H.N.B.GARHWAL UNIVERSIY SRINAGAR GARHWAL
DEPARTMENT OF PHARMACEUTICAL SCIENCES
UNDER THE FACULTY OF SCIENCE

ORDINANCE FOR BACHELOR OF PHARMACY (w.e.f. session 2007-08)

1. There shall be four examination leading to the degree of Bachelor of Pharmacy namely:
   (i) B. Pharm I year
   (ii) B. Pharm II year
   (iii) B. Pharm III year
   (iv) B. Pharm IV year.
2. An applicant for admission to the examination specified in paragraph I shall pursue a regular course of study in the courses prescribed for the examination concerned by the appropriate bodies for not less than one academic year in University Department of Pharmaceutical Sciences.
3. The applicant for admission to:
   (i) The first year B.Pharm shall have passed (10+2) intermediate examination of Uttaranchal board Nainital or equivalent with Physics, Chemistry, Biology or Mathematics and English as subject of study in intermediate and secured at least 50% marks (45% for SC/ST/OBC)
   (ii) The second year B.Pharm shall have passed not less than one academic year previously, the Ist B.Pharma examination of the University or shall have cleared the norms for admission at as per Para 9. For direct admission to B.Pharm II year (for D. Pharm. candidates only) D. Pharm. with 60% marks and eligibility as per para 3(i).
   (iii) The third year B.Pharm. shall have passed the IInd B.Pharm. Examination of the University not less than one academic year previously or shall have cleared the norms for admission as per para 9.
   (iv) The final (IVth) year B.Pharm shall have passed the IIIrd B.Pharm. Examination of the University not less than one academic year previously or shall have cleared the norms for admission as per para 9.
4. The fee for the course shall be prescribed by the University from time to time assessing the requirements of the course. The examination fee etc. shall also be notified from time to time.
5. The applicant for the admission to an examination shall fulfill the norms of the study in all practical and theoretical class as prescribed in the syllabus.
6. The student of B.Pharm shall clear the norms of terminal and other tests conducted during the academic year regarding suitability to take the examination.
7. The maximum marks allotted to the sessional examination in each paper, the theoretical part and the practical part for each of the four examinations are indicated in the syllabus.
8. In order to pass the examination, an examinee :
   (i) Shall obtain not less than 40% of the total marks allotted to each written paper and the sessional examination taken together as given in the prescribed syllabus.
   (ii) Shall obtain not less than 40% of the total marks allotted in the annual practical examination and the sessional evaluation each of which include day to day assessment, viva, attendance and laboratory record taken together as given in the syllabus.
9. The examinees at first, second, third or fourth B.Pharm. Examinations, who failed to secure the prescribed minimum marks in not more then four paper which will include theory or practical or both (theory and practical) may seek admission into next class subject to the condition that admission in III year will be permitted only after clearing I year all paper (including practical) and the admission in the IV year will be permitted only after clearing II year all papers (including practicals).
10. The candidate will have to clear all norms decided by the University and should have clear all paper of each year as per para 8 to be declared pass in B.Pharm. Examinations.
11. The examinee who fails in more than four papers (theory or practical or both) will reappear in that examination in all papers (theory and practical) as an ex-student at the time of annual examination. However he/she may reappear in the sessional exams to improve his /her marks otherwise the sessional marks will remain same.
12. The department shall conduct maximum three theory sessional exams of 20 marks each during an academic year and the average of best two sessional exams shall be included in the final marks.

However, their practical sessional marks shall be awarded on the basis of their day to day performance including viva-voce, attendance and laboratory works.

13. An unsuccessful examinee (para-11) may, at the discretion of the department, be permitted for such period as the department consider necessary to attend a further course in theory or practical, as the case may be. If the candidate wishes to attend the regular classes he/she will have to deposit all fees again. In such a case the department shall award fresh sessional marks on the basis of repeat performance of the candidate.
14. The division of successful examinee at the final year B.Pharm. Examination shall be determined on the basis of the aggregate marks obtained at the first, second, third and final year B.Pharm. Examinations taken together.
15. For the students admitted directly to the second year, the division of successful examinees in the final year examination shall be determined on the basis of aggregate marks obtained in second, third and fourth year examinations, taken together.
16. Those obtaining 60% or more in the aggregate shall be placed in the first division and those who secure 50% or more than 50% but less than 60% shall be placed in second division, while rest will be declared pass only.
17. The University shall publish a list of successful examinees as soon as possible after the final year examination. The list of successful examinees at the final B.Pharm. Examination shall be arranged in the first division and second division as envisaged in paragraph-10 of this ordinance.
18. The total span of B.Pharm. Course should not exceed seven years from the year of admission.
19. In order to bring at par the students admitted directly to B. Pharm II year will have to clear the following subjects of B.Pharm I year ***in lieu*** of the subjects in B.Pharm II year.

B.Pharm I year	**B.Pharm II year**
Mathematics and Statistics	Hospital Pharmacy
Computer Science	Forensic Pharmacy
Pharmaceutical Chemistry-I (Organic Chemistry) (Theory and Practical both)	Pharmacognosy-I (Theory and Practical both)

20. No regular student shall be permitted to appear in the annual examination until he/she has regularly attended the theory and practical classes and his/her attendance is not less than 75%. Provided the University may condone the shortage of percentage in attendance not exceeding 10% in each subject, theory/practical for the following reasons :
    (a) Participation in NCC/NSS Camps.
    (b) Participation in the games organized by University.
    (c) Participation in some extra co-curricular activities organized by University
    (d) Prolonged illness (after getting the supported evidence/ certificate from Competent authority)
21. All other rules will be applicable as the University decides from time to time.
22. The new regulations and the syllabus shall be effective from the session 2007-08 onwards.

PROPOSED SYLLABUS STRUCTURE FOR B. PHARM.
(Four year integrated course)

I year			II year			III year			IV year		
Theory code (2 hrs)	**Practical Code (4 hrs)**	**Subject**	**Theory code (2 hrs)**	**Practical Code (4 hrs)**	**Subject**	**Theory code (2 hrs)**	**Practical Code (4 hrs)**	**Subject**	**Theory code (2 hrs)**	**Practical Code (4 hrs)**	**Subject**
1T -1	1P-1	General & Dispensing	2T-1	2P-1	Physical Pharmacy	3T- 1	3P-1	Pharm. Tech I	4T- 1	4P-1	Biopharmaceutics And Pharmacokinetics
1T -2	1P-2	Inorganic Medicinal Chemistry	2T -2	2P–2	Chemistry Of Natural Products	3T-2	3P-2	Medicinal Chemistry I	4T- 2	4P-2	Medicinal Chemistry II
1T -3	1P-3	Pharm. Analysis I	2T -3	2P–3	Pharmacology I	3T-3	3P-3	Pharmaceutical Microbiology And Biotechnology	4T-3	4P-3	Pharm. Tech II
1T -4	1P-4	Pharm. Org. Chemistry	2T -4	2P–4	Pharm. Analysis II	3T-4	3P-4	Pharmacognosy II	4T-4	4P-4	Pharmacognosy III
1T -5	1P-5	Human Anatomy & Physiology	2T -5	2P–5	Unit Operations	3T-5	3P-5	Pharm. Biochemistry	4T-5	4P-5	Pharm. Analysis III
1T -6		Mathematics & Statistics	2T -6	2P–6	Pharmacognosy I	3T-6	3P-6	Pharmacology II	4T-6		Pharm. Management
1T -7		Computer Sciences	2T -7		Hospital & Community Pharmacy	3T-7		Clinical Pharmacy And Drug Interactions			
			2T -8		Pharm. Jurisprudence						
					Environment Sciences Paper						

GENERAL & DISPENSING PHARMACY
(1T-1)

The question paper will comprise of 50% from General Pharmacy & 50% from Dispensing Pharmacy

GENERAL PHARMACY

1. **Extraction Process:** Infusion, Decoction, Maceration & Percolation process & preparations involving them.
2. **Size reduction & size separation**: Objectives, factors effecting, methods of size reduction, construction & working of hammer mill, ball mill, fluid energy mill & colloid mill. Official standard for powders, sieving methods, sedimentation & cyclone separator
3. **Filtration**: Definition, theory, factor effecting & mechanism of filtration. Filter media & filter aids, study of filter press, leaf filter and rotary filter
4. **Mixing:** Definition, objectives, types of mixtures, study of equipment's used in mixing, propeller, turbine, paddle mixer, tumbler mixer, sigma arm mixer, colloid mixer.
5. **Pharmaceutical Literature**: History of Pharmacy & Introduction to the Indian Pharmacopoeia, British Pharmacopoeia, United state Pharmacopoeia and International Pharmacopoeia.
6. **Preparation of following dosage forms**: Syrups, elixirs, infusions, decoctions, tinctures, spirits, extracts, jellies, lotions, liniments, douches, gargles, enemas, inhalations, sprays, eye drops, ear drops & nasal drops, water

DISPENSING PHARMACY

1. **Principles of dispensing**: Definition of prescription & its parts, handling, pricing of the prescription, detection of overdose in prescription, common Latin terms & abbreviations useful in the interpretation of prescription & their translation into English.
2. **Posology:** Calculation of pediatric doses & factors affecting doses (sex, age, body weight, etc)
3. **Pharmaceutical Calculations:** Weights & measures of pharmaceutical importance & their interrelationships. Percentage calculation, allegation method, isotonicity adjustments, displacement value of drugs in suppositories, proof spirit
4. **Pharmaceutical Dosage forms:** Dispensing of powders, suspensions, emulsions, creams, ointments, pastes, gels, suppositories, with special reference to closures & containers required to dispense the above dosage forms.
5. **Incompatibility**: Type of incompatibilities and their correction (where ever possible) with examples

PRACTICALS (1P-1)

- Dispensing of various dosage forms mentioned in theory**.**

BOOKS RECOMMENDED

- E.A. Rawlins, Bentley's TextBook of Pharmaceutics, 8th ed., Bailliere Tindall, London, 2002.
- S.J. Carter, Cooper & Gunn's Dispensing for Pharmaceutical students, 12th ed. CBS Publishers & Distributors, Delhi, 1987.
- J.W. Cooper & C. Gunn, General Pharmacy.
- Indian Pharmacopoeia 1996, vol. I & II, Controller of Publications, Govt of India, 1996.
- British Pharmacopoeia 1993, Vol. I & II , HMSO, UK, 1993.
- The United States Pharmacopoeia USP 24 and the National Formulary, NF 19, Asian Ed. Tata Donnelley Limited, India 1999.
- Walter Lund, The Pharmaceutical Codex, 12th ed. , The Pharmaceutical Press, London 1994.
- M. J. Stoklosa, H.C. Ansel, Pharmaceutical Calculations, 10th ed., B.I. Waverly Pvt. Ltd. N. Delhi, 1996.
- N.K. Jain & S.N. Sharma, A Text Book of Professional Pharmacy 3rd ed. Vallabh Prakashan, Delhi 1994.
- A.J. Winfield, R.M.E. Richards, Pharmaceutical Practice, 2nd ed. Churchill Livingstone, London 1998.
- S.J. Carter, Copper and Gunn's Tutorial Pharmacy 6th ed., CBS Publishers & Distributors, New Delhi, 2000.

INORGANIC MEDICINAL CHEMISTRY
(1T- 2)

The following inorganic topics will be treated covering outline of methods of preparations, limits, chemical properties, assays and use of compounds listed in IP & BP.

1. **Major intra and extra cellular electrolytes**
   Major physiological ions, electrolytes used in replacement therapy (sodium chloride and potassium chloride), physiological acid-base balance, & electrolytes used is acid base therapy (sodium acetate, potassium acetate, sodium bicarbonate, sodium citrate, potassium nitrate, sodium lactate, ammonium chloride), electrolyte used in combination therapy.
2. **Gastrointestinal agents**
   - Acidifying agents : Dilute Hydrochloric acid
   - Antacids : Aluminum hydroxide, magnesium carbonate Magnesium trisilicate, magnesium oxide.
   - Protective & Adsorbents : Bismuth sub carbonate & kaolin
   - Saline cathartics : Sodium potassium tartarate & magnesium sulphate
3. **Topical Agents**
   - Protective : Talc, zinc oxide, calamine, zinc stearate, titanium dioxide.
   - Antimicrobials : Hydrogen peroxide, potassium permanganate, chlorinated lime, iodine, boric acid, silver nitrate, yellow mercuric oxide, precipitated sulphur & selenium sulphide.
   - Astringents : Alum, zinc sulphate
4. **Dental Products**
   - Anticaries agents : Sodium fluoride, stannous fluoride.
   - Dentifrices : Calcium carbonate, dicalcium phosphate, Sodium metaphosphate, zinc chloride
5. **Nuclear chemistry**
   Nuclear composition, forces and stability, isotopes, radioactive emission, measurement of radioactivity, modes of decay, half life period, artificial radioactivity, applications in pharmacy
6. **Radio pharmaceuticals & contrast media**
   Radiopharmaceuticals, radiopharmaceutical preparation and radio-opaque contrast media.
7. **Pharmaceutical Aids & Necessities**
   - Buffers : Study of various pharmacopoeial buffer systems.
   - Anti-Oxidants : Hypophosphorus acid, sodium bisulphite, sodium thiosulphate, sodium nitrite.
   - Water : Official waters
8. **Miscellaneous inorganic pharmaceutical agents**
   - Inhalants : Oxygen, carbon dioxide, nitrous oxide.
   - Respiratory stimulants : Ammonium carbonate.
   - Expectorants & emetics : Ammonium chloride, potassium iodide, and antimony potassium tartarate.
   - Antidotes : Sodium nitrite
9. **Source of impurities and their control, limit test for iron, arsenic, lead, heavy metals, chloride and sulphate.**

PRACTICALS (1P-2)

- Limit test for chloride, sulphate, iron, arsenic, and heavy metals.
- Identification tests, Preparation and purification of some I.P. / B.P. inorganic compounds.

BOOK RECOMMENDED

- Indian Pharmacopoeia 1996, vol. I & II, Controller of Publications, Govt of India, 1996.
- British Pharmacopoeia 1993, Vol. I & II , HMSO, UK, 1993.
- John H. Block, Edward B. Roche, Taito O. Soine and Charles O. Wilson, Inorganic Medicinal and Pharmaceutical Chemistry, 1st ed. (Indian ed.), Varghese Publishing house, Mumbai, 1986.
- N. C. Chaudhry, & N. K. Gurbani, Pharmaceutical Chemistry- I, 1st ed., Vallabh Prakashan, Delhi, 1995.
- G.R. Chatwal, Pharmaceutical Chemistry Inorganic, vol. I, 2nd ed. Himalaya Publishing house, Mumbai, 1996.

PHARMACEUTICAL ANALYSIS-I
(1T-3)

1.General: Computation of analytical results, significant figures, concept of error, precision and accuracy, standard deviations, calibration of analytical equipments.

2. Fundamental of volumetric analysis: Method of expressing concentrations, primary and secondary standards

3. Physical and chemical concepts required for analysis: Electrolytic dissociations, chemical equilibrium, pH, buffer solutions and actions, Handerson-Hasselbach equation, solubility product, common ion effect, hydrolysis of salts and amphoteric substances

4. Acid base titrations: Modern concept of acids and bases, role of solvent, relative strengths of acids and bases, ionization, law of mass action, ionic product of water, neutralization curves, acid base indicators, theory of indicators, choice of indicators, mixed indicators

5. Precipitation titrations: Precipitation reactions, solubility products, effect of acids, temperature and solvent upon the solubility of the precipitate. Argentometric titrations and titrations involving ammonium or potassium thiocyanate, Mercuric nitrate and barium sulphate, Indicators, Gaylussac method, Mohr's method, Volhard's method and Fajan's method

6. Non aqueous titrations: General discussion and principle of titration in non aqueous media, aprotic, protophillic, protogenic and amphiprotic solvents. Titrations with perchoric acid, potassium methoxide and tetrabutyl ammonium hydroxide

7. Oxidation reduction titrations: Concepts of oxidation and reduction, redox reactions, strengths and equivalent weights of oxidizing and reducing agents.

8. Miscellaneous methods of analysis: Principle of diazotization titrations using sodium nitrite, Kjeldahl method of nitrogen estimation, Karl Fischer titrations

PRACTICALS (1P-3)

- Experiments involving acid-base titration, oxidation-reduction titration, non-aqueous titration & precipitation titration

BOOK RECOMMENDED

- H. Becket and J. B. Stenlake, Practical Pharmaceutical Chemistry, Part I, 4th ed., CBS Publishers & Distributors, New Delhi, 1997.
- G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney Vogel's Text Book of Quantitative Chemical Analysis 5th ed., ELBS, U.K., 1989.
- Keneth & A. Connors, A Text Book of Pharmaceutical Analysis, 3rd ed., Wiley Interscience Singapore, 1982.

ORGANIC CHEMISTRY
(1T-4)

1. Structure and properties

Relation of structure with properties like density, melting point, boiling point, solubility

Atomic structure, atomic orbital, molecular orbital, hybridization, sigma, and Pi bond, covalent, electrovalent and coordinate bond, inductive effect, hyper conjugation, resonance

Geometrical isomerism, stereochemistry including optical activity, stereoisomerism

2. The following topics shall cover nomenclature, important methods of preparation and chemical reactions with special reference to mechanism of the following classes of compounds:

a. Aliphatic compounds: Alkanes, alkenes, alkynes and dienes, cycloalkanes, alcohols, ethers, alkyl halides
b. Aromatic compounds: Aromatic character, structure of benzene, resonance, orientation of aromatic substitution, arenes, amines (aliphatic and aromatic), phenols, aryl halides, Polynuclear aromatic hydrocarbons (naphthalene, anthracene)
c. Aldehydes and ketones (aliphatic and aromatic), carboxylic acids and their derivatives
d. Dicarboxyllic acids, malonic acid esters and its importance, acetoacetic acid and its importance
e. Organometalic compounds: Grignard reagents, organolithium compounds, their preparation and synthetic application

PRACTICALS (1P-4)

- Systematic identification of unknown organic compounds based on element detection, solubility their functional groups, physical constants and derivatives**.**

BOOKS RECOMMENED

- R.T. Morrison & R.N. Boyd, Organic Chemistry, 1st Indian ed. Pearson Education Pte Ltd, Indian Branch, Delhi, 2002.
- I.L. Finar, Organic chemistry, Vol. I, 1st Indian ed. Pearson Education Pte Ltd Indian Branch, Delhi, 2002.

HUMAN ANATOMY, PHYSIOLOGY AND PATHOPHYSIOLOGY
(1T-5)

Note: Study of the system should cover the anatomy and Physiology along with the disorders associated with them (only definitions)

1. **Introduction to anatomy and Physiology:** Definition, anatomical terms, organs and systems (only introductory knowledge)

2. The cell: Structure, physiology of plasma membrane, transport across cell membrane (Active and passive transport)

3. The Tissue: Classification, distribution, properties of epithelial, connective, muscular and nervous tissue, bone and cartilage

4. Blood and lymph : Composition and function of blood, blood groups, blood coagulation, lymph formation and functions, lymph channels, structure and function of spleen, disorders of blood and lymph

5. Cardiovascular system: Heart-structure and dynamics of heart, cardiac cycle. Circulation-systemic, pulmonary, portal and coronary, blood pressure and its regulation, ECG, disorders of CVS

6. Digestive system: Digestive organs, movements of alimentary tract, gastric secretions, role of enzymes in digestive process.

7. Respiratory system: Organs of respiration, physiology and control of respiration.

8. Nervous system: Structure and functions of neuron, impulse generation, impulse conduction and transmission.

a. ANS: Neurotransmission in ANS, physiology and function
b. CNS: Neurotransmission in CNS, parts and functions (Brain, spinal cord and reflex arc**)**

9. Muscular Skeletal system: Knowledge of human skeleton, joints and their functions (Name of the major bones). Gross anatomy and physiology of muscle contraction and movement, muscle fatigue, muscular disorders,

10. Urinary system: Structure of kidney, nephron, physiology of urine formation, role of kidney in maintaining extra cellular fluid volume and composition, acid-base balance, osmoregulation

12. Special senses: Anatomy and physiology of ear, eye, nose, tongue and skin (hearing and equilibrium, vision, olfaction, gustation)

13. Reproductive system: Male and female reproductive system, family planning methods and sexually transmitted diseases

14. Endocrine glands and physiology: Thyroid, parathyroid, pancreas, pituitary, adrenals and gonads.

PRACTICALS (1P-5)

- Study of microscope.
- Study of human skeleton.
- Study of different systems of body with the help of charts & models.
- Microscopic study of different tissues.
- Blood typing, estimation of hemoglobin in blood, determination of bleeding time, clotting time, RBC counts, TLC, DLC & ESR.
- Recording of body temp, pulse rate, and blood pressure, basic understanding of ECG.

BOOKS RECOMMENDED

- Ross and Wilson, Anatomy, Physiology in Health and Illness, 9th ed., Churchill Livingstone, N. Y., 2001.
- C.C. Chatterjee, Human Physiology, vol. I&II, 11th ed., Medical Allied Agency, Ballygurge 2nd Lane, Calcutta.
- Guyton Arthure C. and Hall John E., TextBook of Medical Physiology, 9th ed., W.B. saunders Company, Bangalore, 1996.
- Doroland's Medical Dictionary, 25th ed., Oxford University press.
- Principles of Anatomy and Physiology, Tortora & Grabowski, 10th edition.
- Textbook of Practical Physiology by C.L. Ghai.
- Mosby's Medical dictionary, 4th edition, Mosbey publications.

MATHEMATICS AND STATISTICS
(1T-6)

TRIGNONOMETRY & CALCULUS (50%)

1. Trigonometry: T-ratios, addition, subtraction and transformation formulae. T-ratios of multiple, sub- multiple and allied angles. Simple T-identities based on above concept**.**

2. Differential Calculus: Continuity and limit, differentiation of algebraic, trigonometric, exponential, logarithmic and inverse functions. Right and left hand derivatives. Elementary maxima and minima.

3. Integral Calculus: Definite Integration of algebraic, trigonometric, exponential, logarithmic and inverse functions, integration by parts and by substitution, Simple cases of area and volume

4. Differential Equations: General formation of differential equation. Variable separable differential equation, Homogeneous linear equation, first order and first degree differential equation.

5. Matrices: Simple definition of matrices, addition, subtraction and multiplication of matrices

STATISTICS (50%)

1. Frequency distribution: Graphical representation of data, frequency polygon, frequency curve and cumulative frequency curve, histogram, diagrams and types of graphs.

2. Measures of central tendency: Mean, median, mode, quartiles and partitions values. Comparison to frequency distribution

3. Measures of dispersion and skewness: Dispersion, range, quartile dispersion, measures of deviation, mean deviation, standard deviation and root mean square deviation.

4. Correlation Regression: Correlation of samples, Karl Pearson`s coefficients of correlation. Line of regression X on Y and Y on X and regression coefficient

5. Sampling: Sampling distribution, confidence interval, non-probability and probability samples, computing 99% and 95% fudicial limits from tables of areas and normal curve probability rules, Z score computing' t' test and analysis of variance. All calculations should be illustrated with examples from true laboratory biological experimental models.

BOOKS RECOMMENDED:

- P.N. Arora, Biostatistics, Himalaya Publishing House, Mumbai, 2003.
- B.K. Mahajana, Methods in Biostatistics, Jaypee Brothers Medical Publishers (P) Ltd, New Delhi, 2003.
- S. Narayan, Integral Calculas and Differential Calculus, S. Chand Publisher (P) Ltd. Delhi, 2003
- M.Ray and S.S. Seth. Integral Calculus and Differential Calculus, Shiv lal Aggarwal and company, Agra
- A.R. Vashishtha, Matrices, Krishna Prakashan, Meerut

COMPUTERS
(1T-7)

1. **Introduction to computer**
   - Definition, Generation, Types, Parts of Computers, Central Processing Unit, Memory, Input/Output Devices. Computer Languages and their Hierarchy (Machine Level, Assembly Language, High Level Language). Microcomputers and their Applications, Software and Hardware.
   - Operating System concept, elements of DOS/UNIX, etc, DOS commands,
   - Introduction to Networking, Network communication and Internet
   - Introduction to software likes MS-Word, MS Excel, etc.
2. **Flow Charting and Algorithm Development**
   Definition and properties of algorithm, pseudo code, flowcharting, Application and, Conversion of algorithm/flow chart to high level language
3. **Introduction to C programming:** History of 'C', difference between C and C++, basic data types and operators in 'C', conditional statements [if –else, nested if], looping (for loop, while and do-while loop). Introduction to arrays (single and double dimension).
4. **A. Introduction to DATABASES:** Concept of database, fields, records, data files, table. Database Management System, Table manipulation (addition, deletion etc.), Introduction to MS- ACCESS
   B. Computer application to pharmaceutical and clinical studies

BOOKS RECOMMENDED

- P. K. Sinha, Fundamental of Computer, BPB Publication New Delhi, 2003
- Y. Kanetkar, Programming in C, C++, BPB Publication New Delhi ed. 2003.

PHYSICAL PHARMACY
(2T-1)

1. **States of matter:** Binding force between molecules, states of matter, gaseous state, liquid state, solid and crystalline state, liquid crystalline state, phase equilibria and the phase rule and thermal analysis
2. **Micromeretics and Powder Rheology**
   Particle size and size distribution, average particle size, number and weight distribution, methods for determining particle size, particle shape, specific surface, methods for determining surface area, pore size, derived properties of powders, flow properties
3. **Surface and Interfacial Phenomenon**
   Liquid interface, surface and interfacial tension, surface free energy, measurement of surface and interfacial tension, spreading coefficient, adsorption at solid interfaces, solid gas and solid-liquid interfaces, complex film, electrical properties of interfaces, Surfactants and their applications
4. **Viscosity and Rheology**
   Newtonian systems of flow, kinematic viscosity, effect of temperature, non-Newtonian systems: Plastic, Pseudoplastic, dilatant, thixotropy, thixothropy in formulation, determination of viscosity; capillary, falling sphere and rotational viscometers, applications
5. **Disperse Systems**
   Colloidal Dispersions: Definition, types, properties of colloids, protective colloids, application of colloids in pharmacy, solubilization
   Suspensions: Interfacial properties of suspended particles, settling in suspensions, theory of sedimentation, effect of Brownian movement, sedimentation parameters, wetting of particles, controlled flocculation, flocculation in structured vehicles, rheological considerations
   Emulsions: Emulsion types, theories of emulsification, physical stability of emulsions, preservation of emulsions, emulsion formulation
6. **Kinetics and Drug Stability**
   General considerations and concepts, half-life determination, effect of temperature, light, solvent, catalytic species and other factors, accelerated stability study, expiration dating
7. **Complexation**
   Classification of complexes, methods of preparation, analysis and applications
8. **Solubility and Distribution Phenomenon**
   Solute-solvent interactions, Solubility of gases n liquids, solubility of liquids in liquids, solubility of solids in liquids, factors affecting solubility
9. **Buffers**
   Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity.

PRACTICAL (2P-1)

Experiments based on following topics shall be performed: Micrometrics, surface tension, rheology disperse systems, complexation, HLB value, critical micellar concentration, and kinetics- (rate constant determinations, order of reaction, Accelerated stability testing)

BOOK RECOMMENDED

1. A. Martin, Physical Pharmacy, 4th ed., B.I. Waverly Pvt. Ltd., Delhi, 1997.
2. E.A. Rawlins, Bentley's, Textbook of Pharmaceutics, 8th ed., Bailliere Tindall, U.K., 1992.
3. C.V.S. Subrahmanyan, Text Book of Physical Pharmaceutics, 2nd ed. Vallabh Prakashan, Delhi, 2000.
4. A.R. Gennaro, Remingtons Pharmaceutical Sciences, & Practice of Pharmacy, Vol. I & II, 28th ed., Lippincott William & Wilkins, Philadelphia, N. Y. 2000.

CHEMISTRY OF NATURAL PRODUCTS (CNP)
(2T-2)

1. **Heterocyclic compounds:** Nomenclature, preparation and properties of 5 & 6 membered ring containing one or two heteroatom like O, N, and S: Furan, pyrrole, thiophene, pyridine, imidazole, thiazole, pyrazole, pyrimidines, quinoline and isoquinoline
2. **Carbohydrates:** Introduction, classification, nomenclature, reaction of monosaccharides like glucose & fructose, ring structure of glucose, mutarotation. Structural determination of disaccharides (sucrose, lactose and maltose), polysaccharides (starch and cellulose).
   Glycosides- Introduction, classification, structural elucidation of salicin, arbutin, amygdalin
3. **Alkaloids:** Introduction, classification, general methods of structure elucidation of alkaloids, structure determination (atropine, ephedrine, nicotine) and methods of structure determination of purines -caffeine, theophylline, theobromine and uric acid.
4. **Terpenes:** Introduction, classification, methods of structure determination of terpenes like citral, menthol, camphor, limonene.
5. **Proteins and Amino acid:** Introduction, classification, general methods of preparation and properties of amino acids. General nature of protein and synthesis of peptides. End group analysis
6. **Lipids:** Introduction, chemistry and pharmaceutical importance of oils and fats, general study of waxes and physico-chemical properties of oil.

PRACTICAL (2P-2)

- Experiments based on determination of saponification value, acid value, ester value and iodine value of vegetable oils.
- Isolation of caffeine, curcumin, piperine nicotine and sennosides from natural sources.

BOOKS RECOMMENDED:

1. I.L. Finar, Organic chemistry, Vol. II, 1st Indian ed., Pearson Education Pte Ltd Indian Branch, Delhi, 2002.
2. O.P. Agarwal, Chemistry of Natural Products, Vol. I & II, 7th ed., Goel Publishing House, Meerut, 1983
3. Chatwal: Chemistry of Natural Products,

PHARMACOLOGY-I
(2T-3)

Pharmacology of the drugs of under mentioned categories will include classification, mechanism of action, doses, clinical uses, drug interactions and contraindications

1. **General Pharmacology**
   Introduction to Pharmacology, dosage form and routes of administration, factors modifying drug action,
   Pharmacokinetics: ADME studies,
   Pharmacodynamics: mechanism of drug action, dose- response relationship, bioavailability, therapeutic index, synergism & antagonism, adverse drug reactions, drug interactions.
2. **Drugs acting on Respiratory System**
   Bronchodilators, Drug therapy of Asthma, Anti-tussive and Expectorants, Respiratory stimulants.
3. **Drugs acting on Haemopoietic System**
   Drugs acting on blood and the blood forming organs, hematinics, anticoagulants, fibrinolytic (thrombolytic) agents, antiplatelet agents, hypo-lipidemic agents
4. **Drug acting on Gastrointestinal Systems**
   Laxatives, anti-diarrhoeal agents, emetics, antiemetics, agents controlling gastric acidity and treatment of peptic ulcers.
5. **Chemotherapy**
   Basic concepts and principles of chemotherapy, antibacterial and antibiotics sulfonamides, macrolides, aminoglycosides, drugs used in chemotherapy of tuberculosis, leprosy, helminthiasis and protozoal infections (malaria, amoebiasis, leishmaniasis, trypanosomiasis), antifungal agents, antineoplastic agents, immunomodulating drugs
6. **Bioassays of ADH, digitalis, insulin, oxytocin and d-tubocurarine**
7. **Vitamins**
   Vitamin toxicity, Vitamin drug Interaction, role of vitamins in management of adverse drug reactions

PRACTICALS (2P-3)

- Bioassay of Acetylcholine, digitalis, d- tubocurarine using appropriate isolated tissue preparations.
- Study of effects of various drugs on tissues.
- Study of dose response curves and calculation of affinity constants.
- Calculation of pA_2 for antagonists.

BOOKS RECOMMENDED:

1. Text book of Pharmacology- Barar.
2. Pharmacology and Pharmacotherapeutics- Vol.I&II, Satoskar Bhandarkar.
3. Goodman and Gilman- The Pharmacological Basis of Therapeutics.
4. Handbook of Experimental Pharmacology- S.K. Kulkarni.
5. Screening methods in Pharmacology- Turner
6. Basic and Clinical Pharmacology- Katzung.
7. Principles of Pharmacology- Munson.
8. Essentials of Medical Pharmacology- K. D. Tripathi
9. Experimental pharmacology- M. N. Ghosh.
10. Pharmacology-Rang and Dale.
11. Human Pharmacology- Brody and Larner.

PHARMACEUTICAL ANALYSIS
(2T-4)

1. Quality Assurance:

a. GLP, ISO 9000, TQM, Quality Review and Quality Documentation.
b. Regulatory Control, Regulatory Drug Analysis, Interpretation of Analytical Data.

2. Oxidation-reduction titration: Theory of redox titrations, redox indicators, oxidation reduction curves, iodometry and iodimetry, titrations involving cerric sulphate, potassium iodate, potassium bromate, and potassium permanganate

3. Gravimetric analysis: Precipitation techniques, solubility products, the colloidal state, super saturation, co-precipitation, post-precipitation, digestional washing of the precipitate, filtration, filter papers and crucibles, ignition, thermo-gravimetric curves, specific examples like barium as barium sulphate, aluminum as aluminum oxide, organic precipitants

4. Complexometric titrations: Principle of complexometric titrations, complexometric methods using EDTA, chelating agents, indicators, titrations with disodium edetate.

5. Thermal methods: Instrumentation and applications of Thermogravimetric analysis (TGA), differential thermal analysis (DTA), Differential scanning calorimeter (DSC)

6. Separation techniques:

- Solvent extraction: Distribution law, technique for solvent extraction, classification of solvent extraction systems, advantages of solvent extraction
- Chromatography: Principle, general procedure and applications of thin layer chromatography (TLC), paper chromatography (PC), Column chromatography and gel chromatography.

7. Electrochemistry: Introduction, dielectric cell, electrode potential, Nernst's equation, salt bridge, standard potential, reference and indicator electrode, measuring the relative voltage of cell. potentiometry, conductometry and their applications in analysis of drugs

8. Optical methods of analysis: Principle, instrumentation and applications of refractometry and polarimetry

PRACTICALS (2P-4)

- Titrations based on theory

BOOKS RECOMMENDED:

R.M. Silverstein, G. C. Bassler and T. C. Morrill, Spectrometric Identification of Organic Compounds, 5th ed., Wiley Interscience, Singapore, 1991

A.H. Becket and J.B. Stenlake, Practical Pharmaceutical Chemistry, part- II, 4th ed., CBS Publishers & Distributors, New Delhi, 1997

W. Kemp, Organic Spectroscopy, 1st ed. ELBS/Macmillan, London, 1975. G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney Vogel's Text Book of Quantitative Chemical Analysis 5th ed., ELBS, U.K., 1989

Keneth & A. Connors, A Text Book of Pharmaceutical Analysis, 3rd ed., Wiley Interscience, Singapore, 1982

D.A. Skoog, F.J.Holler and T. A. Nieman, Principle of Instrumental analysis, 5th edition, Saunders College publishing, Philadelphia

T. Higuchi, E. Brochmann and H. Hanssen, Pharm. Analysis, 1st edition, 1997, CBS Publisher, New Delhi.

UNIT OPERATIONS
(2T-5)

1. **Unit Operations:** Introduction, basic laws, material balance
2. **Fluid Flow:** Types of flow, Reynolds's number, viscosity, concept of boundary layer, basic equations of fluid flow, valves, flow meters, manometers and measurement of flow and pressure.
3. **Material Handling Systems**
   Liquid Handling: Different types of pumps.
   Gas Handling: Various types of fans and blowers
   Solid Handling: conveyers and air transport.
4. **Centrifugation:** Principles of centrifugation, industrial centrifuge and centrifugal sedimenters, zonal centrifuges.
5. **Crystallization:** Importance of crystal purity, size, shape, geometry, habit, forms and types, solubility curves and calculation of yields. Material and heat balances around Swenson Walker Crystallizer. Super saturation theory and its limitations. Nucleation mechanism, crystal growth. Classification of crystallizers, tanks, agitated batch, Swenson Walker, single vacuum, circulating magma and crystal crystallizer, caking of crystals and its prevention.
6. **Dehumidification and Humidity Control:** Basic concepts and definitions, wet bulb temperature, dry bulb temperature and adiabatic saturation temperature, psychometric chart and measurement of humidity, equipments for humidification operations, refrigeration.
7. **Heat Transfer:** Sources of heat, heat transfer, classification and heat flow processes, Fourier's law, parallel current and counter current flow, radiations, black body, tubular heaters and heat interchangers
8. **Evaporation** :Basic concepts of phase equilibrium, factors affecting evaporation, evaporators, film evaporators, single effect and multiple effect evaporators ,accessories of evaporator
9. **Distillation**: Raoult's law, phase diagrams: simple, steam and flash distillations, principle of equipments for rectification, azeotropic and extractive distillation, molecular distillation
10. **Drying:** Moisture content and mechanism of drying, rate of drying, classification and type of dryers, dryers for pharmaceutical industries and special drying methods, lyophilization

PRACTICAL (2P- 5)

Experiments based on flow of heat, flow of fluids, evaporation, distillation, centrifugation, crystallization, drying, and humidity. Exercises on engineering drawing shall also be done.

BOOKS RECOMMENDED

1. W.L. McCabe, J.C. Smith & Peter Harriott, Unit Operations of Chemical Engineering, 5th ed., International Students Edition, McGraw Hill International Book Co., New Delhi, 1993.
2. S.J. Carter, Cooper and Gunn's Tutorial Pharmacy, 6th ed., CBS Publishers & Distributors, New Delhi, 1999.
3. R.H. Perry & Don Green, Chemical Engineer's Handbook, 6th ed. McGraw Hill Inc., New Delhi, 1984.
4. Water L. Badger & Julius T. Banchero, Introduction to chemical engineering, McGraw Hill Book Company, New Delhi, 1955.
5. K. Sambamurthy, Pharmaceutical Engineering, New Age International Pvt. Ltd., New Delhi, 1997.
6. Salil K. Ghosal, Shyamal K. Sanyal & Siddhartha Datta, Introduction to chemical Engineering, Tata McGraw Hill Publishing Company Ltd., New Delhi- 1998.
7. George Granger Brown, Unit operations, I ed., CBS Publishers & Distributors, New Delhi, 1995.
8. C.V.S. Subramanian, Pharmaceutical Engineering, Vallabh Prakashan, Delhi, 2001.

PHARMACOGNOSY-I
(2T-6)

1. **Introduction:** Definition, historical background, present status and future scope of pharmacognosy
2. **Classification of crude drugs:** Alphabetical, Morphological, Pharmacological and Chemical classification.
3. **Adulteration and evaluation of drugs:** Causes and types of adulteration, organoleptic, microscopic, biological, chemical and physical methods of evaluation.
4. **General principles of formation of primary and secondary plant metabolites:** Biogenesis of carbohydrates, lipids, volatile oils and steroids.
5. Endogenous and exogenous factors influencing the variability in drug content and plant growth hormones.
6. **Systematic study of crude drugs including English, Indian names, their Synonyms: Official, Biological, Geographical sources, Preparation, Identification (by microscopic characteristics of drugs in bold and italics), Chemical constituents, Chemical and Micro chemical tests, Uses, Adulterants and Evaluation of the following drugs**:
   Drugs containing carbohydrates: Starch, honey, agar, alginates, ***Ispaghula***, bel, pectin, acacia, tragacanth, sterculia, katira and guar gum.
   Drugs containing fixed oils, fats and waxes: Castor oil, sesame oil, olive oil, arachis oil, cotton seed oil, chaulmoogra oil, neem oil, fish liver oil, theobroma, lard, lanolin, beeswax and spermaceti.
   Drug containing volatile oils: ***Mentha, eucalyptus***, lemon grass, orange peel, ***coriander*****,** caraway, ***fennel*****,** ***dill***, black-pepper, cardamom, ***clove***, garlic, pyrethrum, turmeric, ***cinnamon***, valerian, chenopodium, nutmeg and turpentine oil.
   Drug containing resins: Benzoin, balsam of tolu, colophony, asafoetida, jalap, kaladana, ginger, colocynth, capsicum and ***podophyllum*****.**
7. **Study of the sources, physical and chemical tests of identity, salient microscopic features and uses of the following**
   Cellulose and cellulose derivatives
   Fibers used as pharmaceuticals: Wool, cotton wool, jute, silk nylon, terylene and polyesters
   Inorganic pharmaceutical aids: Talc, asbestos, bentonite, kaolin and prepared chalk.

PRACTICAL (2P- 6)

1. Study of macroscopic characters of following crude organized drugs.
   Fennel, Coriander, Caraway, Dill, Cardamon, Cinnamon, Ginger, Nutmeg, Turmeric, Jalap, Black Catechu, Pale Catechu, Jatamansi, Blackpepper, Linseed, Mustard, Benzoin. Podophyllum,mentha, eucalyptus, vasaka, clove, orange peel, capsicum
2. Study of microscopic characters of following crude drugs.
   Fennel, Cinnamon, Clove, Coriander, Caraway, Dill, Linseed ,Ginger, Eucalyptus.
3. Identification tests and microscopic study of the fibres: wool, cotton, jute, silk
4. Chemical evaluation of following unorganized drugs.
   Agar, Acacia, Tragacanth, Benzoin, Aloes,Catechu, Honey, Asafoetida, Colophony and Bentonite
5. Isolation of phyto-constituents such as starch, volatile oils & resins.
6. Organoleptic, microscopic and physical evaluation of drugs including moisture content, optical rotation, refractive index , ash and extractive values etc.

BOOKS RECOMMENDED

1. W.C. Evans, Trease & Evans, Pharmacognosy, 15th ed., Harcourt Publishers Limited, London, 2002.
2. C.K. Kokate, Pharmacognosy, 12th ed., Nirali Prakashan, Pune, 1999.
3. Edward P. Claus, Pharmacognosy, 6th ed.,Lea & Febiger, Philadelphia, 1970.
4. T.E. Wallis, Text Book of Pharmacognosy, 5th ed., CBS Publishers and Distributors, Delhi, 1985.
5. C.S. Shah & J. S. Qaudry, Text Book of Pharmacognosy, 7th ed., B. S. Shah Prakashan, Ahmedabad, 1989-90.
6. Mohammad Ali, Text Book of Pharmacognosy, 1st ed., CBS Publishers & Distributors, Delhi, 1994.
7. S.S. Handa & V. K. Kapoor, Pharmacognosy, 2nd ed., Vallabh Prakashan, Delhi, 1989.
8. C. K. Kokate, Practical Phramacognosy, 4th ed., Vallabh Prakashan, Delhi, 1994.
9. K. R. Kandelwal, Practical Pharmacognosy, 5th ed., Nirali Prakashan, Pune, 1998.
10. Rasheeduz Zafar & Neerja Gandhi, Practical Pharmacognosy, 1st ed., CBS Publishers & Distributors, Delhi, 1994.

HOSPITAL & COMMUNITY PHARMACY
(2T-7)

The question paper will comprise of 60% from Hospital Pharmacy & 40% from Community Pharmacy

HOSPITAL PHARMACY

1. **Organization & Structure:** Organization of a hospital & hospital pharmacy, responsibilities of a hospital pharmacist, pharmacy & therapeutic committee, budget preparation & implementation.
2. **Hospital formulary:** Contents, preparation and revision of hospital formulary.
3. **Drug store Management & inventory control:**
   Organization of drug store, types of materials stocked, storage conditions.
   Purchase and inventory control, principles, purchase procedure, purchase order, procurement and stocking.
   Dispensing of drugs to inpatients & ambulatory patients
   Dispensing of controlled drugs
4. **Central sterile supply unit & its management:** Types of materials for sterilization, packing of materials prior to sterilization, sterilization equipments & supply of sterile materials.
5. **Surgical products:** Definition, primary wound dressing, absorbents: surgical, cotton, surgical guaze etc, bandages, adhesive tapes, protectives, cellulosic haemostates, official dressing, absorbable sutures, catgut & other non absorbable sutures & other medical prosthetics & organ replacement materials.
6. **Biological Pharmacy:** Glandular products, preparation of extracts or isolation of pure substances & their dosage forms- pituitary, adrenal, pancreas, thyroid, parathyroid, ovary, liver, stomach, urine
7. **Radio diagnostic techniques:** RIA, ELISA etc.
8. **Blood products and plasma substitutes:** Collection, processing and storage of whole human blood, concentrated human RBC, dried human plasma, protein fraction, dried human serum, human fibrinogen, human thrombin.
   Plasma substitutes: Ideal requirements, PVP, Dextran

COMMUNITY PHARMACY

1. **Organization & structure:** Organization & structure of retail & wholesale drug store, types of drug stores & their design, legal requirements for establishment, maintenance of drug store, dispensing of proprietary products, maintenance of records of retail & wholesale.
2. Concept of health, Theories of concept of disease, demographic cycle & family planning methods.
3. **Communicable Disease**
   Causative agents, modes of transmission, prevention & control:
   Respiratory infections: Chicken pox, measles, influenza, diphtheria, whooping cough, tuberculosis
   Intestinal Infections: Poliomyelitis, hepatitis, cholera, typhoid, food poisoning, hookworm infection.
   Arthropod borne infection**:** Plague, malaria, filariasis.
   Surface infections: Rabies, trachoma, tetanus, leprosy.
   Sexually transmitted diseases: Syphilis, gonorrhoea, AIDS.

BOOKS RECOMMENDED

1. P. Nand & R.K. Khar, A Text Book of Hospital & Clinical Pharmacy, 1st ed., Birla Publications, Delhi 2003-2004.
2. S.J. Carter, Cooper & Gunn's, Dispensing for Pharmaceutical students, 12th ed. CBS. Publishers & Distributors, Delhi 1987.
3. W.E. Hassan, Hospital Pharmacy, 5th ed., Lea & Febiger, Philadelphia, 1986.
4. S.H. Merchant, J.S. Qadry, A Text Book of Hospital Pharmacy, 2nd ed. Shah Prakashan, Ahmedabad 1998.
5. P.C. Dandiya, Z.Y.K. Zafer, Afifa Zafer, Health Education & Community Pharmacy, 2nd ed., Vallabh Prakashan, Delhi 1997.
6. A. R. Gennaro, Remington, The Science & Practice, of Pharmacy vol. I & II 20th ed. (International students Edi) Lippincot-Williams & Wilkins, Philadelphia, 2000.

PHARMACEUTICAL JURISPRUDENCE
(2T-8)

Introduction

- Pharmaceutical legislation- a brief view
- Drug and pharmaceutical industry- a brief view
- Pharmaceutical education- a brief view

An elaborate (practical oriented) study of the following

- Pharmaceutical ethics
- Pharmacy Act 1948
- Drugs & cosmetic Act 1940 & Rules 1945
- Medicinal & Toilet Preparations (Excise duty) Act 1940 & Rules 1955
- Narcotic Drugs & Psychotropic Substances Act 1985 & Rules
- Drugs Price Control Order

A brief study of following with special reference to the main provision

- Poison Act 1919
- Drugs & Magic Remedies (objectionable advertisement) Act 1954
- The Medical Termination of Pregnancy Act 1970 and Rules 1975
- Prevention of cruelty to Animal Act 1960
- Insecticides Act 1968
- Patents Act 1970
- Factory Act 1948

Note: The teaching of all the above acts should cover the latest amendments.

BOOKS RECOMMENDED

1. B.M. Mithal, A text Book of Forensic Pharmacy, 10th ed., Vallabh Prakashan, Delhi, 1999.
2. N.K. Jain, A textbook of Forensic Pharmacy, 3rd ed., Vallabh Prakashan, Delhi, 1995.
3. The patents Act, 1970, Published by Universal land Publishing to Pvt. Ltd, New Delhi, 2000.
4. V. Malik, Drug and Cosmetics Act, 1940. 11th ed., Eastern Book Company, Lucknow, 1998.
5. N. B. Zaveri, Patents for Future, 1st ed., Vakils Feffer and Simms Ltd., Mumbai, 2001.
6. Bare Acts & Rules and Amendments Published by Govt. of India

PHARMACEUTICAL TECHNOLOGY-I
(3T-1)

1. **Preformulation Studies**
   (a). Study of Physical properties of drug like physical form, particle size, shape, density, wetting, dielectric constant, solubility, dissolution and organoleptic properties and their effect on formulation, stability and bioavailability.
   (b). Study of chemical character of drug molecule like hydrolysis, oxidation, reduction, racemization, polymerization, etc and their influence on stability of products.
2. **Liquid Dosage forms**
   Introduction, type, additives used in formulations, vehicles, stabilizers, preservatives, suspending agents, emulsifying agents, solubilizers, colors, flavors, etc. Manufacturing, packaging and evaluation of clear liquids, suspensions and emulsions
3. **Semisolid Dosage Forms**
   Definitions, types, mechanism of drug penetration through skin, factors influencing penetration, semisolid bases and their selection, general formulation of semisolids, manufacturing procedure, evaluation and packaging.
4. **Tablets**
   (a). Formulation of different types of tablets, granulation methods, technology of production of granules on large scale by various techniques, physics of tablet making, manufacturing, packaging and evaluation of tablets.
   (b). Coating of Tablets: Types of coating, film forming materials, formulation of coating solutions, equipments for coating, coating process, evaluation of coated tablets.
5. **Capsules**
   Advantages and disadvantages of capsule dosage form, material for production of hard gelatin capsule shell, size of capsules, method of capsule production, soft gelatin capsule shell and capsule content, importance of base adsorption and minim per gram (M/g) factor in soft capsules, quality control, stability testing and storage of capsule dosage form
6. **Microencapsulation**
   Types of microcapsules, importance of microcapsules in pharmacy, microencapsulation by coacervation phase separation, multiorifice centrifugal process, spray drying, spray congealing, air suspension technique, coating pan and other techniques.
7. **Quality Control and Quality Assurance (including c-GMP) and Pharmaceutical Process Validation.**
8. **Packaging of Pharmaceutical Products** Packaging components, types of specifications and methods of evaluation, stability aspects of packaging, packaging equipments, factors influencing choice of containers, legal and other official requirements for containers, package testing.

PRACTICALS (3P-1)

- Experiments based on preparation and evaluation of the dosage forms described in the syllabus.

BOOKS RECOMMENDED:

Hand book of Basic Pharmacokinetics-Ritschel, W.A., Drug Intelligence Publication, M. Hamilton, 1977.
Fundamentals of Clinical Pharmacokinetics-Wagner, J.C., Drug Intelligence Publication, M. Hamilton, 1975.
Remington's Pharmaceutical Sciences-Gennaro A.R., ed., 19th Edition, Mack Publishing kco., Easton, PA. 1995.
Clinical Pharmacokinetics-Rowland, M, & Tozer, N., 2nd edition, Lea & Febiger, Philadelphia, 1989.
Pharmacokinetics-Gibaldi M. & Perrier, D., 2nd ed., Marcel Dekker, New York, 1982.
Pharmacokinetics for the pharmaceutical scientist-Wagner, J.C., Technomic Publishing AG, Switzerland, 1993.
Biopharmaceutcs and Pharmacokinetics- Notrari, R.E., 2nd ed., marcel Dekker, New York, 1975.
Biopharmaceutcs and Pharmacokinetics: Bramhankar & Jaiswal.

MEDICINAL CHEMISTRY I
(3T-2)

1. **Basic principles of medicinal chemistry:** Structural features and pharmacologic activity (Optical isomerism, Geometric isomerism, Bioisosterism), Receptor: Receptor theories, Forces involved in drug receptor interaction

2**. The following categories shall cover general study, IUPAC nomenclature of drugs, classification, structure activity relationship (SAR) (Chemical classes wherever applicable), Mode/Mechanism of action, therapeutic uses and syntheses of individually mentioned drugs**

a) **Anaesthetics:** Syntheses of Thiopental sodium, Lidocaine, Benzocaine and Procaine

b) **Hypnotics and Sedatives:** Syntheses of Pentobarbitone, Amobarbitone and Nitrazepam

c) **Anticonvulsants:** Syntheses of Phenytoin, Paramethadone and Ethosuximide

d) **Antipsychotics:** Syntheses of Chlorpromazine and Haloperidol

e) **Analgesics and Anti-inflammatory agents:** Syntheses of Codiene, Nalorphine, Aminopyrine, Paracetamol, Mefenamic acid, Indomethacin and Aspirin

f) **Antihistaminics:** Syntheses of Dimenhydrate, Antazoline, Pyrilamine maleate, Promethazine and Diphenhydramine

g) **Adrenergic and cholinergic agents:** Syntheses of Epinephrine, Isoproterenol, Salbutamol and Dicyclomine

h) **Central Nervous System Stimulants:** Syntheses of Nikethamide

i) **Antihypertensive agents:** Syntheses of Propanolol, Prazocin and Hydralazine hydrochloride

j) **Diuretics:** Syntheses of Acetazolamide, Hydrochlorthiazide, Chlorthiazide, Ethacrynic acid and Furosemide

k) **Expectorants and Antitussive agents:** Synthesis of Guaiphenesin

l) **Gastrointestinal Drugs**

PRACTICALS (3P-2)

- Syntheses involving some name reactions, heterocyclic nuclei and some simple drugs

BOOKS RECOMMENDED

1. William O. Foye, Principles of Medicinal Chemistry, 3rd ed., Varghese Publishing House,Mumbai, 1989.
2. Jaime N. Delgado & William A. Remers, Wilson and Gisvold's, Text Book of Organic Medicinal and Pharmaceutical Chemistry, 9th ed. J.B. Lippincott Company, Philadelphia, 1991.
3. Manfred E. Wolff, Burger's Medicinal Chemistry & Drug Discovery, 5th ed., Wiley Interscience, New York, 1995.
4. H. Singh and V.K. Kapoor, Medicinal and Pharmaceutical Chemistry, 1st ed., Vallabh Prakashan, Delhi, 1996.
5. Ashutosh Kar, Medicinal Chemistry, New Age International (P) Limited, New Delhi, 1993.
6. I.L. Finar, Organic Chemistry, vol. II, Stereochemistry & The Chemistry of Natural Products, 5th ed., ELBS. Singapore, 1975.

PHARMACEUTICAL MICROBIOLOGY

(3T-3)

1. **Definition of microbiology & application of microbiology in pharmacy**.
2. **Structure of bacterial cell**
3. **Classification of microbes and their taxonomy:** Actinomycetes, bacteria, reickettsiae, spirochetes and viruses.
4. **General techniques:** Preparation of media, sterilization, maintenance of cultures, stains and staining techniques.
5. **Control of microbes by physical and chemical methods.**
   a) Sterilization: Different methods, evaluation of sterilization methods. Sterility testing of sterile pharmaceutical products.
   b) Antiseptics & Disinfectants: Definition, factors influencing disinfectants, dynamics of disinfection, common disinfectants, antiseptics and their evaluation.
6. **Microbial genetics and variation:**
   a) Extra chromosomal genetic elements (plasmid)
   b) Genotypic and phenotypic variation.
   c) Mutation, gene transfer, colicinogenic factors, genetic mechanisms of drug resistance in bacteria.
7. **Microbial attack and host defense, virulence and pathogenicity, primary and specific defense mechanisms of body, infection and its transmission, interferons**
8. **Microbial standardization of antibiotics, vitamins and amino acids**
9. **Immunology and Immunological preparations:** Principles, antigens and haptens, immune system, cellular and humoral immunity, immunological tolerance, antigen-antibody reactions and their applications. Hypersensitivity, active and passive immunization products, their preparation, standardization and storage.
10. **Genetic engineering:** Transformation, conjugation, transduction, protoplast fusion and gene cloning and their applications, hybridoma and monoclonal antibodies.
11. **Biologicals obtained by fermentation:** general requirements, media, equipments and production of penicillin, streptomycin, tetracycline, vitamin C, riboflavin, citric acid

PRACTICALS (3P-3)

List of Experiments

1. Preparation and sterilization of media (solid, liquid agar and broth)
2. Isolation of pure colonies
3. Staining techniques (Gram's staining, negative and simple staining)
4. Aseptic transfer techniques
5. Antibiotic assays
6. Sterility testing of water for injection and normal saline and other sterile pharmaceutical products
7. Hanging drop techniques

BOOK RECOMMENDED

1. R. Anatnaryan & C.K. J Panikar, Text Book of Microbiology, 6th ed., Orient Longman, Hyderabad, 2001.
2. S.J. Carter, Copper & Gunns, Tutorial Pharmacy, 6th ed., CBS, Publishing House, New Delhi, 1999.
3. W.B. Hugo & A.D. Russel, Pharmaceutical Microbiology, 4th ed., Blackwell Scientific Publication, Oxford, 1987.
4. B. D. Davies, R. Dulbecco, H.N. Eisen, H.S. Ginsberg, Microbiology, 4th ed., Harper and Raw Publishers, Singapore, 1990.
5. Gennaro A.R., Remingtons Pharmaceutical Sciences 20th ed., Lippincott Williams and Wilkin Publications, Philadelphia, 2001.
6. M.T. Madigan, J.M. Martinko, J. Parker, Brock Biology of Microorganisms, 9th ed., Prentice Hall International Inc., London, 2000.
7. P.F. Stanbury, A Whitaker, S.J. Hall, Principle of Fermentation Technology, 1st Indian ed., Aditya Books (P) Ltd., New Delhi, 1997.

PHARMACOGNOSY -II
(3T-4)

1. **Commerce in Crude Drugs**
   Collection, preparation, drying and storage of drugs with special emphasis on factors influencing quality of drugs, cultivation of medicinal plants
2. **Biogenesis of medicinally important glycosides and alkaloids, general techniques of biosynthetic studies**
3. **Systematic Study of Crude Drugs**
   Including synonyms, biological/ geographical sources, identification (microscopic characteristics of drugs in italics and bold), chemical constituents, chemical tests, uses, adulteration and evaluation of glycosidal, alkaloidal drugs belonging to following groups:

   Glycosidal Drugs:

   (a). Anthraquinone glycosidal drugs: ***Senna,*** Aloe, ***Rhubarb***, Cascara.
   (b). Saponin glycosidal drugs: Dioscorea, Solanum, ***Liquorice***, Senega, Ginseng.
   (c). Cyanogenetic glycosidal drugs: Wild Cherry
   (d). Coumarins and Furanocoumarin glycosidal drugs: Psoralea
   (e). Miscellaneous glycosidal drugs: Gentian, Quassia, Saffron.

   Alkaloidal Drugs:

   (a). Indole alkaloidal drugs: Ergot, ***Nux-vomica, Rauwolfia,*** Catharanthus.
   (b). Tropane alkaloidal drugs: ***Stramonium, Hyoscyamus,*** Datura, ***Belladonna,*** Duboisia.
   (c). Isoquinoline alkaloidal drugs: ***Ipecac, Opium,*** Curare
   (d). Quinoline alkaloidal drugs: ***Cinchona.***
   (e). Pyridine alkaloidal drugs: Areca, Lobelia, Nicotiana.
   (f). Imidazole alkaloidal drugs: Pilocarpus.
   (g). Quinazoline alkaloidal drugs: ***Vasaka***.
   (h). Steroidal alkaloidal drugs: Ashwagandha, Kurchi, Veratrum.
   (i). Proto- alkaloidal drugs: ***Ephedra***, Colchium.
   (j). Terpenoid alkaloidal drugs: Aconite.
4. **Enzymes**
   Source, chemical nature and uses of Papain, Pancreatin, Urokinase, Diastase, Pepsin, Trypsin, Penicillinase, Hyaluronidase.
5. **Study of drug of marine origin.**
6. **An overview of steroidal drug precursor from plants.**

PRACTICALS (3P-4)

- Evaluation of drugs (included in theory) in whole and powder form by macroscopic, microscopic, chemical and chromatographic examination.
- Preparation of herbariums of plants from wild sources.
- Quantitative microscopy of drugs

BOOKS RECOMMENDED:

1. R.D. Chaudhary, Herbal Drug Industry, 1st ed., Eastern Publishers, New Delhi, 1996
2. Ayurvedica Pharmacopoeia of India,
3. V.D. Rangari, Pharmacognosy and Phytochemistry, Part I & II, 1st ed., Career Publications, Nashik, 2002.
4. W.C. Evans, Trease & Evans, Pharmacognosy, 15th ed., Harcourt Publishers Limited, London, 2002.
5. C.K. Kokate, Pharmacognosy, 12th ed., Nirali Prakashan, Pune, 1999.
6. Blumenthal, Herbal medicine, 1st ed., Integrative medicine communications, Newton, 2000.
7. WHO monographs on selected medicinal plants, vol. I & II, 1st ed., Word
8. Indian Materia Medica: Nadkarni

PHARMACEUTICAL BIOCHEMISTRY
(3T-5)

1. **Introduction**
   Biochemistry and its importance in pharmaceutical Sciences.
2. **Cell**
   Biochemical organization of the cell, production of cell energy, ATP and its biological significance, Biochemical importance of colloidal systems, Donnan Effect.
3. **Enzymes**
   Classification, nomenclature, factors affecting enzyme action, enzyme kinetics, mode and mechanism of enzyme action and inhibition, isozymes and their importance in diagnosis, enzyme immobilization.
4. **Vitamins**
   Vitamins as co-enzyme and their significance, metals as co-factors.
5. **Carbohydrate Metabolism**
   Classification, glycolysis, citric acid cycle, glycogenesis, glycogenolysis, hexose monophosphate shunt (HMP), uronic acid pathway, blood sugar and its regulation, abnormalities of carbohydrate metabolism.
6. **Lipid Metabolism**
   Oxidation of fatty acids, biosynthesis of fats, ketogenesis and ketosis, metabolism of cholesterol, essential fatty acids, eicosanoids, phospholipids, sphingolipids, abnormalities of lipid metabolism.
7. **Bioenergetics**
   Biological oxidation and reduction, respiratory chain, oxidative phosphorylation, enzyme and co-enzyme of bio-redox system.
8. **Metabolism of Amino Acids and Proteins**
   General biochemical reactions of amino acids like transamination, deamination, and decarboxylation, metabolism of sulphur containing amino acids, urea cycle, nitrogen balance, biosynthesis of bile salts and bile pigments.
9. **Metabolism of Nucleic Acids and Protein Biosynthesis**
   (a).Biosynthesis and catabolism of purines and pyrimidines containing nucleotide, abnormalities of nucleic acid metabolism.
   (b). Biosynthesis of DNA and its replication, mutation and repair mechanism, genetic diseases.
   (c) An introduction to genetic engineering, biosynthesis of RNA, genetic code and protein synthesis.
10. **Liver and Kidney function tests of biochemical importance.**

PRACTICALS (3P-5)

- Simple experiments on enzymes, proteins and amino acids, lipids, carbohydrates, nucleic acids
- Urine analysis, blood analysis, food analysis, water analysis.

BOOKS RECOMMENDED

1. Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell, Harper's Biochemistry, 25th ed. McGraw Hill health Professions Division, New York, USA, 1998.
2. A.V.S.S. Rama Rao, Text Book of Biochemistry, 6th ed., L. K. & S. Publishers, Visakhapatnam, 1991.
3. Melson David L. Lehninger Principles of Biochemistry, 3rd ed. Macmillan worth Publishers, N. Y. USA, 2001.
4. Stryer Lubert, Berg Jeremy M., Tymoczko Johan L, Biochemistry, 5th ed. W. H. Freeman & Company New York, 2002
5. M. C. Pant, Essentials of Biochemistry, 8th ed., Kedarnath Ramnath & Co. Publishers, Meerut, 1996.

PHARMACOLOGY-II
(3T-6)

Pharmacology of the drugs of under mentioned categories will include classification, mechanism of action doses, clinical uses, drug interactions and contraindications

1. **Drug acting on Autonomic Nervous system**
   General considerations, cholinergic and anti-cholinergic agents, adrenergic agonists and antagonists, ganglionics blocking agents, skeletal muscle relaxants, local anaesthetic agents.
2. **Drug acting on Central Nervous system**
   General consideration, neurotransmitters in CNS, pre-anaesthetic medication, alcohol and disulfiram, general anaesthetics, sedatives and hypnotics, narcotic analgesics, antipyretics, NSAID'S,anti-gout agents, anti-depressants, anti-psychotics, psychedlics, psychopharmacological agents, antiepileptics, CNS stimulants, antiparkinsonian agents, centrally acting muscle relaxants.
3. **Drugs acting on Cardiovascular system**
   Digitalis and cardiac glycosides, antihypertensives, antianginals and vasodilators, antiarrythmics.
4. **Toxicology**
   Principles of toxicology, manifestations of toxicity, immunotoxicity, toxic effects on genetic material cell replication, non therapeutic toxicants, air pollutants, food additives and contaminants, animal toxins, metals, solvents, pesticides.
5. **Drug affecting Endocrine system**
   a. Hypothalamic and Pituitary hormones
   b. Thyroid hormones and antithyroid drugs, calcitonin, parathormones, vitamin D
   c. Insulin, oral hypoglycemic agents and glucagons.
   d. Adrenocorticoids, anabolics, antifertility agents
   e. Drugs acting on Uterus.
6. **Drugs acting on Urinary System**
   Fluid electrolyte balance, diuretics.
7. **Preclinical and Clinical Trials (Phase I,II,III and IV)**
8. **Autacoids**
   Histamine, antihistaminics, serotonin and its antagonists, prostaglandins, prostacyclines, thromboxanes, platelet activation factors, lipoxanes, leukotrienes,

PRACTICALS (3P-6)

1. Experiments on CNS:
   a. Recording of spontaneous motor activity, stereotype, analgesia, anticonvulsant activity, anti-inflammatory activity and muscle relaxant activity of drugs using simple experiment

2. CVS pharmacology:
   a. To study the ionotropic and chorontropic effects of drugs on isolated frog heart
   b. To study the effect of drugs on normal and hypo-dynamic frog heart

3. To calculate the PA_2 value of atropine and chlorpheniramine

4. Bioassay of Acetylcholine, histamine, oxytocin on suitable isolated preparation using matching assay, bracketing assay, three point and four point assay

BOOKS RECOMMENDED

Goodman & Gillman, The Pharmacological Basis of Therapeutics 9th ed., McGraw Hill Companies, New York, USA, 1996.

Katzung G. Bertram, Basic and Clinical Pharmacology, 8th ed., McGraw Hill Companies, New York, USA, 2001.

Rang H.P., Dale M.M., Ritter J.M., Pharmacology, 4th ed., Churchill livingstone, N. Y., 1999.

R.S. Satoshkar, Pharmacology and Pharmacotherapeutics, vol. I & II: 16th ed., Mumbai Popular Prakashan, 1999.

Munson L. Paul, Principles of Pharmacology, Chapman & Hill, N. Y. 1995.

S. K. Kulkarni & P.C. Dandiya, Introduction to Pharmacology, 5th ed. Vallabh Prakasha, 1998.

Laurence & Bennett, Clinical Pharmacology, 8th ed., Churchill Livingstone, N. Y. 1997.

S. D. Seth, Text Book of Pharmacology, 2nd ed. Churchill Livingstone Pvt. Ltd., New Dlhi.

CLINICAL PHARMACY AND DRUG INTERACTIONS
(3T-7)

1. **Introduction :**Development and scope of clinical pharmacy, concept of health care team, role of clinical pharmacist as a member of health care team and his/her important functions
2. **Basic Concept of Pharmacotherapy**
   (a). Clinical Pharmacokinetics and Individualization of Drug Therapy.
   (b). Recording of medication history, self medication, non-prescription drug usage, Improving patient compliance and providing patient counseling.
   (c). Drug Delivery Systems and their Biopharmaceutic and Therapeutic Consideration, Generic Vs Patent drugs, principles of pharmacoeconomics.
   (d). Drug used in Infancy and Elderly (Pediatrics and Geriatrics).
   (e). Drug use during Pregnancy.
   (f). Drug induced diseases.
   (g). Drug Interactions: Prescription monitoring, documentation and other methods for minimizing clinically relevant drug interactions
   (h). General Principles of Clinical Toxicology.
   (i). Interpretation of Clinical Laboratory Tests: Hematological, Pathological and biochemical investigations as marker of major organ damage and their effect on drug therapy decision.
   (j). Adverse drug reactions (ADR) and the role of clinical pharmacist in their monitoring and prevention (concepts of pharmacoepidemiology and pharmacovigilance).
   (k). Drug information centre in a hospital, its need, component and activities. Innovations in information retrieval systems
   (l) Communication skills: Behavioral and interpersonal with patients and other professionals.
3. **Important Disorders of Organ Systems and their Management**
   (a). **Cardiovascular Disorders:** Hypertension, Congestive heart failure(CHF), Angina, Acute Myocardial Infraction, Cardiac arrhythmias.
   (b). **CNS Disorders:** Epilepsy, Parkinsonism, Schizophrenia, Depression and Migraine.
   (c). **Respiratory Diseases:** Asthma.
   (d). **Gastrointestinal Disorders:** Peptic Ulcer, Ulcerative colitis, Hepatitis, Cirrhosis.
   (e). **Endocrine Disorders:** Diabetes Mellitus and Thyroid disorders.
   (f). **Infectious Diseases:** Tuberculosis, Urinary Tract Infections, Enteric Infections, Upper Respiratory Infections, Sexually transmitted diseases (STD) and AIDS
   (g). **Hematopoietic Disorders:** Anemias.
   (h). **Joint and connective tissue Disorders:** Rheumatic Diseases, Gout and Hyperuricemia.
   (i). **Neoplastic Diseases:** Acute Leukaemias, Hodgkin's disease and carcinoma of breasts.
4. **Therapeutic Drug Monitoring.**
5. **Concept of Essential Drugs and Rational Drug Use.**

BOOKS RECOMMENDED

1. R. Walker, Clinical Pharmacy & Therapeutics, 2nd ed., Churchil Livingstone, N.Y. 1999.
2. D. H. Lawson, Clinical Pharmacy & Hospital Management, 1st ed., Chapmen Hall, N.Y., 1980.
3. A.J. Winfield & R.M. E. R. Chards, Pharmaceutical practice, 2nd ed., Churchill livingstone, N.Y. 1999.
4. W.E. Hassan, Hospital Pharmacy, 3rd ed., Lea and Fiebiger, Philadelphia, USA, 1974.
5. A. R. Gennaro, Remington's the science & Practice of Pharmacy, vol. I & II, 20th ed., Lippincott William and Wilkins, Philadelphia, N.Y. 2000.

BIOPHARMACEUTICS AND PHARMACOKINETICS
(4T-1)

1. **Drug Absorption:** Gastrointestinal absorption, membrane physiology, mechanism of solute transport across the cell membrane. Mechanism, physico-chemical, biological and pharmaceutical factors affecting drug absorption through GIT, techniques for GIT absorption assessment.
2. **Drug Distribution:** Disposition process, distribution in blood, factors affecting drug distribution (blood pH, drug pK_a and partition coefficient), physiological barriers like plasma membrane, blood barriers, CSF barrier, placental barrier to drug distribution, perfusion rate of tissue, drug tissue binding, protein drug binding (P-D), etc. Plasma protein binding, kinetics of binding, factors affecting P-D binding and therapeutic significance of P-D binding. Tissue redistribution and its significance.
3. **Bioavailability and Bioequivalence:** Definitions, federal requirements, methods of determination of bioavailability using blood and urinary excretion data, Protocol design for bioavailability assessment. Methods for bioequivalence determination.
4. **Drug Biotransformation:** Drug elimination process, drug metabolizing enzymes, non-microsomal enzymes, chemical pathways of drug metabolism (Phase-I and Phase-II reactions), factors affecting drug metabolism (chemical and biological), first pass/ presystemic metabolism, biotransformation reaction and pharmacological activity, Pro-drug to overcome pharmaceutical and pharmacokinetic problems.
5. **Drug Excretion:** Renal excretion mechanisms, factors affecting renal clearance of drug, Non renal routes of drug excretion like, biliary, pulmonary, salivary, mammary, skin, etc. Total body clearance, organ clearance, hepatic clearance, renal clearance, blood and urinary excretion data in calculation of various pharmacokinetic parameters.
6. **Pharmacokinetics:** Introduction to pharmacokinetics, basic and clinical pharmacokinetics, significance of plasma drug concentration measurement, pharmacokinetics of drug absorption (zero order and first order absorption rate constants), volume of distribution, curve fitting (method of residuals), regression procedures.
7. **Compartment Models:** Definition, Basis of Classification, Model selection criteria
    a. One compartment open model with first order elimination kinetics, pharmacokinetics of single dose administration as applied to intravenous (rapid/bolus) and oral administration, intravenous infusion, pharmacokinetic basis of sustained release formulation.
    b. Two compartment open model with first order elimination kinetics, pharmacokinetics of single and multiple dose administration as applied to intravenous (rapid/bolus) and oral administration, intravenous infusion, pharmacokinetic basis of sustained release formulation.
8. **Non Compartment Models:** Statistical moments, application in bioavailability determination, linear system pharmacokinetics, unit impulse response, Michaeles Menten equation
9. **Dosage Regimen:** Dosage regimen adjustment in patients with and without renal failure

PRACTICALS (4P-1)

- Experiments based on ADME process, bioavailability, bioequivalence, protein binding, compartment models, non-linear pharmacokinetic analysis.
- In-vitro evaluation of marketed products
- Experiments designed for the estimation of various pharmacokinetic parameters with given data.
- Statistical treatment of data

BOOKS RECOMMENDED:

1. Hand book of Basic Pharmacokinetics-Ritschel, W.A., Drug Intelligence Publication, M. Hamilton, 1977.
2. Fundamentals of Clinical Pharmacokinetics-Wagner, J.C., Drug Intelligence Publication, M. Hamilton, 1975.
3. Remington's Pharmaceutical Sciences-Gennaro A.R., ed., 19th Edition, Mack Publishing kco., Easton, PA. 1995.
4. Clinical Pharmacokinetics-Rowland, M, & Tozer, N., 2nd edition, Lea & Febiger, Philadelphia, 1989.
5. Pharmacokinetics-Gibaldi M. & Perrier, D., 2nd ed., Marcel Dekker, New York, 1982.
6. Pharmacokinetics for the pharmaceutical scientist-Wagner, J.C., Technomic Publishing AG, Switzerland, 1993.

MEDICINAL CHEMISTRY II
(4T-2)

1. **Principles of Drug Designing:** QSAR parameters and methods (Free Wilson and Hansch Analysis), Introduction to computer aided drug designing and Molecular modelling.
2. **Drug metabolism:** Phase I and Phase II pathways of drug biotransformation and conjugation
3. **Steroid and Related Drugs:** Nomenclature, classification, SAR (wherever applicable) and therapeutic uses. Syntheses of Estradiol, Diethylstilbestrol, Hexestrol, Testosterone and Dienesterol
4. **Antibiotics:** Nomenclature and mode of action. Study of drugs under the following classes: Penicillin, Cephalosporin, Tetracycline (SAR included), Amino glycosides, Chloramphenicol (SAR included)
5. **Sulphonamides:** Nomenclature, Classification, Mode/mechanism of action, physicochemical parameters and bacteriostatic activity and therapeutic uses. Syntheses of Sulphadiazine, Sulfacetamide and Sulfioxazole
6. **Vitamins:** Study of Vitamin A, Thiamine, Riboflavin, Ascorbic acid, Folic acid, Pantothenic acid, Pyridoxine and Tocopherol
7. **Antitubercular agents:** Nomenclature, chemical classification and mode of action. Syntheses of Isoniazid, Ethionamide and Ethambutol
8. **Antimalarials:** Nomenclature, chemical classification and mode of action, Syntheses of Primaquin, Pyrimethamine, Dapsone and Trimethoprim
9. **Antiviral agents:** Nomenclature, classification and mode of action. Synthesis of Amantadine
10. **Eicosanoids:** Biosyntheses of eicosanoids. Prostaglandins and their importance
11. **Antineoplastic agents:** A study of alkylating agents and antimetabolites in therapy of neoplastic diseases. Syntheses of Methotrexate, Mephalan and Chlormabucil
12. Concepts and brief introduction to following topics: **Antisense oligonucleotides, Combinatorial chemistry** and **Peptidomimetics**

PRACTICAL (4P-2)

- Syntheses involving some name reactions, heterocyclic nuclei and some simple drugs

BOOKS RECOMMENDED

William O. Foye, Principles of Medicinal Chemistry, 3rd ed., Varghese Publishing House,Mumbai, 1989.

Jaime N. Delgado & William A. Remers, Wilson and Gisvold's, Text Book of Organic Medicinal and Pharmaceutical Chemistry, 9th ed. J.B. Lippincott Company, Philadelphia, 1991.

Manfred E. Wolff, Burger's Medicinal Chemistry & Drug Discovery, 5th ed., Wiley Interscience, New York, 1995.

H. Singh and V.K. Kapoor, Medicinal and Pharmaceutical Chemistry, 1st ed., Vallabh Prakashan, Delhi, 1996.

Ashutosh Kar, Medicinal Chemistry, New Age International (P) Limited, New Delhi, 1993.

I.L. Finar, Organic Chemistry, vol. II, Stereochemistry & The Chemistry of Natural Products, 5th ed., ELBS. Singapore, 1975.

PHARMACEUTICAL TECHNOLOGY-II
(4T-3)

Parenteral Products:

(a). Preformulation factors, routes of administration, water for injection, pyrogenicity, non- aqueous vehicles, isotonicity and methods of its adjustment.

(b). Formulation detail, containers and closures and selection.

(c) Pre-filling treatment, washing of container and closures, preparation of solution and suspensions, filling and sealing of ampoules and vials, infusion fluids, equipments for large scale manufacture and evaluation for particulate matter.

(d) Aseptic techniques, source of contamination and method of prevention, design of aseptic area, laminar flow benches, services and maintenance.

Ophthalmic Preparations: Requirements, formulation, method of preparation, containers, evaluation.

Pharmaceutical Aerosols: Definition, propellants, general formulation, manufacturing, packaging and evaluation methods

Sustained and Controlled Drug Delivery System: Design and development, physico-chemical, biological and pharmacokinetic properties influencing design and performance of controlled release products, material and methods used in their formulation, dose designing, *in- vitro* and *in-vivo* evaluation.

Novel Drug Delivery Systems: Introduction to novel drug delivery systems, their merits and demerits, drug targeting.

Stability Testing Protocols:

Cosmetology and Cosmetic Preparations: Fundamentals of cosmetic science, structure and functions of skin and hair, formulation, preparation and packing of cosmetics for skin, hair, dentifrices and manicure preparations, like nail polish, lipstick, eye lashes, etc.

PRACTICALS (4P-3)

- Experiments based on preparation and evaluation of the dosage forms described in the syllabus.

BOOKS RECOMMENDED

1. Gilbert S. Banker and Christopher T. Rhodes, Modern Pharmaceutics, Vol. 72, 3rd., Marcell Dekker, Inc., N. Y., 1996.
2. Leon Lachman, H. A. Lieberman & J.L. Kanig, The theory and Practice of Industrial pharmacy, 3rd ed., K.M. Varghese Co., Bombay, 1987.
3. H. A. Lieberman, Leon Lachman & Joseph B Schwartz, Pharmaceutical Dosage Forms: Tablets, Vol. I, II & III, 2nd ed., Marcel Dekker, Inc., N. Y., 1996.
4. N.K. Jain, Advances in Controlled and Novel Drug Delivery, 1st ed., CBS Publishers and Distributors, New Delhi, 2000.
5. Howard C. Ansel, Nicholas, G. Popovich & Loyd V. Allen Jr., Pharmaceutical Dosage forms and Drug Delivery Systems, 6th ed., B.I. Waverly Pvt. Ltd., New Delhi, 1995.
6. Quality Assurance of Pharmaceuticals WHO, Geneva, Vol. I & II, Pharma Book Syndicate, Hyderabad, 2002.
7. Wilmer A Jenkins & Kenton R. Osborn, Packing Drugs and Pharmaceuticals, Technomic Publishing Co., Inc., Lancaster, 1993.
8. S. P. Vyas & R.K. Khar, Targetted & Controlled Drug Delivery, CBS Publishers and Distributors, New Delhi, 2002.
9. H. A. Lieberman, Leon Lachman & Joseph B Schwartz, Pharmaceutical Dosage Forms: Parentral Medications, Vol. I, II & III, 2nd ed., Marcel Dekker, Inc., N. Y., 1996.

PHARMACOGNOSY-III
(4T-4)

1. **Study of Indigenous Traditional drugs, Botanical sources (including alternative/controversial sources), clinical uses, chemical constituents, pharmacological action and authentication of following drugs:**
   Amla (*Phyllanthus emblica*), Bahera (*Terminalia belerica*), kantkari (*solanum Xanthocarpum*), Malkangi (*Celastrus paniculata*), Tylophora indica, Bhilwa (*Semicarpus anacardium*), Satavar (*Aspargus racemosus*), Bach (*Acorus calamus*), Rasna (*Pluchea lanceolata*), Punarnava (*Boerhavia diffusa*), Chitrak (*Plumbago Zeylanicum*), Apamarg (*Achyranthus aspera*), Shanskpushpi (*Convolvulus microphyllus*), Guduchi (*Tinospora cardifolia*), Brahmi (*Centella asiatica*), Lahsun (Garlic) (*Allium sativum*), Guggal (*Commiphora mukul*), Kalmegh (*Andographis paniculata*), Tulsi (*Ocimum sanctum*), Valerian (*Veleriana officinalis*), Gokhru (*Tribulus terristris*), Harad (Myrobalan- *Terminalia chebula*), Vidang (*Embelica ribes*), Artemisia (*Artemisia annua*), Chiraita (*Swertia chirata*), Arjuna (*Terminalia arjuna*), Ashok (*Saraca indica*), banafsha (*Viola odorata*).
2. **Introduction to Ayurvedic Dosage Forms, Preparation and standardization of Ayurvedic Preparations such as Asavas, Aristha, Avaleha, Churna.**
3. **General methods of Extraction, Isolation, Identification and Characterization of Phyto-constituents:**
   Carbohydrates, Glycosides, Phenolic compounds, Steroids and Alkaloids.
   a. **Isolation of the following Phyto-constituents (including industrial methods):**
   Morphine, Quinine, Reserpine, Sennosides, Digitalis glycosides, Diosgenin, Menthol, Thymol, Rutin, Psoralen.
4. **Study of Hallucinogenic and poisonous plants, Mycotoxins and Toxic Mushrooms, Allergens and Allergenic preparations.**
5. **Herbs as Health food and cosmetics.**
6. **History and development of Plant Tissue Culture, media, latest techniques to improve production of phyto-pharmaceuticals (hairy root culture, immobilization, biotransformation)**
7. **WHO guidelines for standardization of herbal formulation.**
8. **An overview of plants as antitumor agents, bitters, sweeteners and photo- sensitizing agents.**

PRACTICALS (4P-4)

1. Extraction, isolation of medicinally important phytoconstituents.
2. Chromatography and characterization of isolates.
3. Herbal drug standardization techniques.
4. Microscopic evaluation of churnas, polyherbal preparations.
5. WHO Standardization methods for herbo-mineral preparations.

BOOKS RECOMMENDED

1. R.D. Chaudhary, Herbal Drug Industry, 1st ed., Eastern Publishers, New Delhi, 1996
2. Ayurvedica Pharmacopoeia of India,
3. V.D. Rangari, Pharmacognosy and Phytochemistry, Part I & II, 1st ed., Career Publications, Nashik, 2002.
4. W.C. Evans, Trease & Evans, Pharmacognosy, 15th ed., Harcourt Publishers Limited, London, 2002.
5. C.K. Kokate, Pharmacognosy, 12th ed., Nirali Prakashan, Pune, 1999.
6. Blumenthal, Herbal medicine, 1st ed., Integrative medicine communications, Newton, 2000.
7. WHO monographs on selected medicinal plants, vol. I & II, 1st ed., Word
8. Indian Materia Medica: Nadkarni

PHARMACEUTICAL ANALYSIS-III
(4T-5)

The theoretical aspects, basic instrumentation, elements of interpretation of spectra and application of the following analytical techniques to be discussed

1. Fundamentals and principles of spectroscopy
2. **Ultra-Violet (UV) and Visible Spectrophotometry:** Electronic excitation, Lambert-Beer law, deviation from Beer's law, chromophores, instrumentation, single and double beam instruments
3. **Infrared Spectrophotometry:** Theory, characteristic absorbance bands of organic functional groups, interpretation of infrared absorption spectra, preparation of sample, sample cells, IR instrumentation qualitative and quantitative applications in pharmaceutical analysis.
4. **Nuclear Magnetic Resonance spectroscopy:** An introduction to the theory of ^{1}H NMR, chemical shift & spin-spin coupling, brief introduction to ^{13}C NMR.
5. **Mass Spectrometry:** Introduction to mass spectra, molecular ions peak, fragmentation peak, mass spectra of some simple compounds.
6. **Flame Photometry:** Origin of spectra, atomization and ionization, instrumentation, background emission, interferences, qualitative and quantitative applications in pharmaceutical analysis.
7. **X-ray Diffraction:** Introduction, production and detection of X rays, Bragg's Law, identification of powder diffraction patterns.
8. **Fluorimetry:** Theory, quantitative description, experimental factors affecting fluorescence intensity, factors affecting OC and F directly, relationship to fluorescence to molecular structure, instrumentation, correction of spectra, pharmaceutical applications**.**
9. **Chromatography:** Basis of GLC (instrumentation excluded) and instrumentation and applications of HPLC
10. **Electrophoresis:** Definition, free solution electrophoresis, Tiselius method, moving boundary electrophoresis, density gradient electrophoresis, zone electrophoresis, paper electrophoresis and its applications
11. **Validation, Quality Audit: quality of equipment, validation of equipment, validation of analytical procedures**

PRACTICALS (4P-5)

- Experiment based on paper and thin layer chromatography
- Estimation of potassium, sodium and calcium ions using flame photometry

BOOKS RECOMMENDED

1. R.M. Silverstein, G. C. Bassler and T. C. Morrill, Spectrometric Identification of Organic Compounds, 5th ed., Wiley Interscience, Singapore, 1991.
2. A.H. Becket and J.B. Stenlake, Practical Pharmaceutical Chemistry, part- II, 4th ed., CBS Publishers & Distributors, New Delhi, 1997.
3. W. Kemp, Organic Spectroscopy, 1st ed. ELBS/Macmillan, London, 1975.

INDUSTRIAL MANAGEMENT
(4T-6)

1. **Plant Location and layout of an Industry:** Various factors affecting locational aspects, layout of building and equipment, product layout vs. process layout, compliance of pollution control measures. Elementary knowledge of Factories act.
2. **Planning and Decision making:** Definition, importance of planning, step involved in decision making, objectives, strategies, policies and programme.
   Management by objectives: MBO process, objectives, multiplicity.
3. **Production Planning and Control:** Scientific purchasing, quality control, problems of productivity, stores organization, location of store, receiving, inspection and issue of materials: control of stores and stocks, store accounting and record.
4. **Personnel Management:** Basic/ Brief idea of selection, appointment, training, transfer, promotion and demotion, remuneration, job evaluation, human relation.
5. **Pharmaceutical Marketing:** Introduction to functions, buying, selling, transportation, storage, finance, feedback information, channel of distribution, wholesale, retail, departmental store, multiple shop and mail order business.
6. **Sales forecasting:** Various methods, analysis, limitations and advantages.
7. **Salesmanship:** Principles of sales promotion, advertising, ethics of sales, merchandising, literature, detailing.
8. **Market Research:** Recruitment, training, evaluation, compensation to the pharmacist.
9. **Finance:** Principles of economics with special reference to the laws of demand and supply, demand schedule, demand curves, procedure of exporting and importing goods.
10. **Accountancy:** Principles and definitions of account, ledger posting and journal entries, preparation of trial balance, columns of a cash book, bank reconciliation statement, rectification of errors, profit and loss account, balance sheet, purchase, keeping and pricing of stocks, treatment of cheques, bills of exchange, promissory notes and hundies, documentary bills.

BOOKS RECOMMENDED:

1. M.C. Shukla, Business Organisation and Management, 18th ed., S. Chand & Company Ltd., New Delhi, 1995.
2. A.F. James Stones, Management, 6th ed., Prentice Hall of India Private Ltd., New Delhi, 1999.
3. Economics, 2nd ed., Tata McGraw-Hill Publishing Company Ltd., 1996.
4. H. Koontz, Heenz Weihrich, Essentials of management, 5th ed., Tata McGraw, Hill Publishing Company Ltd., New Delhi, 1998.
5. Philip Kotler, Marketing management, 9th ed., Prentice Hall of India Pvt. Ltd., New Delhi, 1999.
6. S.V.R. Subba Rao, Handbook of Pharmaceutical Marketing in India, 2nd ed., Panther Publishers Pvt. Ltd., Bangalore, 1997.
7. Mohammed Ali and Jyoti Gupta, Drug store and Business Management, 1st ed., CBS Publishers and Distributors, New Delhi, 1996.