan, Bomby, 1993.
5. J D Tripathy, **Essential of Medical Pharmacology**, Japees Brother, New Delhi, 4th Ed., 2000.
6. D R Laurance, **Clinical Pharmacology,** ELBS, London, 6th Ed., 1987.
7. Katzung B G, **Basic and Clinical Pharmacology**, McGraw-Hill Medical Publishers, New York, 8th Ed., 2001.
8. Lipponcott, **Pharmacology**, Lippincot William & Willkin, USA, 2001
9. Manuchair Edabi, **Pharmacology**, Little Brown & Company, London, 1993.
10. Prof Dr A Qayum, **Fundamentals of Experimental Pharmacology**.
11. Bertram G K, **Basic and Clinical Pharmacology**, Paramount Publishing Business & Professional Group, USA, 6th Ed., 1995.
12. William F Ganong, W F, **Review of Medical physiology**, Prentice Hall International Inc, New Jersey.

410 PHARMACOGNOSY-II (Theory) Cr. Hr. 03

1. ALLERGENS AND ALLERGENIC PREPARATION: Introduction, case history, skin test, treatment off allergy, inhalant, ingestant, injectant, contactant, infectant and infestant allergens. Mechanism of allergy.

2. ENZYMES: Enzymes obtained from plant source. (Phytoenzymes). Papain Bromelain and Malt Extract. Enzymes obtained from Animal source. Rennin pepsin, Pancreatin and Pancrealipase.

3. POISONOUS PLANTS: General introduction of poisonous plants with special reference to Pakistan.

4. PESTICIDES: Introduction. Methods of controlling pests with special reference to natural methods.

412 PHARMACOGNOSY-II (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Microscopic examination of powders and sections of plant drugs.

A Study Tour will be an integral part of the syllabus and will be arranged at the end of the session for collection of medicinal plants from various hilly areas of the country**.**

Recommended Books

1. V E Tyler, L R Brady and J E Robbers, **Pharmacognosy,** 9th Ed., Lea and Febiger, Philadelphia, 1988.
2. G E Trease and W C Evans, **Pharmacognosy,** W B Saunders, Philadelphia, Toronto, 2002.
3. K Usmanghani, **Topics in Pharmacognosy,** University Grants Commission Monograph Series, Islamabad, pp74, 1985.
4. T E Wellis, **Text book of Pharmacognosy**, CBS Publishers & Distributors, New Delhi, 1986.
5. Varro E Taylor, **Pharmacognosy**, Lee Febiger Philadelphia, 9th Ed.
6. Mohammad Ali, **Introduction to Pharmacognosy**, CBS Publishers & Distributors, New Delhi, 1986.
7. K Usmanghani, **Chemical Pharmacognosy**, University Grants Commission, Islamabad, 1985.
8. Youngkin H W, **Text Book of Pharmacognosy**, The Blakiston Co, Toronto, 6th Ed., 1948.

414 PHARMACEUTICAL MICROBIOLOGY-II
(Theory) Cr. Hr. 03

Note:- The topics will be taught with special reference to their Pharmaceutical Applications.

2. INDUSTRIAL MICROBIOLOGY: Introduction to Sterilization/ Disinfection. Fermentation. Pharmaceutical products produced by fermentation process (Penicillins, Cepalosporins, Gentamycin, Erythromycin, Tetracyclines, Rifamycin, Griseofulvin)

3. IMMUNOLOGY: Introduction, Types of Imunity: Specific and non-specific (Cellular basis of Immune response. Immunity, autoimmunity, tolerance. Antigen. Antibodies). Antigen-Antibody reactions and their clinical and diagnostic applications. Hypersensitivity and allergy. Drug allergy mechanism. Vaccination: Introduction and aims. Types of Vaccines. Current vaccine practices.

4. FACTORY AND HOSPITAL HYGIENE AND GOOD MANUFAC-TURING PRACTICE: Introduction, Control of Microbial contamination during manufacture, Mnaufacture of Sterile products, A Guide to Current Good Pharmaceutical Manufacturing Practices.

416 PHARMACEUTICAL MICROBIOLOGY-II
(LABORATORY) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Sterilization of Glassware and pharmaceutical products by various methods. Microbiological assays of: Antibiotics and vitamins.

Recommended Books

1. Jawetiz, **Medical Microbiology and Immunology**, 5th Ed., Churchill Livingstone, London, 1998.
2. W B Hugo & A D Russell, **Pharmaceutical Microbiology**, Black Well Science Ltd, London, 6th Ed., 1998.
3. Lippincot, **Microbiology by lipponcott**, William & Willkin, USA, 2001.
4. Alcamo, **Introduction to Microbiology**, John Bartlett Publishers, 6th Ed., 2003.
5. Collin and Lynes, **Microbiological Methods**, Vutterworth Heineman,

Oxford, 1995.
6. M Mekallee, **Microbiology: Essentials and Application**, McGraw-Hill Inc, 2nd Ed.
7. Singleton and Sainsbury, **Dictionary of Microbiology and Molecular biology**, John Willey & Sons, New York, 2000.
8. Pelczar, **Microbiology**, McGraw-Hill Inc, 1996.
9. Prescott, Harley, **Microbiology**, 2nd Ed., Klein Wm C Brown Publishers, 2001.

418 ISLAMIYAT (Theory) Cr. Hr. 03

As per syllabi of B.A/B.Sc. classes, approved by the respective University.

THIRD PROFESSIONAL

5th TERM

501 PATHOLOGY (Theory) Cr. Hr. 03

1. SCOPE OF PATHOLOGY & CONCEPT OF DISEASES:

2. DEFINITION AND TERMINOLOGY: Ischemia, Hypoxia, Necrosis, Infarction, Atrophy, Hypertrophy, Hyperplasia, Metaplasia, Aplasia, Anaplasia.
3. RESPONSE OF BODY TO INJURY AND INFECTION: Acuate inflammation, Chronic inflammation, Immunity, Allergy, Hyper Sensitivity.

4. SPECIFIC: Ulcer (Peptic, Doudenal), Hypertension, Leukemia or Blood Cancer (Malignant Carcinoma, Sarcoma & Lymphomas), Diagnosis and treatment of Cancer in general, fate, survival and prognosis with tumors.

503 PATHOLOGY (Laboratory) Cr. Hr. 01

Study of Pathological Slides of various Pathological Conditions
Acute inflammation, Chronic inflammation, Chronic specific inflammation, Different types of Degeneration, Thrombosis, Embolism, Infarction, Necrosis, Gangrene, Hyperplasia, Metaplasia, Pigmentation, Calcification, CVC, Papilloma, Adenoma, Chondroma, Fibroma, Leomyoma, Neofibroma, Sq. Cell

Carcinoma, Basal Cell Carcinoma, Transitional Cell Carcinoma, Adenocarcinoma, Fibrocarcinoma, Rhadomyosarcoma, Leomyosarcoma, Lymphosarcoma, Liposarcoma, Reticular Cell Sarcoma, Hodgkins disease, Breast Carcinoma, Osteogenic Sarcoma, Osteoclastoma.

Examiantion of different body fluids in various Pathological Conditions

Urine complete Examination, stool Examination, Blood Complete Examination, Semen Examination, Cerebrospinal Fluid Examination, Pericardial fluid examination, Pleural Fluid Examination, Ascitic Fluid Examination, Blood Sugar, Blood Urea, Blood Choleterol etc.

Tests for various Specimens of Clinical Importance

Techniques of Clinical Blood Examination for various disases, Gastric Analysis, Tests for liver function test, Renal function test, Tests for endocrine abnormalities, Biopsies and cytologic techniques.

Recommended Books

1. Kumar Cotran Robins, **Basic Pathology,** 6th Ed., W B Saunders Company, Philadelphia (1992).
2. Walters and Israel, **General Pathology**, Churchill Livingstone, London (1998).
3. Peter S Macfarlane, Robin Reid, Robin Collander, **Pathology Illustrated**, Churchill Livingstone, London (1998).
4. **Robbins Pathology**, W B Saunders Co, London, 2nd Ed., 1962.
5. Walter G B, **General Pathology**, Churchill Livingstone, New York, 1996.

505 PHARMACOLOGY & THERAPEUTICS (Systemic Pharmacology) (Theory) Cr. Hr. 03

1. DRUGS ACTING ON CENTRAL NERVOUS SYSTEM
   (a) CNS – Depressants: Hypnotic & Sedatives and Analgesics (Narcotic Analgesics and opioid antagonists, Analgesic, Antipyretic and Anti-inflammatory drugs [NSAID] including Disease-modifying antirheumatic drugs and Drug treatment of Gout)
   (b) CNS – Stimulants: Cerebral Stimulants, Medullary stimulants, Spinal Cord Stimulants, Antidepressants, Psychotomimetic or Hallucinogenics, Psychotherapeutic Agents (Anxiolytics and Antipsychotics), Drug treatment of Epilepsy and Drug treatment of Parkinsonism and other movement disorders.

2. ANAESTHETICS
   (a) Anaesthesia and its clinical importance.

(b) General Anaesthesia, Mechanism of action and its application.
(c) General Anaesthetics.
(d) Local Anaesthetics.
(e) Spinal Anaesthesia and drug used.
(f) Techniques of Local Anaesthesia.

Note:

1. Only an introduction will be given of the banned and obsolete drug products.
2. While dealing with Pharmacology stress should be laid to the group actions of related drugs and only important differences should be discussed of the individual drugs placed in same group.
3. Newly introducted drugs should be included in the syllabus while drugs with no clinical and therapeutic values ought to be excluded from syllabus at any time.
4. The prototype drugs in each group from the latest edition of the recommended books.

507 PHARMACOLOGY & THERAPEUTICS (Systemic Pharmacology) (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. To study the convulsant effects of strychnine and picrotoxin in frogs and to determine the site of action. To identify the unknown (convulsant) drug and determine its site of action. To study the effects of Adrenaline on Human Eyes.

To study the effects of Pilocarpine on Human Eyes. To study the effect of Homatropine on Human Eyes. To identify and observe the effects of unknown drugs on Human Eyes. To study the effects of local anaesthetic drugs on human and the nerve plexus of frog.

Recommended Books

1. Goodman Gillman, **Pharmacological basis of therapeutics**. McGraw-Hill Book Company, New York, 1996.
2. Winguard and Brody, **Human Pharmacology**, Mosby Year Book, Boston, 1991.
3. James M Ritter and Lionel De Levis, **A Text book of Clinical Pharmacology**, Oxford University Press, New York, 1995.
4. R S Satorkar and S D Bhandarkar, **Pharmacology and Pharmaco-therapeutics**, Popular Prakashan, Bomby, 1993.
5. J D Tripathy, **Essential of Medical Pharmacology**, Japees Brother, New Delhi, 4th Ed., 2000.

6. D R Laurance, **Clinical Pharmacology,** ELBS, London, 6th Ed., 1987.
7. Katzung, B G, **Basic and Clinical Pharmacology**, McGraw-Hill Medical Publishers, New York, 8th Ed, 2001.
8. Lipponcott, **Pharmacology**, Lippincot William & Willkin, USA, 2001.

9. Manuchair Edabi, **Pharmacology**, Little Brown & Company, London, 1993.
10. Prof Dr A Qayum, **Fundamentals of Experimental Pharmacology**.
11. Bertram G K, **Basic and Clinical Pharmacology**, Paramount Publishing Business & Professional Group, USA, 6th Ed., 1995.
12. William F Ganong, W F, **Review of Medical physiology**, Prentice Hall International Inc, New Jersey.

509 PHARMACOGNOSY-III (Theory) Cr. Hr. 03

1. SEPARATION AND ISOLATION OF PLANT CONSTITUTIONS: An introduction to chromatography and chromatographic techniques e.g. Adsorption Chromatography and Partition Chromatography.

2. CARBOHYDRATES: Introduction of carbohydrate.
   (a) Sucrose and Sucrose containing drugs: Sucrose, Dextrose, Liquid glucose, Fructose, Lactose, Xylose, Caramel, Honey, Starch, Inulin, Dextrine etc.
   (b) Cellulose and Cellulose Derivatives: Purified cotton, Powdered cellulose, Microcrystalline cellulose, Methyl cellulose, Sodium Carboxy-methyl cellulose.
   (c) Gums and Mucilages: Tragacenth, Acacia, Sodium Alginate, Agar, Pectin.

3. GLYCOSIDES: Introduction, classification, chemistry and medicinal uses of:
   (a) Cardioactive glycosides: Digitalis, Strophanthus and white squill.
   (b) Anthroquinone glycosides: Cascara, Aloe, Rhubarb, Cochineal and Senna.
   (c) Saponin glycosides: Glycyrrhiza, Sarsaparilla.
   (d) Cyanophore glycosides: Wild cherry.
   (e) Isothiocyanate glycosides: Black Mustard.
   (f) Lactone glycosides: Cantharide.
   (g) Aldehyde glycosides: Vanilla.
   (h) Miscellaneous glycosides: Gentian,. Quassia, Dioscorea.

4. TANNINS: Introduction, classification, properties and chemical identity tests of Tannins and Tannin containing compounds. Detailed study of Hammamelis, Catechu and Nut Galls.

5. LIPIDS: Introduction. Detailed study of:

(a) Fixed Oils: Castor oil, cotton seed oil, olive oil, peanut oil, sun flower oil, corn oil, coconut oil, Almond oil, Linseed oil, Mustard oil, Sesame oil and soybean oil.
(b) Fats and Related Compounds: Theobroma oil and Lenolin.
(c) Waxes: Bees wax, carnauba wax, spermaceti and Jojoba oil.

511 PHARMACOGNOSY-III (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Extraction of the active constituents of crude drugs and chemical tests for their identification.

Recommended Books

1. V E Tyler, L R Brady and J E Robbers, **Pharmacognosy,** 9th Ed., Lea and Febiger, Philadelphia, 1988.
2. G E Trease and W C Evans, **Pharmacognosy,** W B Saunders, Philadelphia, Toronto, 2002.
3. K Usmanghani, **Topics in Pharmacognosy,** University Grants Commission Monograph Series, Islamabad, pp74, 1985.
4. T E Wellis, **Text book of Pharmacognosy**, CBS Publishers & Distributors, New Delhi, 1986.
5. Varro E Taylor, **Pharmacognosy**, Lee Febiger Philadelphia, 9th Ed.
6. Mohammad Ali, **Introduction to Pharmacognosy**, CBS Publishers & Distributors, New Delhi, 1986.
7. K Usmanghani, **Chemical Pharmacognosy**, University Grants Commission, Islamabad, 1985.
8. Youngkin H W, **Text Book of Pharmacognosy.** The Blakiston Co. Toronto, 6th Ed., 1948.

513 PHARMACEUTICAL CHEMISTRY-III (Instrumentation-I) (Theory) Cr. Hr. 03

Note:- The topics will be taught with special reference to their Pharmaceutical Applications.

Theory, Instrumentation and Pharmaceutical Applications of the following Spectroscopic Methods

1. Atomic Absorption and Emission Spectroscopy.
2. Molecular fluorescence spectroscopy.
3. Flame Photometry.
4. I.R. Spectroscopy.

5. Mass Spectroscopy.
6. NMR Spectroscopy.
7. UV/Visible Spectroscopy.

515 PHARMACEUTICAL CHEMISTRY-III (Instrumentation-I) (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the requirements, e.g. Determination of the Purity and Composition of the unknown drugs by using at least each of the above techniques.

Recommended Books

1. Lough W J, **High Performance Liquid Chromatography**, Blacki Academic Press, New York, 1996.
2. William Kemp,**Organic Spectroscopy**, Ellsi Horwood, London, 1990.
3. M Aminuddin & Javed Iqbal, **Theory and Practice of Chromatography,** University Grants Commission, Islamabad-Pakistan (2000).
4. A H Beckett and J B Stennlake, **Practical Pharmaceutical Chemistry**, Part I and II, the Aulton Press, London.
5. A M Knevel and F E Digangi, **Jenkins's quantitative Pharmaceutical Chemistry**, McGraw-Hill Book Company, New York.
6. Braithwaite and F J Smith, **Chromatographic Methods**, Chapman and Hall, London.
7. E Heftmann, **Chromatography**, Von Nostrond Reinheld Co, New York, 1975.
8. Pryde and M J Gilbert, **Applications of High Performance Liquid Chromatography**, Chapman & Hall, London, 1979.
9. E Stahl, **Thin Layer Chromatography**, Springer-Verlag, Berlin, 1969.
10. R Hamilton, **Introduction to HPLC**, P A Sewell, Chapman & Hall, London, 1982.

517 PHARMACEUTICS-V (Dispensing Pharmacy) (Theory) Cr. Hr. 02

1. Basic Principles of Compounding and Dispensing Including:
   Weights and Measures, Calculations for compounding and Dispensing, Fundamental operations in Compounding, Containers and closures for Dispensed Products, Prescription-Handling (Parts of Prescription, Filling, Interpretation, Pricing) and Labelling of Dispensed Medication.
2. Extemporaneous Dispensing of:

Solutions, Suspensions, Emulsions, Creams, Ointments, Pastes and gels, Suppositories and pessaries, Powders and granules and Oral unit dosage form.

3. Pharmaceutical Incompatibilities:
   Types of Incompatibilities, Manifestations, Correction and Prevention with reference to typical examples.
4. Classical dosage Forms.
5. I.V. Admixtures.
6. Radio-Pharmacy-Techniques and Applications.

519 PHARMACEUTICS-V (Dispensing Pharmacy) (Laboratory) **Cr. Hr. 01**

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Practical introduction to prescription-handling, interpretation, filling and Labeling.

1. Mixtures: Dispensing of simple mixtures containing soluble substances only, mixtures containing diffusable substances, indiffusable substances and mixtures forming precipitate.
2. Powders: Dispensing of simple powders, compound powders and effervescent powders for external use.
3. Incompatibility: Practical Importance of Incompatibilities.
4. Ointments And Creams: Dispensing of iodine and Methyl salicylate ointment. Dispensing of cold cream and vanishing creams.
5. Cosmetics: Lipstic, talcum powder, after shave lotion, shaving cream.
   (Note: A minimum of 20 practicals will be conducted)

Recommended Books

1. Cooper and Guns, **Dispensing**, CBS Publishers & Distributors, New Delhi, 1986.
2. **Hussa's Dispensing.**
3. **Remington's Pharmaceutical Sciences**, Mack Publishing Company, USA, 2001.
4. Martindale's **Extra Pharmacopoeia.**

6th TERM

502 COMPUTER AND ITS APPLICATIONS IN PHARMACY (Theory)

Cr. Hr. 03

1. Fundamentals basic concept of computers
   History of Data Processing, Types of Computers, Components of a Computer, Computer System and Business Computer System, Backing Storage Devices, Unit of Memory, Viruses and Anti-viruses Issues.
2. System Analysis and Design
   What is a System? Steps in system life cycle, Data Gathering and Data Analysis, Designing a New System, Development and Implementation of New System, Documentation.
3. Data Processing
   Data Processing, The Data Processing Cycle, The Collection and Computing of data, Manual collection of data, The main methods of data input, Devices used to collect data, Data Verification, Data Validation, Output and Recording of data, Types of data processing systems, Types of Computer Operation, Batch Processing and Real-time Processing.
4. Data Communication
   Applications of Data Communication, Components of a data communication system, Rate of data Transmission, Computer Networks, Network Topology, Gateway, E-mail/Internet concepts.

504 COMPUTER AND ITS APPLICATIONS IN PHARMACY (Laboratory)

Cr. Hr. 01

1. Internet and E-mail
   Internet and Microsoft Internet Explorer 5, Addresses, Links and Downloading, Searching the Internet, E-mail and Newsgroups, Favorites, security and Customizing Explorer.
2. Web Page Development
   Introduction to Front-page, Creating a First Web site, Basic Formatting Techniques, Manipulating Tables within Front-page, Front-page, Picture and Multimedia, Hyper linking, Bookmarks and Image Maps, Introducing Front-page "components", Front-page and Frames, Managing your Web, Good site design, Publishing and publicizing.
3. Complete Statistical Package like SPSS.
4. Languages
   At least two prevailing languages will be taught.

Recommended Books

1. Elias M **System Analysis**. Award Galgotia Publications, New Delhi, 1989.

2. Peter Norton, **Inside IBM PC**. Brady Computer Books, New York, 1988.
3. Dennis N, **MS-DOS**. Jump Practice Hall Press, New York, 1987.
4. Peter Norton, **PC-DOS**. Brady Computer Books, New York, 1985.

506 PHARMACOLOGY AND THERAPEUTICS-IV (Systemic Pharmacology-II (Theory) Cr. Hr. 03

1. CHEMOTHERAPY
   (a) Classification of drugs.
   (b) Antimicrobials: Sulphonamides, Antivirals, Antiprotozoals (Treatment of Malaria and Treatment of Amebiasis), Antifungals, Anthelmintics, Anti-neoplastic and Immunosuppressive drugs, Drug treatment of Leprosy and Antibiotics (Penicillins, Cephalosporins, Aminoglycosides, Tetracyclines, Chloramphenicol, Macrolides, Quinolones and Miscellaneous Antibiotics).
   (c) Antihypertensive Drugs.
   (d) Steroids and Antisteroid drugs.

2. HORMONES, ANTAGONISTS AND OTHER AGENTS AFFECTING ENDOCRINE FUNCTION
   (a) Endocrine function and dysfunctions.
   (b) Drug used for therapy of Diabetes Mellitus: Insulins and Oral Hypoglycemic agents.
   (c) Corticosteroids.
   (d) Thyroid hormone and anti-thyroid drugs.

3. TOXICOLOGY
   (a) Pollution and its typers (water, air, food).
   (b) Poison and principle of treatment of poisoning.
   (c) Poisoning (Sign & symptom and treatment): Ethanol, Barbiturates, Digitalis, Salicylides, Strychnine, Narcotics, Nicotine, Paracetamol, Benzodiazepines and Organophosphorous compounds.
   (d) Chelating agents and their role in poisoning: Dimercaprol, Calcium disodium edentate, Pencillamine and Defroxamine.

Note:

1. Only an introduction will be given of the banned and obsolete drug products.
2. While dealing with Pharmacology stress should be laid to the group actions of related drugs and only important differences should be discussed of the individual drugs placed in same group.
3. Newly introducted drugs should be included in the syllabus while drugs with no clinical and therapeutic values ought to be excluded from syllabus at any time.

4. The prototype drugs in each group from the latest edition of the recommended books.

508 PHARMACOLOGY AND THERAPEUTICS-IV (Systemic Pharmacology-II) (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g.

1. To identify and differentiate the effects of unknown drug on human and the nerve plexus of frog.
2. To demonstrate the effects of Acetylcholine on the Rectus abdominus muscle of frog and competitive.
3. Pharmacological antagomism by Neuromuscular blocking agent e.g. Gallamine.
4. To identify the unknown drug by performing pharmacological competitive antagonism on Rectus.
5. Abdominus muscle of Frog.
6. To study the anti-coagulant effects of Heparin and oral anti-coagulants on Rabbits.
7. To identify the unknown anti-coagulant drug using Rabbits.
8. To demonstrate the graded Dose-Response curve of Acetylcholine on Rabbit intestine.
9. To identify unknown concentration of Acetycholine from graded Dose-Response curves.

Recommended Books

1. Goodman Gillman, **Pharmacological basis of therapeutics**. McGraw-Hill Book Company, New York, 1996.
2. Winguard and Brody, **Human Pharmacology**, Mosby Year Book, Boston, 1991.
3. James M Ritter and Lionel De Levis, **A Text book of Clinical Pharmacology**, Oxford University Press, New York, 1995.
4. R S Satorkar and S D Bhandarkar, **Pharmacology and Pharmacotherapeutics**, Popular Prakashan, Bomby, 1993.
5. J D Tripathy, **Essential of Medical Pharmacology**, Japees Brother, New Delhi, 4th Ed., 2000.
6. D R Laurance, **Clinical Pharmacology,** ELBS, London, 6th Ed., 1987.
7. Katzung, B G, **Basic and Clinical Pharmacology**, McGraw-Hill Medical Publishers, New York, 8th Ed., 2001.
8. Lipponcott, **Pharmacology**, Lippincot William & Willkin, USA, 2001.

9. Manuchair Edabi, **Pharmacology**, Little Brown & Company, London, 1993.
10. Qayum A **Fundamentals of Experimental Pharmacology**. Ghandhara University, Peshawar.
11. Bertram G K, **Basic and Clinical Pharmacology**, Paramount Publishing Business & Professional Group, USA, 6th Ed., 1995.
12. William F Ganong, W F, **Review of Medical physiology**, Prentice Hall International Inc, New Jersey.

510 PHARMACOGNOSY-IV (Theory) Cr. Hr. 03

1. VOLATILE OILS (ESSENTIAL OILS): Introduction, significance, methods of obtaining volatile oils, chemistry and classification of:
   (a) Hydrocarbon volatile oils: Cubeb and Terpentine oil.
   (b) Alcoholic volatile oils: Peppermint, Coriander and Cardamom.
   (c) Aldehydic volatile oils: Bitter orange peel, sweet orange peel, lemon, cinnamon and bitter almond oil.
   (d) Ketonic volatile oils: Camphor, spearmint, caraway, Buchu.
   (e) Phenolic volatile oils: Clove, Thyme.
   (f) Phenolic ether volatile oils: Fennel, Anise, Myristica.
   (g) Oxide volatile oils: Eucalyptus, chenopodium.
   (h) Ester volatile oils: Rosemary.
   (i) Miscellaneous volatile oils: Allium, Anethum.

2. RESINS AND RESIN COMBINATION: Introduction, properties and difference between glycoresins, oleoresins, oleo-gum resins and balsams.
   (a) Resins: Rosin, Cannabis.
   (b) Glycoresins: Podophyllum, Jalap, Ipomoea, Colocynth.
   (c) Oleoresins: Terpentine, Capsicum, Ginger.
   (d) Oleo-gum resins: Asafoetida, Myrrh.
   (e) Balsams: Storax, Peruvian balsam, Tolu balsam, Benzoin.

3. ALKALOIDS: Introduction, Properties, Cassification, Function of alkaloids in plants, Methods of extraction and identification tests.
   (a) Pyridine — Piperidine Alkaloids: Areca nut, Lobelia, Tobacco.
   (b) Tropane Alkaloids: Belladonna, Hyoscyamus, Stramonium.
   (c) Quinoline Alkaloids: Cinchona.
   (d) Isoquinoline Alkaloids: Ipecacuanha, Opium.
   (e) Indole alkaloids: Rauwolfia, catharanthus, nux vomica, physostigma, ergot.
   (f) Imidazole alkaloids: Pilocarpus.
   (g) Steroidal alkaloids: Veratrum.
   (h) Alkaloidal amines: Ephedra, colchicum.

(i) Purine Bases: Tea, Coffee.

4. TUMOUR INHIBITORS FROM PLANT: Detailed study of various anti-tumour agents isolated from plants.

512 PHARMACOGNOSY-IV (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Isolation and separation of active constituents of crude drugs by paper and thin layer chromatography.

Recommended Books

1. V E Tyler, L R Brady and J E Robbers, **Pharmacognosy,** 9th Ed., Lea and Febiger, Philadelphia, 1988.
2. G E Trease and W C Evans, **Pharmacognosy,** W B Saunders, Philadelphia, Toronto, 2002.
3. K Usmanghani, **Topics in Pharmacognosy,** University Grants Commission Monograph Series, Islamabad, pp74, 1985.
4. T E Wellis, **Text book of Pharmacognosy**, CBS Publishers & Distributors, New Delhi, 1986.
5. Varro E Taylor, **Pharmacognosy**, Lee Febiger Philadelphia, 9th Ed.
6. Mohammad Ali, **Introduction to Pharmacognosy**, CBS Publishers & Distributors, New Delhi, 1986.
7. K Usmanghani, **Chemical Pharmacognosy**, University Grants Commission, Islamabad, 1985.
8. Youngkin H W, **Text Book of Pharmacognosy**, The Blakiston Co, Toronto, 6th Ed., 1948.

514 PHARMACEUTICAL CHEMISTRY-IV (Instrumentation) (Theory) Cr. Hr. 03

Note:- The topics will be taught with special reference to their Pharmaceutical Applications.

1. CHROMATOGRAPHIC METHODS: Column Chromatography, Thin Layer Chromatography, Gas Liquid Chromatography, HPLC and GC-MS.

2. ELECTRO CHEMICAL METHODS: Potentiometry, Polarography and Radiochemical Techniques.

3. DIFFERENTIAL SCANNING CALORIMETRY.

516 PHARMACEUTICAL CHEMISTRY-IV (Instrumentation) (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the requirements, e.g. Determination of the Purity and Composition of the unknown drugs by using at least each of the above techniques.

Recommended Books

1. Lough W J, **High Performance Liquid Chromatography**, Blacki Academic Press, New York, 1996
2. William Kemp,**Organic Spectroscopy**, Ellsi Horwood, London, 1990.
3. M Aminuddin & Javed Iqbal, **Theory and Practice of Chromatography,** University Grants Commission, Islamabad-Pakistan (2000).
4. A H Beckett and J B Stennlake, **Practical Pharmaceutical Chemistry**, Part I and II, the aulton Press, London.
5. A M Knevel and F E Digangi, **Jenkins's quantitative Pharmaceutical Chemistry**, McGraw-Hill Book Company, New York.
6. A Braithwaite and F J Smith, **Chromatographic Methods**, Chapman and Hall, London.
7. E Heftmann, **Chromatography**, Von Nostrond Reinheld Co, New York, 1975.
8. A Pryde and M J Gilbert, **Applications of High Performance Liquid Chromatography**, Chapman & Hall, London, 1979.
9. E Stahl, **Thin Layer Chromatography**, Springer-Verlag, Berlin, 1969.
10. R Hamilton, **Introduction to HPLC**, P A Sewell, Chapman & Hall, London, 1982.

518 PHARMACEUTICS-IV (Community Pharmacy) (Theory) **Cr. Hr. 04**

1. DEFINITIONS AND BACKGROUND.

2. PUBLIC HEALTH AND COMMUNITY PHARMACY: Epidemeology & its Control, Preventive Health (EPI & CDC), Family Planning and Health Policy & National Drug Policy.

3. PATIENT ASSESSMENT.

4. MEDICAL COMPLICATION OF DRUG TAKING: General and Socio-economic Aspects.

5. PATIENT PHARMACIST COMMUNICATION.

6. PATIENT EDUCATION AND COUNCELLING.

7. CONTROL OF DRUG ABUSE AND MISUSE.

8. ROLE OF PHARMACIST: As Public Health Educator in the Community for Drug Monitoring and Drug Information.

Recommended Books

1. Roy Robertson, **Management of Drug Users in the Community**: A Practical Handbook.
2. **Remington's Pharmaceutical Sciences**, Mack Publishing Company, USA, 2001.
3. Martindale's **Extra Pharmacopoeia.**

FOURTH PROFESSIONAL

7th TERM

601 PHARMACEUTICS-VII (Hospital Pharmacy-I) (Theory) **Cr. Hr. 03**

1. INTRODUCTION
   (a) Role of Pharmacist in Hospital.
   (b) Minimum standards for pharmacies in Institutions/Hospitals.
   (c) Research in Hospital Pharmacy.

2. HOSPITAL AND ITS ORGANIZATION
   (a) Classification of Hospitals.
   (b) Organizational Pattern.
   (c) Administration.
   (d) Clinical Departments.
   (e) Nursing, Dietectic, Pathology, Blood Bank, Radiology and other supportive services etc.
   (f) Role of Pharmacy in Hospital.
   (g) Hospital Finances.

3. PHARMACY, ITS ORGANIZATION AND PERSONNEL
   (a) Pharmacy specialist.
   (b) Drug information Centre.
   (c) Poison Control Centre and Antidote Bank.
   (d) Pharmacy Education.
   (e) Determining the need of Professional and other departmental staff.
   (f) Professional services rendered.

4. PHARMACY AND THERAPEUTIC COMMITTEE.

5. THE HOSPITAL FORMULARY
   (a) General Principles and guidelines to develop Formulary.
   (b) Format.
   (c) Preparation of the Formulary & Role of Pharmacist.
   (d) Benefits and problems.
   (e) Keeping up-to-date Formulary.
   (f) Contraceptives.

6. DISPENSING TO INPATIENTS
   (a) Methods of Dispensing & SOP's.
   (b) Unit dose dispensing.

(c) Other concepts of dispensing, Satellite Pharmacy etc.

7. DISPENSING TO AMBULATORY PATIENTS.

8. DISTRIBUTION OF CONTROL SUBSTANCES.

9. DISPENSING DURING OFF-HOURS.

10. SAFE USE OF MEDICATION IN THE HOSPITAL
    (a) Medication error.
    (b) Evaluation & Precautions of Medication Error.
    (c) Role of Pharmacist in Controlling Medication Error.

Recommended Books

1. William Hassan, **Hospital Pharmacy**, Lee & Febiger, Washington, 5th Ed., 1986.
2. N I Bukhari, **Hospital Pharmacy**, Aziz Book Depot, Lahore-Pakistan, 2000.
3. Martin Stephen, **Hospital Pharmacy**, Pharmaceutical Press, London, 2003.

603 PHARMACEUTICS-VIII (Clinical Pharmacy-I) (Theory) **Cr. Hr. 03**

1. GENERAL INTRODUCTION TO CLINICAL PHARMACY:
   Terminologies, Basic Components and Scope.

2. PATIENT PROFILE:
   (a) Patient disease profile.
   (b) Taking case History.
   (c) Drug Profile of 25 Drugs (Adrenaline, Aminoglycosides, Anti TB Drugs, Antiepileptics, Atropine, Benzodiazepines, Cepahlosporins, Chlorpheniramine, Cimetidine, Digoxin, Dobutamine, Dopamine, Fluroquinolone, Frusemide, Lactulose, Macrolides, Metoclopramide, Morphine/Pethedine, Nifedipine, NSAIDS, ORS, Penicillins, Prednisolone, Salbutamol, Vancomycin)

3. CLINICAL TRIALS OF DRUG SUBSTANCES.
   Designing of clinical trials, Types of trials, Choice of patients, Exclusion of patients and Monitoring a clinical trial.

4. EMERGENCY TREATMENT.

605 PHARMACEUTICS-VIII (Clinical Pharmacy-I)

(Laboratory) **Cr. Hr. 01**

Clerkship in the Clinical setting. A project related to Clinical Pharmacy Practices will be completed by the students and will be evaluated by the external examiner.

Recommended Books

1. Roger Walker, **Clinical Pharmacy & Therapeutics,** Churchill Levingstone, London, 3rd Ed., 2003.
2. Guard Paul, **A Behavioral Approach to Pharmacy Practice**, Black Well, USA, 2000.
3. Herfindal Gourley, **Clinical Pharmacy & Therapeutics,** William & Willkins, London, 1992.
4. A J Winfield, **Pharmaceutical Practice**, Churchill Levingstone, London, 2nd Ed., 1998.
5. Kavin Taylor, **Pharmacy Practice**, Taylor & Francis, New York, 1998.
6. Deborah Rosenbaun, **Clinical Research Coordinator Hand Book**, 2nd Ed., Sarrison, Inc, North Carolina, USA.
7. Simon Cook, **Clinical Studies Management**, **a Practical Guide to Success**, Sue Horwood Publishing limited, West Sussex, UK.
8. Joseph. T. Dipiro, **Encyclopedia of Clinical Pharmacy**. Marcel Dekker Publishing. 2003
9. Joseph T Dipiro, **Encyclopedia of Pharmacy**. Marcel Dekker Publishing 2002.
10. Mellainie J Rantucci, **Pharmacist Talking with Patients**.1997
11. Smith GDG and Aronson J K, **Oxford Text Book of Clinical Pharmacology and Drug Therapy**, Oxford Universotu Press, UK, 1990.
12. Hansten P and Horn J, **Drug interactions**. Lee & Febiger, Philadelphia, USA, 1989.

607 PHARMACEUTICS-IX (Industrial Pharmacy-I)
(Theory) **Cr. Hr. 03**

1. MASS TRANSFER.

2. HEAT TRANSFER.

3. DRYING: Theories of drying, Drying of Solids, Classification of dryers, General Methods, Fluidized Bed systems, Pneumatic systems, Spray dryer, Freeze dying.
4. MIXING: Fundamentals, Mechanisms, Mixing Equipment used in Liquid/Liquid, Liquid/Solid and solid/solid mixing, Communition (size reduction), Reasons for size reduction, Factors affecting size reduction,

size analysis, Sieving, Energy Mills (Ball Mill. Endrumer, Edge Rumer, Disintegrant, Colloid Mill, Hammer Mill, Cutter Mill, and Fluid Energy Mill etc.).

5. CLARIFICATION AND FILTERATION: Theory, Filter media, Filter aids, Filter selection and Equipment (Leaf filter, Filter press, Melta filters and Rotary filters).

6. EVAPORATION: General principles of Evaporation, Evaporators and Evaporation under reduced pressure.

7. COMPRESSION AND COMPACTION: The solid-air Interface, Angle of Repose, Flow rates, Mass volume relationship, Density, Heckel Plots, Consolidation, Granulation, Friability, Compression (dry method, wet method, slugging), Physics of Tabletting, tabletting machines and other equipment required, problems involved in tabletting, tablet coating, Capsulation (Hard and Soft gelatin capsules).

8. SAFETY METHODS IN PHARMACEUTICAL INDUSTRY:
   (a) Mechanical, chemical and fire hazards problems.
   (b) Inflammable gases and dusts.

609 PHARMACEUTICS-IX (Industrial Pharmacy-I) (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Manufacture of Tablets by Wet Granulation Method, by Slugging and by Direct Compression. Coating of Tablets (Sugar Coating, Film coatingand Enteric Coating). Clarification of liquids by various processes. Size Reduction. Homogenization.

Recommended Books

1. Lackman, **Theory and Practice of Industrial Pharmacy**, Verghese Publishing House, Bombay, 1987.
2. Cooper and Gunn's, **Tutorial Pharmacy**, CBS Publishers & Distributors, New Delhi, 1986.
3. **Bentley's Pharmaceutical Text Book**, CBS Publishers & Distributors, New Delhi, 1986.
4. **Remington's Pharmaceutical Sciences**, Mack Publishing Company, USA, 2001.
5. John Sharp, **Good Pharmaceutical Manufacturing Practice**, Rational and Compliance.

611 PHARMACEUTICS-X (Biopharmaceutics-I) (Theory) Cr. Hr. 03

1 DEFINITIONS AND TERMINOLOGY:
Biopharmaceutics, Generic Equivalence, Bioavailability, Bioequivalence, Drug Disposition, Therapeutics, Pharmacokinetics, Biotransformation and Therapeutic Equivalents.

2. GASTRO-INTESTINAL ABSORPTION AND PHYSICO-CHEMICAL CONSIDERATIONS.
Forces which help in transmembrane movements, pH Partition Theory, Lipid Solubility and Factors affecting Bioavailability.

3. BIOAVAILABILITY STUDIES:
Purpose, Relative and Absolute Bioavailability, and Determination of Bioavailability.

4. FACTORS AFFECTING DISSOLUTION IN RESPECT OF BIOAVAILABILITY:
Methods of in-vitro and in-vivo determination of rate of dissolution.

5. MULTIPLE DOSAGE REGEMIN.

6. INTRAVENOUS INFUSIONS.

7. BIOPHARMACEUTICAL AND PHARMACOKINETIC ASPECTS IN DEVELOPING A DOSAGE FORM.

613 PHARMACEUTICS-X (Biopharmaceutics) (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Blood Sampling Techniques: In Laboratory Animals like dog, rabbits, mice etc. In human beings, In-vitro dissolution studies, Optional dose determination, Measurement of rate of Bioavailability, Determination of relative and absolute bio-availability.

Recommended Books

1. Leon Shargel, **Applied Pharmacokinetics and Biopharmaceutics**, Appleton & Lange, New York, 4th Ed., 1999.

2. Malcoln Rouland, Thomous N Tozer, **Clinical Pharmacokinetics**, William & Willkins, London, 1995.
3. Milo Gibaldi, **Biopharmaceutics and Clinical Pharmacokinetics**, Marchel & Dakker Inc, New York, 1982.
4. Gibbson and Skett, **Introduction to Drug Metabolism**, Champ & Hall, London, 1986.
5. Robert E Notari, **Biopharmaceutics and Clinical Pharmacokinetics**, Marchel & Dakker Inc, New York, 1988.
6. Stephen H Curry, **Drug disposition and pharmacokinetics**, Black Well Scientific Publishing, Oxford, 1977.
7. Avraham Yacobi, **Toxicokinetics and New Drug Development**, Paramount Press, New York, 1989.
8. Sarfraz Niazi, **Text Book of Biopharmaceutics and Clinical Pharmacokinetics**. Appleton-Century-Crofts, New York, 1985.
9. P Macheras, C Reppas and J B Dressman, **Biopharmaceutics of orally administered drugs**, Ellis Horwood Limited, London (1995).
10. Albert P Li, **Invitro approaches for evaluation of drug efficacy and toxicity**, CRC Press LLC, USA, 2004.
11. Ronald D Schoenwald, **Pharmacokinetics in drug discovery and Development**, CRC Press, LLC, USA, 2002.

615 PHARMACEUTICS-XI (Pharmaceutical Quality Management-I) (Theory) Cr. Hr. 03

1. SCOPE
   (a) An understanding of the testing, quality control programme and methods adopted in a pharmaceutical industry, dosage form control, process control, testing program and methods, physical, chemical and biological tests and specifications, statitical quality control.
   (b) General understanding of Total Quality Assurance and measures to adopt Quality Assurance.

2. QUALITY CONTROL OF SOLID DOSAGE FORMS:
   (a) Physical tests: Hardness, Thickness and Diameter, Friability, Disintegration, Weight Variation.
   (b) Chemical tests: Content uniformity, Assay of active ingredients and dissolution tests of Powders, Granules, Tablets and Capsules.

3. QUALITY CONTROL OF SYRUPS AND ELIXIRS:
   Viscosity, its determiantion and application in the Quality Control of Pharmaceuticals, Weight per ml and Assay of active ingredients.

4. EVALUATION OF SUSTAINED ACTION PRODUCTS (TABLETS & CAPSULES):
   Stability of viability rate during storage and In-vitro & In-vivo evaluation of sustaining action.

5. QUALITY CONTROL OF SUPPOSITORIES
   Disintegration test, Uniformity of weight, Assay of active ingredients, Liqefaction time test and Breaking test.

6. QUALITY CONTROL OF STERILE PRODUCTS (PARENTERALS)
   Leaker's test, Clarity test, Pyrogen test for parenterals and other sterile preparations and Assay for active ingredients.

617 PHARMACEUTICS-XI (Pharmaceutical Quality Management-I) (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Assay of various spirits, tinctures, extracts, syrups and elixirs, Assay of Ointments and suppositories, Assay of tablets and capsules, Test for alkalinity of glass, Determiantion of alcohol contents in the Pharmaceutical preparations and Pyrogen test.

Recommended Books

1. A H Beckett and J B Stennlake, **Practical Pharmaceutical Chemistry**, Part-I and II, The Alton Press, London.
2. M Knevel and F E Digangi, **Jenkin's Quantitative Pharmaceutical Chemistry**, McGraw-Hill Book Company, New York.
3. K A Connors, **A Text Book of Pharmaceutical Analysis**, John — Wiley and Sons, New York.
4. Braithwaite and F J Smith, **Chromatographic Methods**, Chapman and Hall, London.
5. G D Christian, **Analytical Chemistry**, John Wiley and Sons, New York.
6. Karamt A Javaid, **Pharmaceutical Quality Assurance in Class, Industry and Market,** Aziz Publishers, Lahore-Pakistan (1993).
7. Gil Bismuth and Shosh Neumann, **Cleaning Validation, A practical approach**. CRC Press, LLC, USA, 2003.
8. J T Carstersen and C T Rhodes, **Drug Stability: Principles and Practices,** 3rd Ed. (revised and expanded), Mercel Dekker, New York. 2000.
9. Sydney H Willig, **Good Manufacturing Practices for Pharmaceuticals,** Marcel Dekker Publishing.

10. Bryant R, **The pharmaceutical Quality Control Hand Book**, Aster Publishing Corporation, Eugene, 1989.
11. Braun R E, **Introduction to Instrumental Analysis**, McGraw-Hill Book Co, NY, 1987.

8th TERM

602 PHARMACEUTICS-VII (Hospital Pharmacy-II)
(Theory) Cr. Hr. 03

1. MANUFACTURING BULK AND STERILE.

2. THE PHARMACY-CENTRAL STERILE SUPPLY ROOM.

3. ASEPTIC DISPENSING
   TPN, I/V Admixtures, Cytotoxic Dispensing, Semi-sterile Dispensing (Eye drops, Ear drops) and Hyperailimentation.

4. ROLE OF PHARMACISTS IN SMALL HOSPITALS, NURSING HOMES ETC:

5. PURCHASING, DISTRIBUTION AND CONTROL OF HOSPITAL MEDICINES, MEDICAL & SURGICAL SUPPLIES:
   Purchasing, Stocking, Stock Control, Inventory Management, Drug Distribution, Relationship between purchasing, Distribution and Clinical Pharmacy Services.

6. NUCLEAR PHARMACY.

7. THE PHYSICAL PLANT AND ITS EQUIPMENT

8. INVESTIGATIONAL USE OF DRUGS.

9. HEALTH ACCESSORIES.

10. SURGICAL SUPPLIES.

11. INSPECTION OF WARDS WITH REFERENCE TO DRUG STORAGE AND ADMINISTRATION.

12. MANAGEMENT OF ACCIDENT & EMERGENCY PHARMACY (A & E).

13. COMMON KNOWLEDGE OF ABOUT 100 DRUGS REGISTERED BY MINISTRY OF HEALTH, GOVERNMENT OF PAKISTAN.

Recommended Books

1. William Hassan, **Hospital Pharmacy**, Lee & Febiger, Washington, 5th Ed., 1986.
2. N I Bukhari, **Hospital Pharmacy**, Aziz Book Depot, Lahore-Pakistan (2000).
3. Martin Stephen, **Hospital Pharmacy**, Pharmaceutical Press, London, 2003.

604 PHARMACEUTICS-VIII (Clinical Pharmacy-II) (Theory) Cr. Hr. 03

1. DRUG INTERACTIONS:
   Mechanism, Physiological factors affecting interaction, Types and level of drug interactions, Role of pharmacist in evaluating drug interactions & its management.

2. ADVERSE DRUG REACTIONS:
   Adverse Drug Reactions and Side Effects: Classification, Excessive pharmacological response, Idiosyncrasy, Secondary pharmacological effects, Allergic drug reactions, General toxicity, Toxicity following drug withdrawal, Detection, reporting & Management of ADR.

3. DRUG INDUCED DISEASES.

4. COMPUTERS IN CLINICAL PHARMACY:

5. UTILIZATION OF CLINICAL DRUG LITERATURE: Introduction, Drug literature selection, Drug literature evaluation and Drug literature communication.

606 PHARMACEUTICS-VIII (Clinical Pharmacy-II) (Laboratory) Cr. Hr. 01

Clerkship in the Clinical setting. A project related to Clinical Pharmacy Practices will be completed by the students and will be evaluated by the external examiner.

Recommended Books

1. Roger Walker, **Clinical Pharmacy & Therapeutics,** Churchill Levingstone, London, 3rd Ed., 2003
2. Guard Paul, **A Behavioral Approach to Pharmacy Practice**, Black Well, USA, 2000.
3. Herfindal Gourley, **Clinical Pharmacy & Therapeutics,** William & Willkins, London, 1992.
4. A J Winfield, **Pharmaceutical Practice**, Churchill Levingstone, London, 2nd Ed., 1998.
5. Kavin Taylor, **Pharmacy Practice**, Taylor & Francis, New York, 1998.
6. Deborah Rosenbaun, **Clinical Research Coordinator Hand Book**, 2nd edition, Sarrison, Inc, North Carolina, USA.
7. Simon Cook, **Clinical Studies Management**, **a Practical Guide to Success**, Sue Horwood Publishing limited, West Sussex, UK.
8. Joseph. T Dipiro, **Encyclopaedia of Clinical Pharmacy**. Marcel Dekker Publishing, 2003
9. Joseph T, Dipiro, **Encyclopaedia of Pharmacy**. Marcel Dekker Publishing, 2002
10. Mellainie J Rantucci, **Pharmacist Talking with Patients**, 1997. 11.Smith GDG and Aronson J K, **Oxford Text Book of Clinical Pharmacology and Drug Therapy**, Oxford University Press, UK, 1990.
12. Hansten P and Horn J, **Drug interactions**. Lee & Febiger, Philadelphia, USA, 1989.

608 PHARMACEUTICS-IX (Industrial Pharmacy-II) (Theory) Cr. Hr. 03

1. EMULSIONS:
   Mechanical Equipments, Specific formulation Considerations and Emulsion stability.

2. SUSPENSIONS:
   Formulation of suspensions, Equipment used in preparation and test methods for pharmaceutical suspensions.

3. SEMISOLIDS:

Equipment used for Ointments, Pastes, Gels and Jellies. Packaging of ointments.

4. STERILE PRODUCTS:
   Sterile area and its Classification, Ophthalmic ointments, Preparation of praenterals (Building, Equipment), Complete Sterility (Aseptic area), air control, (Laminar flow etc.), air locks, Environmental monitoring methods, Sterilization, Filling/Packaging (Plastic and glass containers), Added substances (Preservatives, antioxidants, solubilizer, suspending agents, buffers, stabilizers etc.), Inprocess Quality Control of Parenterals (Sterility, leakage, pyrogens, clarity etc.).

5. STANDARDIZATION OF PHARMACEUTICALS:
   An understanding of quality assurance system adopted in pharmaceutical industry. Good Manufacturing Practices and Current Good Manufacturing Practices.

6. PACKING & PACKAGING:
   Influence of Packaging materials, Stability, Packaging Lines, Packaging Area, Packaging Equipment.

7. EQUIPMENTS USED FOR:
   Patches, Sprays, Implants, Sutures, Plasters and Sachet packing.

8. STUDY TOUR**:**
   A visit to the pharmaceutical industries will be an integral part of the syllabi.

610 PHARMACEUTICS-IX (Industrial Pharmacy-II) (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g.

1. Ampoule filling, sealing and sterilization clarity and leakage tests in injectables.
2. Capsule filling by semi automatic machines. Manufacture of sustained action drugs.
3. Tablets Tests like Disintegration. Dissolution. Friability. Hardness and thickness tests. Determination of weight variation in tablets. Density of powder. Particle size analysis.

Recommended Books

1. Lackman, **Theory and Practice of Industrial Pharmacy**, Verghese Publishing House, Bombay, 1987.
2. Cooper and Gunn's, **Tutorial Pharmacy**, CBS Publishers & Distributors, New Delhi, 1986.
3. **Bentley's Pharmaceutical Text Book**, CBS Publishers & Distributors, New Delhi, 1986.
4. **Remington's Pharmaceutical Sciences**, Mack Publishing Company, USA, 2001.
5. John Sharp, **Good Pharmaceutical Manufacturing Practice**, Rational and Compliance.

612 PHARMACEUTICS-X (Biopharmaceutics-II) (Theory) Cr. Hr. 03

1. INTRODUCTION TO PHARMACOKINETICS:
   Determination through plasma drug level studies. Application of pharmacokinetics in clinical situations.

2. CONCEPT OF COMPARTMENT (S) MODELS:
   One compartment open model. Two compartment open model. Three compartment open model and Non-compartmental method of analysis.

3. BIOLOGICAL HALF-LIFE AND VOLUME OF DISTRIBUTION:
   Concept and Methods of Determination.

4. DRUG CLEARANCE:
   Mechanism, determination and relationship of clearance with half-life.

5. ELIMINATION OF DRUGS:
   a) Hepatic Elimination. Percent of Drug Metabolized, Drug Biotransformation reactions, (Phase-I reactions and phase-II reactions), First pass effect, Hepatic clearance of protein bound drugs and Biliary excretion of drugs.
   b) Renal Excretion of Drugs: Renal clearance, Tubular Secretion and Tubular Reabsorption.
   c) Elimination of Drugs through other organs: Pulmonary excretion, Salivary excretion, Mammary excretion, Skin excretion and Genital excretion.

6. PROTEIN BINDING:
   Determination of plasma protein binding and Clinical significance of drug-protein binding.

7. APPLICATIONS OF PHARMACOKINETICS AND BIOAVAILABILITY IN CLINICAL SITUATIONS.

8. APPLICATIONS OF PHARMACOKIENTICS IN DISEASE STATES.

614 PHARMACEUTICS-X (Biopharmaceutics-II) (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g.

1. Plasma level-time curve: Determination of Pharmacokinetic parameters.
2. Determination of plasma protein binding.
3. Urinary sampling techniques.
4. In Laboratory animals. In humans. Renal excretion of drugs or drug disposition.

Recommended Books

1. Leon Shargel, **Applied Pharmacokinetics and Biopharmaceutics**, Appleton & Lange, New York, 4th Ed., 1999.
2. Malcoln Rouland, Thomous N Tozer, **Clinical Pharmacokinetics**, William & Willkins, London, 1995.
3. Milo Gibaldi, **Biopharmaceutics and Clinical Pharmacokinetics**, Marchel & Dakker Inc, New York, 1982.
4. Gibbson and Skett, **Introduction to Drug Metabolism**, Champ & Hall, London, 1986.
5. Robert E Notari, **Biopharmaceutics and Clinical Pharmacokinetics**, Marchel & Dakker Inc, New York, 1988.
6. Stephen H Curry, **Drug disposition and pharmacokinetics**, Black Well Scientific Publishing, Oxford, 1977.
7. Avraham Yacobi, **Toxicokinetics and New Drug Development**, Paramount Press, New York, 1989.
8. Sarfraz Niazi, **Text Book of Biopharmaceutics and Clinical Pharmacokinetics**. Appleton-Century-Crofts, New York, 1985.
9. P Macheras, C Reppas and J B Dressman, **Biopharmaceutics of orally administered drugs**, Ellis Horwood Limited, London (1995).
10. Albert P Li, **Invitro approaches for evaluation of drug efficacy and toxicity**, CRC Press, LLC, USA, 2004.
11. Ronald D Schoenwald, **Pharmacokinetics in drug discovery and Development**, CRC Press, LLC, USA, 2002.

616 PHARMACEUTICS-XVI (Pharmaceutical Quality Managements-II)(Theory) Cr. Hr. 03

1. BIOLOGICAL ASSAYS: Biological methods, Standard praprations and units of activity, Bioassay of antibiotics, Bioassay of insulin injection, Assay of prepared digitalis and Assay of Vitamin D.

2. ALCOHOL DETERMIANTION: Alcoholometric methods, Problem during distillation of alcohol, Method for liquids containing less than 30% or more than 30% alcohol and special treatment before distillation.

3. ALKALOIDAL DRUG ASSAY: Weighing for assay, Extraction of drugs, Maceration, Percolation, Continuous extraction, Puriifcation of Alkaloids and determination of alkaloids.

4. MISCELLANEOUS DETERMINATIONS AND TESTS: Determiantion of weight/ml, Water/Moisture content, Loss on Drying, Toxicity tests & Identification tests, Evaluation of Ointments, Ash contents and Alkalinity of Glass.

5. GENERAL KNOWLEDGE OF APPENDICES ATTACHED TO B.P., BPC, AND USP.

6. STATISTICAL INTERPRETATION OF QUALITY CONTROL CHARTS DURING MANUFACTURING PROCESSES.

618 PHARMACEUTICS-XVI (Pharmaceutical Quality Managements-II) (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Sterility test, Determiantion of Ash contents, Determination of Moisture contents, Determination of total solids, Determination of viscosity of syrups, gels, etc., Determination of emulsion types.

Recommended Books

1. A H Beckett and J B Stennlake, **Practical Pharmaceutical Chemistry**, Part-I and II, The Alton Press, London.
2. A M Knevel and F E Digangi, **Jenkin's Quantitative Pharmaceutical chemistry**, McGraw-Hill Book Company, New York.
3. K A Connors, **A Text Book of Pharmaceutical Analysis**, John — Wiley and Sons, New York.
4. A Braithwaite and F J Smith, **Chromatographic Methods**, Chapman and Hall, London.
5. G D Christian, **Analytical Chemistry**, John Wiley and Sons, New York.
6. Karamt A Javaid, **Pharmaceutical Quality Assurance in Class, Industry and Market,** Aziz Publishers, Lahore-Pakistan (1993).
7. Gil Bismuth and Shosh Neumann, **Cleaning Validation, A practical approach**. CRC Press, LLC, USA, 2003.
8. J T Carstersen and C T Rhodes, **Drug Stability: Principles and Practices,** 3rd Ed. (revised and expanded) Mercel Dekker, New York, 2000.
9. Sydney H Willig, **Good Manufacturing Practices for Pharmaceuticals,** Marcel Dekker Publishing.
10. Bryant R, **The pharmaceutical Quality Control Hand Book**, Aster Publishing Corporation, Eugene, 1989.
11. Braun R E, **Introduction to Instrumental Analysis**, McGraw-Hill Book Co, NY, 1987.

FINAL PROFESSIONAL (FIFTH) PHARM-D

9th TERM

701 PHARMACEUTICAL CHEMISTRY-V (Medicinal Chemistry-I) (Theory) Cr. Hr. 03

Note:- The topics will be taught with special reference to their Pharmaceutical Applications.

1. INTRODUCTION TO MEDICINAL CHEMISTRY:
   Chemical constitution and biological activity: (Receptor, Theory, Structure Activity Relationships (SAR) and Drug Metabolism).

2. CLASSIFICATION OF SYNTHETIC DRUGS:
   Drug Design and recent appraoches to the synthesis of drugs (a brief concept of methods and reactions of synthesis of various drugs).

3. GENERAL PROPERTIES, CHEMISTRY (General methods of determination, the structure & isolation from natural source), BIOLOGICAL ACTION, STRUCTURE ACTIVITY RELATIONSHIP AND THERAPEUTIC APPLICATIONS OF THE FOLLOWING:
   a) Alicyclic Compounds: Cyclopropane, Terpenes, Citral, Pinene, Camphor, Menthol, Carotenes.
   b) Alkaloids: Atropine, Morphine and related compounds (Codeine, Thebaine), Ergotamine, Reserpine, Ephedrine.
   c) Vitamins: Water Soluble Vitamins (B_1, B_2, B_6, B_{12}, Folic acid, Nicotinic acid, Biotin, Pantothenic acid and Ascorbic acid) Fat Soluble Vitamins (A, D, E, and K).
   d) Hormones: Steroidal Hormones (Testosterone, Progesterone, Estrogen, Aldosteron and Cortisol), Proteinous Hormones (Insulin, Glucagon, Oxytocin and Vassopressin).
   e) Anti-neoplastic Agents: Tamoxifen, Fluorouracil, Mercapturine, Methotrexate and Vincristine.
   f) Sedatives and Hypnotics: Benzodiazepines, Barbiturates, Paraldehyde, Glutethimide, Chloral hydrate, and alcohols.
   g) Anaesthetics: Local anaesthetics (Procaine, Lignocaine, Eucaine, Cocaine and Benzocaine), General anaesthetics (Cyclopropane, Halothane, Nitrous oxide, Chloroform, Thiopental Sodium, Ketamine, Methohexital, Thioamylal Sodium, Fantanyl Citrate, Tribromo ethanol).
   h) Analgesics and Antipyretics: Paracetamol, Salicylic acid analogues, Quinolines derivatives, Pyrazolone and Pyrazolodiones, N-arylanthranilic acids, Aryl and heteroaryl acetic acid derivatives.

703 PHARMACEUTICAL CHEMISTRY-V (Medicinal Chemistry-I) (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g.

1. Estimation of functional groups; Carboxylic, Hydroxy, Amino and Nitro groups; Determination of Molecular weights of Organic Compounds.
2. Synthesis of Paracetamol, Salicylic Acid, Methyl salicylate, Azobenzene, Benzoic Acid, 5-Hydroxy-1,3-benzoxazol-2-one, Aspirin, P-nitrosophenol, 3-nitrophthalic acid, o-Chloro-benzoic acid.

Recommended Books

1. Martin and Cook, **Remington Practice of Pharmaceutical Science**, Mack Publishing Company, USA, 2001
2. Foye W O, **Principles of Medicinal Chemistry**, Verghese Publising House, Bomby, 1995.
3. Tyagi, **Text Book of Synthetic Drugs**, Anmol Publications, Delhi, 1990.
4. Alferd Burger, **Medicinal Chemistry**, Jhon Willey & Sons, New York, 1996.
5. Block, Roche, Soine and Wilson, **Inorganic and Medicinal Pharmaceutical Chemistry**, Verghese Publishing House, Bombay, 1986.
6. Block, Roche, Soine and Wilson. **Inorganic and Medicinal Pharmaceutical Chemistry**, Lee & Febiger, Philadelphia, USA, 1983.

705 PHARMACEUTICS-XVII (Clinical Pharmacy-III) (Theory) Cr. Hr. 03

1. RATIONAL USE OF DRUGS: Rational Presribing, Rational Dispensing, Problems of Irrational Drug Use, Learning about drug use problem, Sampling to study drug use, Indicators of drug use.

2. INTRODUCTION TO ESSENTIAL DRUGS: Criteria for selection, Usage and Advantages.
3. DRUG UTILZATION EVALUATION & DRUG UTILIZATION REVIEW (DUE/DUR): Development of protocol of use of few very low therapeutic index drug groups like Steroids, Vancomycin and Cimetidine.

4. DRUG ABUSE & MISUSE.

5. PRACTICAL PHARMACOKINETICS: Therapeutic Drug Monitoring of Digoxin, Theophyline, Gentamycin, Lithium, Phenytoin, Cabamazepine, Phenobarbitone, Primidone, Walparic Acid, Cyclosporins and Vancomycin.

6. PHARMACOECONOMIC STUDIES.

707 PHARMACEUTICS-XVII (Clinical Pharmacy-III) (Laboratory) Cr. Hr. 01

Clerkship in the Clinical setting. A project related to Clinical Pharmacy Practices will be completed by the students and will be evaluated by the external examiner.

Recommended Books

1. Roger Walker, **Clinical Pharmacy & Therapeutics,** Churchill Levingstone, London, 3rd Ed., 2003.
2. Guard Paul, **A Behavioral Approach to Pharmacy Practice**, Black Well, USA, 2000.
3. Herfindal Gourley, **Clinical Pharmacy & Therapeutics,** William & Willkins, London, 1992.
4. A J Winfield, **Pharmaceutical Practice**, Churchill Levingstone, London, 2nd Ed., 1998.
5. Kavin Taylor, **Pharmacy Practice**, Taylor & Francis, New York, 1998.
6. Deborah Rosenbaun, **Clinical Research Coordinator Hand Book**, 2nd Ed., Sarrison, Inc, North Carolina, USA.
7. Simon Cook, **Clinical Studies Management**, **a Practical Guide to Success**, Sue Horwood Publishing limited, West Sussex, UK.
8. Joseph T Dipiro, **Encyclopedia of Clinical Pharmacy**. Marcel Dekker Publishing, 2003.
9. Joseph T Dipiro, **Encyclopedia of Pharmacy**. Marcel Dekker Publishing, 2002.
10. Mellainie J Rantucci, **Pharmacist Talking with Patients,** 1997. 11.Smith GDG and Aronson J K, **Oxford Text Book of Clinical Pharmacology and Drug Therapy**, Oxford University Press, UK, 1990.
12. Hansten P and Horn J, **Drug interactions**. Lee & Febiger, Philadelphia, USA, 1989.

709 PHARMACEUTICS-XVIII (Pharmaceutical Technology-I) (Theory) Cr. Hr. 03

1. PRINCIPLES OF PHARMACEUTICAL FORMULATION AND DOSAGE FORM DESIGN: Product Formulation, Need for Dosage Form and Preformulation Studies.

2. FORMULATION DEVELOPMENT: Pharmaceutical Aerosoles, Ophthalmic Preparations, and Parenteral Preparations.

3. ADVANCED FORMULATION TECHNIQUES: Development of a formualtion methodology and flow plan for the new product. New technologies in drug delivery system.

4. NOVEL DRUG DELIVERY SYSTEMS:
   a) Introduction to the Drug Carrier: Liposomes, Niosomes and Biodegradable polymers.
   b) Active & Passive Drug Delivery System.
   c) Other Novel GIT Systems.

711 PHARMACEUTICS-XVIII (Pharmaceutical Technology-I) (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the requirements, e.g. Various techniques to develop the formulation, Granulation technology, Study of drug delivery systems, Bio-technological aspect of product development, In-vitro Quality Control of various dosage forms.

Recommended Books

1. Anya M Hellery, **Drug delivery and targeting**, Taylor & Francis, London, 2001.
2. Joseph R **Robinson Controlled drug delivery**, Marcel & Dakker Inc, New York, 2nd Ed., 1987.
3. T V Ramabhadran, **Pharmaceutical design and development**, Ellis Horwood, New York, 1994.
4. M E Aulton, **Pharmaceutics: Science of Dosage Forms Design**, ELBS/Churchill Livingstone, London, 1998.
5. Banker, **Modern pharmaceutics**, Marchell Dakker Inc, New York, 1990.
6. John A Bontempo, **Development of biopharmaceutical parenteral dosage forms**, Marchell Dakker Inc, New York, 1997.
7. N K Jain, **Controlled and Novel drug delivery**, CBS Publishers & Distributers, New Dehi, 1997.
8. Ansel, **Pharmaceutical Dosage Form in Drug Delivery System**, Lee & Febiger, London, 1990.

9. Attaurahman and M I Chaudry, **Bioassay techniques for drug development**, CRC Press, LLC, USA, 2001.
10. Pramod K Gupta, **Inject able drug development,** CRC Press, LLC, USA, 1999.
11. H John Smith, **Introduction to the principals of drug design and action**, CRC Press, LLC, USA, 1998.
12. Rong Liu, **Water Insoluble Drug Formulations**, CRC Press, LLC, USA, 2000.
13. Peter Blaisdell, **Twenty First Century Pharmaceutical Development**. CRC Press, LLC, USA, 2000.
14. Lachman L, Theory and Practice of Industrial Pharmacy, Lee & Febiger, Philadelphia, 3rd Ed., 1986.

713 PHARMACEUTICS-XIX (Forensic Pharmacy-I) (Theory) Cr. Hr. 03

STUDY OF DRUG LAWS:

(a) The Drugs Act 1976 and rules framed thereunder.
(b) Provincial Drug Rules (Respective Drug Rules will be taught in the relevant province).
(c) Advertisement rules.
(d) Other related rules and Legal aspects.

Recommended Books

1. R Z Hussain. **The Manual of Drug Laws in Pakistan,** Irfan Law Book House, Lahore-Pakistan, 2003.
2. The Pharmacy Act, 1967.
3. The Poisons Act, 1919.
4. The Dangerous Drugs Act 1930.
5. The Factory Law 1934.
6. Shop and Establishment Ordinance 1969.
7. Control of Narcotics Substances Act 1997.

713 PHARMACEUTICS-XX (Pharmaceutical Management & Marketing-I) (Theory) Cr. Hr. 03

1. MANAGEMENT:
   a) Nature and Principles of Management.
   b) Types and Functions of Managers.
   c) Planning: Purpose and types of Planning, Steps in Planning.
   d) Organizing.
   e) Management Control Systems

Purpose: Steps in the Control Process, Forms of Operations control. Requirements for adequate control, Critical control points and standards.

f) Motivation.
g) Innovation and creativity.
h) Communication.

2. PRODUCTION MANAGEMENT:
   (a) Material Management.

Recommended Books

1. M Ahmad & N I Bukhari, **Pharmaceutical Management and Marketing,** Tariq Academy, Faisalabad-Pakistan (2002).
2. Patrick Tharp & Pedro J Lecca, **Pharmacy Management** for students and practitioners, The C V Mosby Company, St. Louis, Toronto, London (1979).
3. Harry A Smith, **Principles & Methods of Pharmacy Management,** Lea & Febiger, Philadelphia, 1986.

10th TERM

702 PHARMACEUTICAL CHEMISTRY-VI (Medicinal Chemistry-VI) (Theory) Cr. Hr. 03

Note:- The topics will be taught with special reference to their Pharmaceutical Applications**.**

1. GENERAL PROPERTIES, CHEMISTRY, BIOLOGICAL ACTION, STRUCTURE ACTIVITY RELATIONSHIP AND THERAPEUTIC APPLICATIONS OF THE FOLLOWING:
   (a) Anti-septics: Phenols and related compounds, Halogens and Halogen compounds, Aromatic acid and esters, Dyes, Nitrofuran derivatives, Formaldehyde and its derivatives, Mercurochrome and Thiomersal.
   (b) Sulphonamides: Prontosil, sulphanilamide, Sulphapyridine, sulphadimidine, Sulfamethoxazole, Sulfadiazine and Sulfa-furazole.
   (c) Antimalarials: 4-Aminoquinolines, 8-Aminoquinolines, 9-Amino acridines, Biguanides, Pyrimidine analogues, Mefloquine and Cinchoha alkaloids.
   (d) Anthelmintics: Phenols and related compounds, Piperazine derivatives, Thiabendazole, Mebendazole and Pyrantal.

(e) Diuretics: Mercaptomerin, Meralluride, Thiazides, Sprironolactone, Theophylline, Furosemide, Acetazolamiode, Ethacrynic acid and Triameterene.
(f) Anti-tubercular Drugs: Ethambutol, Isonicotinic acid, Hydrazid, Rifampacin, Thioguanine, Pyrazinamide, cycloserine, Ethunamide, Cytarabine, 5- Flourouracil and Dacarbazine.
(g) Antiviral Drugs: Acyclovir, Tromantadine Hydrochloride and Ribavirin.
(h) Immunosuppressant Agents: Azathioprine and Cyclosporin.

2. ANTIBIOTICS:
Penicillins, Cephalosporins, Streptomycin, Chloramphenicol, Tetracyclines, Kanamycin and Erythromycin.

3. OCCURANCE, PROPERTIES, PREPARATION AND APPLICATION OF OFFICIAL INORGANIC COMPOUNDS:
Aluminium Hydroxide, Ammonium Chloride, Sodium Carbonate, Magnesium Carbonate, Lithium Carbonate, Sodium Nitrite, Calcium Gluconate, Antimony Gluconate, Ferrous Fumarate, Ferrous Sulfate and Silver Nitrate.

704 PHARMACEUTICAL CHEMISTRY-VI (Medicinal Chemistry-VI) (Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g.

1. Assay of the Drugs like Sulpha drugs, Aspirin, Paracetamol, Benzyl Penicillin.

2. Inorganic Preparations.

Recommended Books

1. Martin and Cook, **Remington Practice of Pharmaceutical Science**, Mack Publishing Company, USA, 2001.
2. Foye W O, **Principles of Medicinal Chemistry**, Verghese Publising House, Bomby, 1995.
3. Tyagi, **Text Book of Synthetic Drugs**, Anmol Publications, Delhi, 1990.
4. Alferd Burger, **Medicinal Chemistry**, Jhon Willey & Sons, New York, 1996.

5. Block, Roche, Soine and Wilson, **Inorganic and Medicinal Pharmaceutical Chemistry**, Verghese Publishing House, Bombay, 1986.
6. Block, Roche, Soine and Wilson. **Inorganic and Medicinal Pharmaceutical Chemistry**, Lee & Febiger, Philadelphia, USA, 1983.

706 PHARMACEUTICS-XVIII (Clinical Pharmacy-IV) (Theory) Cr. Hr. 03

1. PHARMACEUTICAL CARE, ITS SCOPE, MANAGEMENT AND APPLICATION OF CARE PLAN.

2. ROLE OF CLINICAL PHARMACIST IN COMMUNITY PHARMACY.

3. CLINICAL THERAPEUTICS:
   (a) General Strategy: Terminology of Disease. Management and Treatment. Drug Selection.
   (b) Basic introduction of some clinical situations, their clinical features, etiology, pathophysiology and treatment of causes: Common Cold, Pharyngitis and Tonsilitis, Pneumonia, Tuberculosis, Diarrhea, Malaria, Meningitis, Tetanus, Typhoid Fever, Measles, Rabies, AIDS, Congestive cardiac failure, Conjunctivitis, Anaemia, Gout, Asthma, Ulcer, Diabetes mellitus, Hypertension, Hapatitis, Dermatology (Scabies, Fungal diseases).

4. CLINICAL TOXICOLOGY:
   (a) General information. Role of pharmacist in treatment of poisoning and general management of poisoning & overdosage. Role and Status of Poison Control Centre.
   (b) Antidotes and their mechanism of action

5. SAVE INTRAVENOUS THERAPY & HAZARDS OF INTRA-VENOUS THERAPY.
6. NON-COMPLIANCE:
   Definition, introduction and importance, Extent of non-compliance, Methods of assessment, Reasons for non-compliance, Strategies for improving compliance and Designing of compliance trials.

708 PHARMACEUTICS-XVIII (Clinical Pharmacy-IV) (Laboratory) Cr. Hr. 01

Clerkship in the Clinical setting. A project related to Clinical Pharmacy Practices will be completed by the students and will be evaluated by the external examiner.

Recommended Books

1. Roger Walker, **Clinical Pharmacy & Therapeutics,** Churchill Levingstone, London, 3rd Ed., 2003.
2. Guard Paul, **A Behavioral Approach to Pharmacy Practice**, Black Well, USA, 2000.
3. Herfindal Gourley, **Clinical Pharmacy & Therapeutics,** William & Willkins, London, 1992.
4. A J Winfield, **Pharmaceutical Practice**, Churchill Levingstone, London, 2nd Ed., 1998.
5. Kavin Taylor, **Pharmacy Practice**, Taylor & Francis, New York, 1998.
6. Deborah Rosenbaun, **Clinical Research Coordinator Hand Book**, 2nd Ed., Sarrison, Inc, North Carolina, USA.
7. Simon Cook, **Clinical Studies Management**, **a Practical Guide to Success**, Sue Horwood Publishing limited, West Sussex, UK.
8. Joseph T Dipiro, **Encyclopaedia of Clinical Pharmacy**. Marcel Dekker Publishing, 2003.
9. Joseph T Dipiro, **Encyclopaedia of Pharmacy**. Marcel Dekker Publishing, 2002.
10. Mellainie J Rantucci, **Pharmacist Talking with Patients**, 1997. 11.Smith GDG and Aronson J K, **Oxford Text Book of Clinical Pharmacology and Drug Therapy**, Oxford University Press, UK, 1990.
12. Hansten P and Horn J, **Drug interactions**. Lee & Febiger, Philadelphia, USA, 1989.

710 PHARMACEUTICS-XIX (Pharmaceutical Technology-II)
(Theory) Cr. Hr. 03

1. MODIFIED DRUG RELEASE DOSAGE FORM:
   The concept of sustained release, First order release approximation, Multiple dosing, Implementation of designing, Approaches based upon dosage form modification, Product evaluation and testing, Matrices tablets, Control release technology, Microencapsulation, Method of particle coating and Instrumentation in granule manufacturing.

2. PHARMACEUTICAL BIOTECHNOLOGY:
   Biotechnological aspects in the product development, Fundamentals of Genetic Engineering and its Application in Medicine, Principle, Synthesis and Application of Monoclonal, Antibodies, Introduction to Gene therapy, Immobilized Enzymes and their application in Medicine, General Principle and Methods of Microbial Assay.

712 PHARMACEUTICS-XIX (Pharmaceutical Technology-II)
(Laboratory) Cr. Hr. 01

NOTE:- Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g. Microbial assay, Particle size analysis using various methods, Stability studies of Pharmaceuticals, Coating of particles and To prepare, examine and control specifications of packaging materials.

Recommended Books

1. Anya M Hellery, **Drug delivery and targeting**, Taylor & Francis, London, 2001.
2. Joseph R **Robinson Controlled drug delivery**, Marcel & Dakker Inc, New York, 2nd Ed., 1987.
3. T V Ramabhadran, **Pharmaceutical design and development**, Ellis Horwood, New York, 1994.
4. M E Aulton, **Pharmaceutics: Science of Dosage Forms Design**, ELBS/Churchill Livingstone, London, 1998.
5. Banker, **Modern pharmaceutics**, Marchell Dakker Inc, New York, 1990.
6. John A Bontempo, **Development of biopharmaceutical parenteral dosage forms**, Marchell Dakker Inc, New York, 1997.
7. N K Jain, **Controlled and Novel drug delivery**, CBS Publishers & Distributers, New Dehi, 1997.
8. Ansel, **Pharmaceutical Dosage Form in Drug Delivery System**, Lee & Febiger, London, 1990.

9. Attaurahman and M I Chaudry, **Bioassay techniques for drug development**, CRC Press, LLC, USA, 2001.
10. Pramod K Gupta, **Inject able drug development,** CRC Press, LLC, USA, 1999.
11. H John Smith, **Introduction to the principals of drug design and action**, CRC Press, LLC, USA, 1998.
12. Rong Liu, **Water Insoluble Drug Formulations**, CRC Press, LLC, USA, 2000.
13. Peter Blaisdell, **Twenty First Century Pharmaceutical Development**. CRC Press, LLC, USA, 2000.
14. Lachman L, Theory and Practice of Industrial Pharmacy, Lee & Febiger, Philadelphia, 3rd Ed., 1986.

714 PHARMACEUTICS-XX (Forensic Pharmacy-II) (Theory) Cr. Hr. 01

1. THE PHARMACY ACT, 1967.
2. THE DANGEROUS DRUGS ACT, 1930.
3. THE FACTORY LAW 1934.
4. SHOPS AND ESTABLISHMENT ORDINANCE, 1969 WITH RULES.
5. THE POISONS ACT, 1919.
6. CONTROL OF NARCOTICS SUBSTANCES ACT, 1997.

Recommended Books

1. R Z Hussain, **The Manual of Drug Laws in Pakistan,** Irfan Law Book House, Lahore-Pakistan (2003).
2. The Pharmacy Act, 1967
3. The Poisons Act, 1919
4. The Dangerous Drugs Act, 1930
5. The Factory Law, 1934
6. Shop and Establishment Ordinance, 1969
7. Control of Narcotics Substances Act, 1997.

716 PHARMACEUTICS-XXI (Pharmaceutical Management & Marketing-II) (Theory) Cr. Hr. 03

1. MARKETING MANAGEMENT:
   Marketing channels, Promotion and Advertising and Salesmanship.

2. SALES MANAGEMENT:
   Personnel, Buying, Receiving, Pricing, Sales promotion and Customer Services.

3. PHARMACY LAYOUT DESIGN:
   Objectives of Layout Design, Types of Community Pharmacies (Pharmaceutical Centre, Prescription-oriented Pharmacies, Traditional Pharmacies and The Super Drug Store), Consumer goods and purchases, Classes of Layout designs, Principles and characteristics of Layout Design and Traffic Flow analysis.

Recommended Books

1. M Ahmad & N I Bukhari, **Pharmaceutical Management and Marketing,** Tariq Academy, Faisalabad-Pakistan (2002).
2. Patrick Tharp & Pedro J Lecca, **Pharmacy Management** for students and practitioners, The C V Mosby Company, St Louis, Toronto, London (1979).
3. Harry A Smith, **Principles & Methods of Pharmacy Management,** Lea & Febiger, Philadelphia, 1986.