

**BIRLA INSTITUTE OF TECHNOLOGY**  
**DEPARTMENT OF PHARMACEUTICAL SCIENCES**  
**B. PHARM. (COURSE STRUCTURE)**  
**(w.e.f. Academic Session : 2009-10)**

Course No.	Course	Unit
<b>First Semester:</b>		
HU1101	Technical English (to develop Communication skills & Report writing)	1.0
MA1102/PS1301	Remedial Mathematics/ Remedial Biology	1.0
PS1303	Pharmaceutical Chemistry I	1.0
PS1305	Pharmaceutical Analysis I	1.0
CH2203	Environmental Science	1.0
CS 1051	Fundamentals of Computer Science	1.0
MA1103/PS1302	Mathematical Practice / Remedial Biology Lab.	0.5
PS1304	Pharmaceutical Chemistry Lab.I	0.5
PS1306	Pharmaceutical Analysis Lab. I	0.5
GA1002	Games/NCC/NSS/Creative Arts	0.5
<b>Second Semester:</b>		
MA2103	Mathematics I	1.0
PS2301	Pharmaceutics	1.0
PS2303	Pharmaceutical Microbiology	1.0
PS2305	Pharmaceutical Chemistry II	1.0
PS2307	Pharmaceutical Analysis II	1.0
PS2309	Human Anatomy, Physiology & Health Education I	1.0
PS2302	Pharmaceutics Lab.	0.5
PS2304	Pharmaceutical Chemistry Lab. II	0.5
PS2306	Pharmaceutical Analysis Lab. II	0.5
CS 2052	Programming Using C Language	1.0
GA2002	Games/NCC/NSS/Creative Arts	0.5
<b>Third Semester:</b>		
MA3102	Mathematics II	1.0
PS3301	Physical Pharmaceutics	1.0
PS3303	Pharmacy Practice-I (Prescription Pharmacy)	1.0
PS3305	Pharmaceutical Chemistry III	1.0
PS3307	Human Anatomy, Physiology & Health Education II	1.0
PS3309	Physiological Chemistry	1.0
PS3302	Pharmaceutical Microbiology Lab.	0.5
PS3304	Pharmaceutical Analysis Lab. III	0.5
PS3308	Human Anatomy, Physiology & Health Education Lab.	0.5
PS3310	Physiological Chemistry Lab.	0.5
GA3001	Games/NCC/NSS/Creative Arts	0.5

Course No.	Course	Unit
<b>Fourth Semester:</b>		
PS4301	Pharmaceutical Systems I	1.0
PS4303	Pharmacy Practice-II (Hospital Pharmacy & Pharmacy Administration)	1.0
PS4305	Pharmaceutical Engineering I	1.0
PS4307	Inorganic Medicinals	1.0
PS4309	Pharmacology I (General Pharmacology, Toxicology & Bioassay)	1.0
PS4311	Pharmacognosy I	1.0
PS4302	Physical Pharmaceutics Lab.	0.5
PS4304	Pharmacy Practice Lab.-I (Prescription Pharmacy I)	0.5
PS4306	Pharmaceutical Engineering Drawing	0.5
PS4308	Inorganic Medicinals Lab.	0.5
GA4001	Games/NCC/NSS/Creative Arts	0.5

#### **Fifth Semester:**

PS5301	Pharmaceutical Systems II	1.0
PS5303	Pharmaceutical Biotechnology & Bioinformatics	1.0
PS5305	Pharmaceutical Engineering II	1.0
PS5307	Natural Medicinals I	1.0
PS5309	Pharmacology II (Neuropharmacology)	1.0
PS5311	Pharmacognosy II	1.0
PS5302	Pharmacy Practice Lab.II (Prescription Pharmacy II including Hospital Training)	0.5
PS5308	Natural Products Lab.	0.5
PS5310	Pharmacology Lab.I	0.5
PS5312	Pharmacognosy Lab.I	0.5

#### **Sixth Semester:**

PS6301	Industrial Pharmacy I	1.0
PS6305	Natural Medicinals II	1.0
PS6307	Chemotherapeutic Agents	1.0
PS6309	Pharmacology III (Systemic Pharmacology)	1.0
PS6311	Pharmacognosy III	1.0
PS6303	Pharmaceutical Engineering III	1.0
PS6302	Product Development Lab.I	0.5
PS6304	Pharmaceutical Engineering Lab.II	0.5
PS6310	Pharmacology Lab.II	0.5
PS6312	Pharmacognosy Lab.II	0.5

Course No.	Course	Unit	
<b>Seventh Semester:</b>			
PS7301	Industrial Pharmacy II	1.0	
PS7303	Biopharmaceutics and Pharmacokinetics	1.0	
PS7305	Synthetic Medicinals I	1.0	
PS7307	Instrumental Drug Analysis	1.0	
PS7309	Pharmacology IV (Chemotherapeutic & Endocrine Pharmacology)	1.0	
PS7311	Pharmacognosy IV	1.0	
PS7302	Product Development Lab. II	0.5	
PS7308	Drug Analysis Lab.	0.5	
PS7310	Pharmacology Lab III	0.5	
PS7312	Project -I	0.5	
<b>Eighth Semester:</b>			
PS8301	Pharmaceutical Enterprise Management	1.0	
PS8303	Biological & Fermentation Products	1.0	
PS8305	Pharmaceutical Jurisprudence	1.0	
PS8307	Synthetic Medicinals II	1.0	
	Elective I	1.0	
	Elective II	1.0	
PS8302	Product Development Lab.III	0.5	
PS8308	Synthetic Medicinals Lab.	0.5	
PS8306	Instrumental Drug Analysis Lab.	0.5	
PS8312	Project -II	0.5	
<b>Electives : (Any Two)</b>			
1.	PS8321	Cosmetic Technology	1.0
2.	PS8323	Drug Design	1.0
3.	PS8327	Pharmaceutical Marketing & Sales Management	1.0
4.	PS8329	Herbal Formulations & Standardization	1.0
5.	PS8331	Quality Assurance & Drug Regulatory Affairs.	1.0
6.	PS8333	Clinical Pharmacy & Drug Interactions.	1.0
7.	PS8335	Clinical Pharmacology.	1.0

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# **I. B. PHARM. : 1<sup>ST</sup> SEMESTER**

## **HU 1101: TECHNICAL ENGLISH**

1. Single Word Substitution
2. Idioms and Phrases
3. Pairs of Words
4. Common Errors
5. Précis
6. Comprehension
7. Expansion
8. Official Correspondence :  
Memorandum, Notice, Agenda, Minutes, Circular Letter, Applying for a Job, Resume, Demi-official Letter.
9. Business Correspondence – Types, Sales Letters.
10. Social Correspondence – Invitation to Speak, Congratulations etc.
11. Report Writing-General and Technical Report: Definition, Types, Structure.
12. Technical Proposals- Definition, Types, Formats.
13. Research Papers and Articles.
14. Mechanics of Manuscript Preparation.
15. Phonetics (Symbols and Transcription) of Daniel Jones, Dictionary of Pronunciations.

### **Books Reference:**

1. Blickle & Houp : “Report for Science and Industry,” Henry Holt & Co.,
2. Duddy & Freeman : “Written Communication in Business,” American Book Co.,
3. Berry : “The Most Common Mistakes in English Usage,” Tata McGraw Hill,
4. Stevensin et al. : “English in Business and Engineering,” Prentice Hall Eaglewood Cliff,
5. Kaul : “Effective Business Communication,” Prentice Hall,
6. Singh : “Business Correspondence including Bank Letters,”
7. Singh : “Theory and Practice of Business Correspondence,” HPJ Kapoor Publications,
8. Mohan & Sharma : “Report Writing and Business Correspondence,” Tata McGraw Hill,
9. Best: “The Students Companion,” Rupa & Co. Publications,

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## MA 1102: REMEDIAL MATHEMATICS

- 1. Algebra:** (12L)
- Complex numbers: Definition, Fundamental operations with complex numbers, modulus, amplitude, conjugate of a complex number, Graphical representation of complex numbers. De Moivre's theorem, Roots of complex numbers (8L)
  - Arithmetic, Geometric and Harmonic progressions, Binomial theorem, Exponential and logarithmic series. (4L)

- 2. Co-ordinate Geometry (Two dimensional):** (4L)
- Cartesian & Polar Co-ordinates, Distance between two points, Area of a triangle, Equation of a straight line, Angle between two lines, Distance of a point from a straight line,
  - Equations of circle, parabola, ellipse, and Hyperbola.

- 3. Determinants and Matrices:** (8L)
- Determinants and their properties. Cramer's rule,
  - Types of matrices. Addition, Multiplication, Transpose, Adjoint and Inverse of a matrix,
  - Solution of linear system of equations by matrix inversion method.

- 4. Trigonometry:** (8L)
- Circular Functions, trigonometric functions and equations,
  - Sides of a triangle and T-ratios, Inverse trigonometric functions, multiple and submultiple angles, Hyperbolic functions.

- 5. Differential Calculus:** (8L)
- Function, Limit and Continuity,
  - Differential coefficients, Differentiation of Algebraic Inverse and Transcendental functions, Differentiation by substitution, Differentiation of Implicit functions. Logarithmic differentiation, Differentiation of parametric functions,
  - Geometrical meaning of the derivative, Equation of tangent and normal lines to a curve. Rate measure and approximations.

**Books Suggested:**

1. Agarwal : "Senior Secondary School Mathematics," Bharti Bhawan Publications
2. Sharma : "Mathematics," Dhanpat Rai Publication
3. Sinha : "A Text Book of Algebra and Coordinate Geometry," Students Friends Publications.
4. Das Mukherjee : "Differential Calculus," U.N. Dhar Publications

## PS 1301: REMEDIAL BIOLOGY

### 1. Cytology:

- Plant cell & its structure,
- Mitosis & meiosis,
- Different types of plant tissues & their functions.

### 2. Genetics:

- Mendalism,
- Chromosomal aberration,
- Polyploidy.

### 3. Morphology & Histology of different parts of the plants:

root, stem, bark, leaf, flower, fruit, and seed.

### 4. Classification of plants: in brief.

### 5. General survey of Animal Kingdom:

1. Structure and life history of parasites as illustrated by amoeba, entamoeba, trypanosoma, plasmodium, taenia, and ascaris.

2. **General Structure and Life History of Insects** (in relation to humans & medicinal crops):

- Mosquito,
- Housefly,
- Mites,
- Tse – Tse fly
- Silkworm

### 6. General overview of Physiology and various terminologies used in physiology and pharmacology.

### 7. Cell & Tissue :

- Structure of cell, its components and their functions,
- Mechanism of Transport through the Cell membrane,

### Books Recommended:

1. Dutta : “Text Book of Botany,”
2. Maheshwari : “Text Book of Botany,”
3. Gupta : “Genetics,”
4. Hess : “Plant Physiology,”
5. Trueman : “Elementary Biology,”
6. Vidyarathi : “Text Book of Biology,”
7. Guyton & Hall: “Textbook of Medical Physiology,” WB Saunders Company,
8. Chatterjee: “Human Physiology,” Vols I & II, Medical Allied Agency, Calcutta,

## PS1303: PHARMACEUTICAL CHEMISTRY-I

The treatment should be on the basis of modern physico-chemical aspects-

1. **Structure, Properties & Stereochemistry:** [12 Hrs.]
  - Atomic and Molecular orbitals, Molecular Orbital theory, Wave equation, Bonding and Antibonding orbitals
  - Modern aspects of covalent bonds
  - Hybrid Orbitals-sp, sp<sup>2</sup>, sp<sup>3</sup> hybridizations
  - Intramolecular forces
  - Bond dissociation energy
  - Polarity of bonds, Polarity of Molecules & Intermolecular forces.
  - Chirality, & Chiral reagents
  - Configuration- Enantiomers, Specification of Configuration by Sequence Rules
  - Diastereoisomerism, Meso-structure & Conformational isomers.
2. **Alkanes:** [06 Hrs.]
  - Energy of Activation
  - Transition states & Free-radical substitution.
3. **Alkenes, Dienes & Alkynes:** [10 Hrs.]
  - Preparation and Reactions of Carbon-Carbon double bonds
  - Carbonium ions, Mechanism of Electrophilic and Free-Radical Addition. Reactions.
  - Preparation and Properties of Alkynes
  - Stability of Conjugated Dienes
  - Isoprene Rule.
4. **Cycloparaffins:** [03 Hrs.]

Modern interpretation of Baeyer's strain theory with special reference to conformation of cyclohexane stereoisomers.
5. **Benzene:** [06 Hrs.]
  - Resonance, Aromatic character
  - Electrophilic Aromatic substitution
  - Orientation, Arenes stability and ease of formation of benzyl Carbonium - ion and benzyl free radical.
6. **Alkyl Halides:** [06 Hrs.]
  - Preparation
  - Substitution- and Elimination- Reactions.
7. **Alcohol, Ethers & Epoxides:** [06 Hrs.]
  - Preparation
  - Properties
  - Hydrogen Bonding in alcohols.

### Books Recommended :

1. Morrison & Boyd: "Organic Chemistry," 6<sup>th</sup> ed.(20<sup>th</sup> Indian Reprint), Prentice-Hall, 1999.
2. Finar : "Organic Chemistry," Vol.1 (The Fundamental Principles), 6<sup>th</sup> ed.(Reprint), ELBS Longman, 1997.
3. Finar : "Organic Chemistry," Vol.2 (Stereochemistry & The Chemistry of Natural Products), 5<sup>th</sup> ed.(1<sup>st</sup> Indian Reprint), ELBS Longman- Pearson Education Asia Pvt.Ltd., 2000.

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## PS1305: PHARMACEUTICAL ANALYSIS – I

- 1. Quantitative Analysis:** [10 Hrs.]
  - Significance of quantitative analysis in Quality Control
  - Preliminaries and definitions
  - Precision and accuracy
  - Different techniques of analysis
  - Analytical balance and its reliability of measurements.
- 2. Titrimetric Methods :** [06 Hrs.]
  - Fundamentals of titrimetric analysis
  - Calculations of titrimetric analysis
- 3. Acid-Base Titration:** [06 Hrs.]
  - Neutralization theory & Neutralization methods
  - Theory of Indicators
- 4. Redox Titrations I:** [07 Hrs.]

Titrations involving oxidation with -

  - Potassium permanganate,
  - Potassium dichromate,
- 5. Redox Titration II:** [07 Hrs.]
  - Ceric Ammonium Sulphate,
  - Iodimetry and Iodometry.
- 6. Precipitation Titrations:** [06 Hrs.]
  - Theory and applications of Volhard's & Mohr's methods
  - Adsorption indicators.
- 7. Complexometric Titrations:** [06 Hrs.]
  - Stability constant
  - Metal-ion indicators
  - Types of EDTA - titrations with applications in Pharmaceuticals.

### Books Recommended:

1. Ayers: "Quantitative Chemical Analysis," 2<sup>nd</sup> ed., (Harper International ed.), Harper & Row, 1969.
2. Beckett & Stenlake: "Practical Pharmaceutical Chemistry," Part - I, 4<sup>th</sup> ed., (1<sup>st</sup> Indian ed.-Reprint), CBS Publishers & Distributors, 1999.
3. Vogel: "A Text-Book of Quantitative Inorganic Analysis (including Elementary Instrumental Analysis)," 3<sup>rd</sup> ed., ELBS-Longman, 1973.
4. Jeffery et al.: "Vogel's Text Book of Quantitative Chemical Analysis," 5<sup>th</sup> ed.(Reprint), ELBS, 1996.

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## CH 2203: ENVIRONMENTAL SCIENCE

### Module I

**Introduction to Environment Pollution:** Environmental Awareness, concept of an ecosystem, structure and function of an ecosystem, energy and nutrient flow biogeochemical cycle, sources, pathways and fate of environmental pollutants. [5]

### Module II

**Air Pollution:** Composition, major sources of air pollution, their detrimental effects, stationary emission sources, some control methods, eg. cyclon separators, wet scrubbers electrostatic precipitators etc.  
Automobile emission control, smog green house effect, ozone depletion, global warming and acid rains etc. [8]

### Module III

**Water Pollution:** Water resources, sources of water pollution, various pollutants their detrimental effects.  
Portability limits as per WHO & PHED specification, treatment of municipal supply water, slow sand filters, rapid sand filter, disinfections, their advantage & disadvantages, break chlorination. [6]

### Module IV

**Industrial Water:** Specification for boiler feed water, internal and external treatment, ion exchange electro dialysis and revers osmosis. [5]

### Module V

**Sewage Treatment:** Composition aerobic & anaerobic treatment, chemical & biological oxygen demand. [5]

### Module VI

A brief Introduction to Noise Pollution & Radioactive Pollution. [3]

### Module VII

Soil pollution and solid waste management. [3]

### Book Recommended:

De. A.K. Environmental Chemistry, Willey Eastern Ltd.  
Miller T. G. Jr. Environmental Science, Wadsworth Publishing House, Meerut  
Odum E.P. 1971. Fundamental of Ecology. W.B. Saunders Co. U.S.A.

### Total contact hours: 35

#### Text books:

1. Applied Chemistry: A text book for engineers technologists, H.D. Gasser, Plenum Publisher.
2. Inorganic Chemistry: J.D. Lee
3. Enginnering Chemistry: Sashi Chawla, Jain & Jain

#### References books:

1. Fundamental of Molecular spectroscopy: C.N. barnwell, TMH Publication.
2. Physical Chemistry: P.W. Atkins

## **CS 1051: FUNDAMENTALS OF COMPUTER SCIENCE (1 UNIT)**

**Module 1: Computer Basics** – Algorithms, Model of a Computer, Characteristics of Computers, Problem Solving using computers.

**Module2: Data Representation** – Representation of characters in computers, Representation of integers, Representation of fractions, Hexadecimal representation of numbers, Decimal to Binary conversion, Error detecting codes.

**Module3: Input /Output units** – Description of Input units, Other input methods, Computer Output units.

**Module4: Computer Memory** – Memory cell, Memory Organization, Read Only Memory, Serial Access Memory.

**Module 5: Binary Arithmetic-** Binary Addition, Binary Subtraction, Signed numbers, 2's compliment representation of numbers, Addition & Subtraction of numbers in 2's compliment notation , Floating-point representation of numbers.

**Module 6: Logic Circuits** - Introduction, Switching circuits, AND/ OR operations, NOT operation, Boolean Functions, Postulates, Duality Principle, Theorems, Precedence of operators.

**Module7: Operating Systems** – Need for an Operating System, Batch Operating System, Multiprogramming Operating System, Time Sharing Operating System, Personal Computer Operating System, UNIX Operating System, Microkernel based Operating System, On-Line and Real-Time systems.

**Generation of Computers-** First Generation, Second Generation, Third Generation, Fourth Generation, Fifth Generation.

Classification of Computers, Distributed Computer System, Parallel Computers.

**Text Book:** Fundamentals of Computer- V.Rajaraman, PHI Publication, 5<sup>th</sup>. Edition

## **MA 1103: MATHEMATICAL PRACTICE**

Actual classroom practice of numerical on the topics covered under Remedial Mathematics.

## PS 1302: REMEDIAL BIOLOGY LAB.

1. Morphology of plant parts (covered in theory).
2. Section Cutting: T.S. of leaf, stem, tubers, etc.
3. Demonstration of different stages of Mitosis and Meiosis.
4. Digestive Systems of frog & cockroach
5. Study of the different systems- skeletal, muscular, etc.
6. Study of different organs like liver, lungs, heart, eyes, ears, etc.

## PS 1304: PHARMACEUTICAL CHEMISTRY LAB. - I

Experiments based on –

- Physicochemical properties of organic compounds  
(Selected group of classes)
- Detection of elements  
(Nitrogen, Sulphur & Halogens)
- Functional group analysis.  
(7 – 8 functional)

List of Experiments:

1. Preliminary examination of organic compounds: Solids & Liquids.
2. Grouping of organic compounds based on solubility division.
3. Detection of (N,S,Cl,Br & I) in the given organic compounds.
4. Determination of melting & boiling point in the given organic samples.
5. Functional group analysis in the given organic compounds for –COOH group and Phenolic (-OH) groups.
6. Functional group analysis for Alcoholic –OH group.
7. Functional group analysis for CHO group.
8. Functional group analysis for NH<sub>2</sub> group.
9. Functional group analysis for Ketone.
10. Functional group analysis for Carbohydrate.
11. a. Distinguish between Primary, Secondary, Tertiary Amines.  
b. Aliphatic & Aromatic Amines.
12. Distinguish between Primary, Secondary, Tertiary Alcohols.

### Books Recommended :

1. Mann & Saunders: "Practical Organic Chemistry," 4<sup>th</sup> ed. (New Impression with Revision -1<sup>st</sup> Indian ed.), Orient Longman, 1986.
2. Vogel: "A Text Book of Practical Organic Chemistry (including Qualitative Organic Analysis)," 3<sup>rd</sup> ed., ELBS, 1975.
3. Furniss et al.: "Vogel's Text Book of Practical Organic Chemistry," 5<sup>th</sup> ed., (Reprint), ELBS, 1996.

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## PS 1306: PHARMACEUTICAL ANALYSIS LAB. – I

Experiments involving-

- Acidimetry, and
- Alkalimetry

with special reference to Pharmaceutical compounds.

List of Experiments:

1. Handling of Analytical balance and calibration of fractional weights.
2. Preparation and Standardization of 0.1 N Sodium Hydroxide Solution.
3. Preparation and Standardization of 0.1 N Hydrochloric Acid Solution.
4. Assay of Sodium Hydroxide I.P.
5. Assay of Acetic Acid Glacial I.P.
6. Assay of Sodium carbonate I.P.
7. Assay of Sodium bicarbonate I.P.
8. Assay of Phosphoric acid I.P.
9. Estimation of Carbonate and Hydroxides in the given sample solution.
10. Estimation of Carbonate and Bicarbonate in the given sample solution.

### Books Recommended :

1. Beckett & Stenlake: "Practical Pharmaceutical Chemistry," Part - I, 4<sup>th</sup> ed., (1<sup>st</sup> Indian ed.-Reprint), CBS Publishers & Distributors, 1999.
2. Vogel: "A Text-Book of Quantitative Inorganic Analysis (including Elementary Instrumental Analysis)," 3<sup>rd</sup> ed., ELBS-Longman, 1973.
3. Jeffery et al.: "Vogel's Text Book of Quantitative Chemical Analysis," 5<sup>th</sup> ed. (Reprint), ELBS, 1996.
4. Controller of Publications: "Indian Pharmacopoeia," 1985. 1996.

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## II. B. PHARM. : 2<sup>ND</sup> SEMESTER

### MA 2103: MATHEMATICS - I

1. **Integral Calculus:** (15L)
  - Integration as the inverse process of differentiation,
  - Integration by the methods of substitution, by parts and by partial fractions,
  - The definite integrals and their simple applications to area, length of curves, volume and surface of revolution.
2. **Differential Equations:** (15L)
  - First - order Ordinary Differential Equations, Equations of first order and first degree, Equations with separable variables, Homogeneous, Linear and exact equations,
  - Second - order linear equations with constant coefficients,
  - Simple applications in growth and Decay problems, etc.
3. **Laplace transforms:** (10L)
  - Definition, Transforms of elementary functions,
  - Properties of linearity and shifting,
  - Inverse laplace transforms, transforms of derivatives,
  - Solution of ordinary and simultaneous differential equations.

#### **Books Suggested :**

1. Das and Mukherjee : "Integral Calculus," U.N. Dhar Publications
2. Schaum: "Differential Equations," McGraw Hill
2. Sueddon : "The Use of Integral Transforms," Tata McGraw Hill
3. Grewal : "Higher Engineering Mathematics," Khanna Publishers.

## PS 2301: PHARMACEUTICS

- I. HISTORICAL BACKGROUND :** (6 hrs)
- 1. Indian Pharmacy-**
    - Origin & Development: with special reference to Charaka Samhita, Sushruta Samhita & Bower's Manuscript,
    - Literature of Iatro –chemical period from the Pharmaceutical Development viewpoint.
  - 2. European & American Pharmacy-**  
Origin and Development in brief.
  - 3. Official Compendia-**
    - Historical Background & Developments,
    - Importance with special reference to IP/BP/USP.
- II. PHARMACEUTICAL CALCULATIONS:** (12 hrs)
- Avoirdupois & Apothecaries' Systems of Weights & Measures,
  - Calculations of Doses in Pediatrics & Geriatrics,
  - Percentage Calculations (including parts per million – ppm),
  - Proportions & Alligations,
  - Proof strengths & Electrolyte solutions ( mEq, mM, mOsm),
  - Calculations on Extracts.
- III. PHARMACEUTICAL DOSAGE FORMS:** (12 hrs)
1. Classification & Definitions (Covering Pharmacopoeial & Marketed Products).
  2. Principles involved in the Preparation of the followings-
    - i) Aromatic Waters,      ii) Spirits,
    - iii) Solutions (including Mouthwashes, Gargles, Douches, Enema, and Collodions),
    - iv) Syrups,      v) Elixirs,
    - vi) Mucilages,      vii) Magmas,
    - viii) Glycerites,      ix) Lotions,
    - x) Liniments,      xi) Extractives.
- IV. GALENICALS:** (10 hrs)
1. Extraction of Active Constituents from Vegetable Drugs-
    - i) Principles & Theory of Extraction.
    - ii) Size Reduction ( in the light of Extraction Requirements)-
      - Objectives,
      - Factors influencing Size Reduction,
      - Mechanisms of Size Reduction & Methods used,
      - Selection of Size Reduction Technique,
      - Choice of Degree of Size Reduction.
    - iii) Size Separation –
      - Powder Grades / Standards,
      - Standardization of Powders (Sieves, Sieve Standards & Sieving Methods).
    - iv) Choice of Solvents for Extraction
    - v) Extraction Processes -
      - Infusion,
      - Decoction,
      - Digestion,
      - Maceration,
      - Percolation, etc.
  2. Finishing, Packaging & Storage of Extractives
  3. Compendial Products (covering a few examples of each extractive type)

**Books Recommended:**

1. Srivastava: "History of Indian Pharmacy," 2<sup>nd</sup> ed., 1954,
2. Harkishan Singh: "History of Pharmacy," Vol. I (Pharmacopoeias & Formularies), Vallabh Prakashan, 2001.
3. Controller of Publications: "Indian Pharmacopoeia," 1966 1985, 1996 & Addendum 2000.
4. Her Majesty's Stationery Office: "British Pharmacopoeia," University Press, Cambridge, 1980, 1988, 1993.
5. "United States Pharmacopoeia," XXI (1985), XXIII NFXVIII (1995).
6. "International Pharmacopoeia," Vol. 5, 3<sup>rd</sup> ed., WHO, 2003.
7. "European Pharmacopoeia,"
8. Lund, Ed.: "The Pharmaceutical Codex – Principles & Practice of Pharmaceutics," 12<sup>th</sup> ed., The Pharmaceutical Press, 1994.
9. Gennaro et al., Eds. : "Remington's The Science & Practice of Pharmacy," 20<sup>th</sup> ed., Lippincott Williams & Wilkins, 2000.
10. Rawlins, Ed. : "Bentley's Textbook of Pharmaceutics," 8<sup>th</sup> ed. (Reprint), Bailliere Tynhall, 2002.
11. Carter, Ed.: "Cooper & Gunn's Tutorial Pharmacy," 6<sup>th</sup> ed., CBS Publishers, 1972.
12. Carter, Ed.: "Cooper & Gunn's Dispensing for Pharmaceutical Students," 12<sup>th</sup> ed., CBS Publishers, 1987.
13. Martin, Ed.: "Dispensing of Medication," Mack Publishing Company, 1972.
14. Stoklosa & Ansel: "Pharmaceutical Calculations," 10<sup>th</sup> ed., Waverly, 1996.
15. Zatz : "Pharmaceutical Calculations," 2<sup>nd</sup> ed., John Wiley, 1981.
16. Ansel : "Introduction to Pharmaceutical Dosage Forms," 3<sup>rd</sup> ed., Lea & Febiger, 1981.
17. Ansel et al. : "Pharmaceutical Dosage Forms & Drug Delivery Systems," 7<sup>th</sup> ed., Lippincott Williams & Wilkins, 2000.
18. Collett & Aulton, Eds. : "Pharmaceutical Practice," ELBS, 1991.
19. Aulton, Ed.: "Pharmaceutics – The Science of Dosage Form Design," ELBS, 1990.
20. Sahu : "The Technology of Preparation & Distribution of Drugs & Cosmetics," 1st ed., Kislal Book House, 1990.



## PS 2303: PHARMACEUTICAL MICROBIOLOGY

1. **Introduction to the Scope of Microbiology.** (1L)
2. **Structure of Bacterial Cell.** (3L)
3. **Classification of Microbes and their Taxonomy-** (4L)  
Actinomycetes, bacteria, rickettsia, spirochetes and virus.
4. **Growth and Nutrition of Bacteria:** (4L)
  - Growth curve, generation time
  - Bacterial nutrition, culture media and their common ingredients
  - Physical factors affecting growth of bacteria.
5. **Identification of Microbes:** (6L)
  - Staining Techniques-simple and differential techniques
  - Bacterial reproduction and spores.
  - Identification of Bacteria (Biochemical test and screening strategies)
6. **Maintenance of Laboratory Organisms :** (3L)
  - Isolation of pure culture
  - Permanent and working stock preparations.
7. **Microbial Genetics and Variations.** (4L)
8. **Control of Microbes by Physical and Chemical Methods :** (8L)
  - i. Disinfection -
    - Disinfectants, factors influencing activity of disinfectants, dynamics of disinfection
    - Antiseptics & their evaluation (Chick Martin test, Rideal Walker test)
  - ii. Sterilization\_-
    - Sterilization methods
    - Validation of sterilization methods and equipments.
9. **Sterility Testing of Pharmaceuticals.** (3L)
10. **Microbial Assays :** (3L)  
Antibiotics, Vitamins and Amino acids.

### Books Recommended:

1. Pelczar et al.: "Microbiology," 5<sup>th</sup> ed., Tata McGraw Hill, 1993.
2. Hugo & Russel: "Pharmaceutical Microbiology," 1<sup>st</sup> ed., Blackwell Scientific Publication, 1977.
3. Controller of Publications: "Pharmacopoeia of India," 4<sup>th</sup> ed., Vol. I & II, 1996.
4. Purohit: "Microbiology," 6<sup>th</sup> ed., Agrobios, 2002.
5. Aulton ,Ed.: "Pharmaceutics-The Science of Dosage Form Design," ELBS, 1990.
6. Collett & Aulton, Eds.: "Pharmaceutical Practice," 1<sup>st</sup> ed., ELBS, 1991.
7. Stanier and Ingraham: "General Microbiology," Wheelis & Painter,
8. "Berger's Manual of Determinative Bacteriology,"
9. Brock & Madigen: "Biology of Microorganism," Prentice Hall,
10. Salle: "Fundamentals and Principles of Bacteriology,"

## PS2305: PHARMACEUTICAL CHEMISTRY-II

The treatment should be done on the basis of modern physico-chemical aspects including nomenclature, methods of preparation and properties-

- 1. Aldehyde and Ketones:** [06 Hrs.]
  - Preparation
  - Nucleophilic-addition reactions
  - Cannizzaro's reaction, Carbanions, Aldol condensation
  - Wittig's- and Reformatsky- reactions.
  
- 2. Carboxylic Acids and their Derivative:** [06 Hrs.]
  - Nomenclature, structure and physical properties
  - Acidity, effect of substituents on acidity preparation oxidation methods
  - Grignard's synthesis, properties, alpha halogenations of acids.
  - Acid chlorides, amides, esters & anhydrides
  - Nomenclature, synthesis
    - Nucleophilic substitution. comparison of nucleophilic reaction of aldehydes and ketones with that of acid derivatives
  - Nucleophilic substitution - alkyl vs. acyl
  - Kinetics of hydrolysis of esters by alkali and acids.
  - Transesterification, reactions of ester with Grignard's reagent.
  
- 3. Amines:** [06 Hrs.]

General- Nomenclature, classification, industrial sources, Physical properties, Stereochemistry of nitrogen preparation of aliphatic and aromatic amines- amination, reductive amination, Hoffmann's Bromamide reaction, 1, 2-shifts, reductive methods of preparation of amines.

  - i. Basicity of aliphatic and aromatic amines - effect of substituents on basicity of amines, conversion to amides. Hinsberg's method of separation of amines and ring substitution of aromatic amines, reaction with nitrous acids. Hoffmann's elimination and its usefulness.
  
  - ii. Diazonium salts - reaction of Diazonium salts, Sandmeyer's reaction, synthesis using diazonium salts, coupling, azo compounds, reduction & oxidation products of azo compounds. Benzedine rearrangement reaction.
  
- 4. Phenols:** [04 Hrs.]
  - Structure, nomenclature, physical properties
  - Industrial sources and methods of preparation
  - Reactions-acidity of phenols, ether formation, ester formation, sulfonation, halogenation, Friedel-Crafts alkylation Friedel-Craft acylation, Fries rearrangement, nitrosation, Carbonation, Reimer-Tiemann reaction, reaction with formaldehyde.

- 5. Aryl Halides:** [04 Hrs.]
- Structure, Nomenclature, physical properties
  - Industrial sources, preparation from diazonium salts, halogenation reaction, formation of Grignard's reagent
  - Electrophilic substitution, nucleophilic substitution, lower reactivity of aryl halides
  - Bimolecular displacement reaction mechanism
  - Elimination addition mechanism in aromatic halides involving BENZYNE transition intermediate.
- 6. Alpha- and Beta- Unsaturated Carbonyl containing Compounds, Malonic Esters and Acetoacetic Esters:** [06 Hrs.]
- a. Interactions of functional groups
  - b. Electrophilic and nucleophilic addition with special reference to the mechanism of Michael's addition
  - c. Introduction to Diel Alder's reaction.
  - d. Synthesis and Properties
  - e. Applications in organic synthesis.
- 7. Conservation of Orbital Symmetry and Rules:** [04 Hrs.]
- a. Electrocyclic, Cycloaddition and sigmatropic reactions; Neighbouring group effects
  - b. Catalysis by transition metal complexes
  - c. Stereoselective and Sterospecific reactions
  - d. New organic reagents used in drug synthesis.

**Books Recommended:**

1. Morrison & Boyd: "Organic Chemistry," 6<sup>th</sup> ed. (20<sup>th</sup> Indian Reprint), Prentice-Hall, 1999.
2. Finar : "Organic Chemistry," Vol.1 (The Fundamental Principles), 6<sup>th</sup> ed. (Reprint), ELBS Longman, 1997.
3. Finar : "Organic Chemistry," Vol.2 (Sterochemistry & The Chemistry of Natural Products), 5<sup>th</sup> ed.(1<sup>st</sup> Indian Reprint), ELBS Longman- Pearson Education Asia Pte. Ltd., 2000.

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## PS2307: PHARMACEUTICAL ANALYSIS – II

Theoretical considerations and applications (in drug analysis and quality control) of the following analytical techniques-

### 1. Gravimetric Analysis:

[06 Hrs.]

- Precipitation methods involving gravimetry
- Purity of the precipitate, co-precipitation, post precipitation
- Washing and ignition of precipitates, fractional precipitation, organic precipitation.

### 2. Non-aqueous Titrations :

[06 Hrs.]

- Titrations of acidic and basic substances in Non-aqueous solvents
- Acidimetry and Alkalimetry in non-aqueous solvents with special reference to Pharmacopoeial compounds.

### 3. Quantitative Elemental Analysis : Nitrogen, Halogens, Sulphur, Oxygen and Phosphorus.

[04 Hrs.]

**Quantitative Functional Groups Analysis :** alcoholic & phenolic hydroxyl, amino, Carboxylic, aldehydes and ketone groups.

[04 Hrs.]

### 4. Oils and Fats Analysis :

[06 Hrs.]

- Introduction to Oils and Fats
- Acid value, acetyl value, saponification value, ester value and iodine value.
- Determination of unsaponifiable matter.

### 5. Moisture Analysis :

[04 Hrs.]

Preparation, standardization and application of Karl-Fischer's reagent.

### 6. Chromatography:

[06 Hrs.]

- Introduction and classification
- TLC, Paper and Column Chromatography.
- Introduction to Instrumental Chromatography

### Books Recommended:

1. Beckett & Stenlake: "Practical Pharmaceutical Chemistry," Part - I, 4<sup>th</sup> ed., (1<sup>st</sup> Indian ed.-Reprint), CBS Publishers & Distributors, 1999.
2. Vogel: "A Text-Book of Quantitative Inorganic Analysis (including Elementary Instrumental Analysis)," 3<sup>rd</sup> ed., ELBS-Longman, 1973.
3. Jeffery et al.: "Vogel's Text Book of Quantitative Chemical Analysis," 5<sup>th</sup> ed.(Reprint),ELBS, 1996.
4. Furniss et al.: "Vogel's Text Book of Practical Organic Chemistry," 5<sup>th</sup> ed. (Reprint), ELBS, 1996.

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## PS 2309: HUMAN ANATOMY, PHYSIOLOGY & HEALTH EDUCATION – I

1. **Osseous system:** (5L)
  - Structure, composition and functions of Skeleton,
  - Classification of joints, types of movements of joints, disorders of joints,
2. **Muscular System** (4L)
  - Gross anatomy & physiology of muscle contraction,
  - Properties of skeletal muscles and their disorders.
3. **Haemopoietic System:** (6L)
  - Composition and functions of Blood and its elements & their disorders,
  - Blood groups and their significance,
  - Mechanism of coagulation, disorders of platelets and coagulation.
4. **Lymph and Lymphatic System:** (4L)
  - Composition, formation and circulation of Lymph, disorders of Lymph and Lymphatic system,
  - Basic physiology and functions of spleen.
5. **Cardiovascular System:** (8L)
  - Physiology of Heart, blood vessels and circulation, Cardiac cycle, heart sounds, ECG,
  - Blood pressure and its regulation,
  - Brief outline of Cardiovascular disorders like Hypertension, Hypotension, Arteriosclerosis, Angina, Myocardial Infarction, Congestive heart failure and Cardiac arrhythmias.
6. **Digestive System:** (7L)
  - Gross anatomy of GIT,
  - Functions of Liver, Pancreas and Gall bladder,
  - GI- secretions and their role in the absorption and digestion of food,
  - Disorders of Digestive system.
7. **Respiratory System:** (6L)
  - Anatomy of Respiratory organs and their functions,
  - Mechanism and regulation of Respiration, Respiratory volumes and vital capacity,
  - Various disorders of Respiratory system.

### **Books Recommended :**

1. Best & Taylor: "Best and Taylor's Physiological Basis of Medical Practice," William & Wilkins: Baltimore.
2. Chaurasia: "Human Anatomy - Regional & Applied." Part I, II, III, CBS Publishers & Distributors, New Delhi.
3. Chatterjee: "Human Physiology", Vols I & II, Medical Allied Agency, Calcutta.
4. Shalya: "Human Physiology", CBS Publishers & Distributors.
5. Edwards: "Davidson's Principles and Practice of Medicine", ELBS/ Churchill Livingstone.
6. Ganong: "Review of Medical Physiology", Prentice Hall International.
7. Guyton & Hall: "Textbook of Medical Physiology", WB Saunders Company.
8. Keele et al.: "Samson Wright's Applied Physiology", Oxford University Press.
9. McNaught & Callander: "Illustrated Physiology", Churchill Livingstone.
10. Parmer: "Health Education and Community Pharmacy," CBS Publishers.
11. Tortora & Anagnostokos: "Principles of Anatomy and Physiology," Harper and Row Publishers N.Y.
12. Vander et.al.: "Human Physiology," Tata Mcgraw Hill Publishing Co.,

## PS 2302: PHARMACEUTICS LAB.

Preparation of Pharmacopoeial Products representing different dosage forms:

- I. Aromatic Waters** (Atleast one product to illustrate each method of preparation) :
    1. Chloroform water IP'66 (Solution method)
    2. Camphor water IP'66 (Alternative Solution method using Alcohol)
    3. Peppermint water BP (Alternative Solution method using Talc)
    4. Concentrated Dill water IP'66 (using Co-solvent)
    5. Dill water IP'66 (Dilution method)
  - II. Spirits (Flavoured & Medicated) :**
    6. Chloroform Spirit IP'66
    7. Aromatic Spirit of Ammonia NF
  - III. Solutions:**
    8. Aqueous Iodine Solution IP'66
    9. Weak Iodine Solution IP'66
    10. Strong Iodine Solution IP'66
    11. Cresol with soap Solution IP'66
  - IV. Mucilages :**
    12. Acacia mucilage IP'66
    13. Tragacanth mucilage IP'66
  - V. Syrups (Simple, Flavoured & Medicated):**
    14. Simple Syrup IP'66
    15. Orange / Lemon Syrup IP'66
    16. Codeine Phosphate Syrup BP'88
  - VI. Elixirs:**
    17. Paediatric Chloral Elixir BP'88
  - VII. Linctus:**
    18. Simple Linctus BP'88
    19. Codeine Phosphate Linctus (Paediatric) BPC
  - VIII. Magmas:**
    - 20 Milk of Magnesia BPC.
    - 21 Bentonite Magma NF.
  - IX. Glycerites:**
    - 22 Borax Glycerin IP'66
    - 23 Phenol Glycerin IP'66
  - X. Others:**
    - 24 Calamine Lotion IP'66
    - 25 Non-staining Iodine ointment with Methyl salicylate BPC
    - 26 Liniment of Turpentine IP'66
    - 27 Orange Tincture / Lemon Tincture IP'66
- Books Recommended:**
3. Dixit et.al.: "Practical Pharmaceutics," Part II, Pragati Prakashan, 1986.
  4. Ansel : "Introduction to Pharmaceutical Dosage Forms," 3<sup>rd</sup> ed., Lea & Febiger, 1981.
  5. Controller of Publications: "Indian Pharmacopoeia," 1966.
  6. Her Majesty's Stationery Office: "British Pharmacopoeia," University Press, Cambridge, 1988.
  7. "United States Pharmacopoeia," XXI (1985), XXIII NFXVIII (1995).
  8. Lund, Ed.: "The Pharmaceutical Codex – Principles & Practice of Pharmaceutics," 12<sup>th</sup> ed., The Pharmaceutical Press, 1994.

## PS2304: PHARMACEUTICAL CHEMISTRY LAB - II

Experiments based on –

- Synthesis of organic compounds involving one step reaction, and
- Their identification by physico-chemical methods.

List of Experiments:

1. Preparation of Benzyl alcohol and Benzoic acid from Benzaldehyde.
2. Preparation of Aspirin from Salicylic acid.
3. Preparation of Nitrobenzene from Benzene.
4. Preparation of Aniline from Nitrobenzene.
5. Preparation of Glucosazone from Glucose.
6. Preparation of Benzylidene aniline from Benzaldehyde.
7. Preparation of Benzoic acid from Benzyl chloride.
8. Preparation of Acetanilide from Aniline.
9. Preparation of Phenol from Aniline.
10. Use of Stereo models.

### Books Recommended:

1. Mann & Saunders: "Practical Organic Chemistry," 4<sup>th</sup> ed. (New Impression with Revision, 1<sup>st</sup> Indian Reprint), Orient Longman, 1986.
2. Vogel: "A Text Book of Practical Organic Chemistry (including Qualitative Organic Analysis)," 3<sup>rd</sup> ed., ELBS, 1975.
3. Furniss et al.: "Vogel's Text Book of Practical Organic Chemistry," 5<sup>th</sup> ed., (Reprint), ELBS, 1996

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## PS2306: PHARMACEUTICAL ANALYSIS LAB – II

Experiments involving –

- Redox titrations,
  - Precipitation titrations, and
  - Gravimetric Analysis
- with special reference to Pharmacopoeial products.

List of Experiment:

1. Preparation and Standardization of 0.1 N Potassium Permanganate Solution.
2. Assay of Ferrous Sulphate I.P.
3. Preparation and Standardization of 0.1 N Sodium Thiosulphate Solution.
4. Assay of Copper Sulphate I.P.
5. Preparation and Standardization of 0.1 N Iodine Solution.
6. Preparation and Standardization of 0.1 N Silver Nitrate Solution.
7. Assay of Sodium Chloride I.P.
8. Preparation and Standardization of 0.1 N Ammonium Thiocyanate Solution.
9. Assay of Sodium Sulphate I.P.
10. Assay of Potassium Permanganate I.P./B.P.

### Books Recommended:

1. Beckett & Stenlake: "Practical Pharmaceutical Chemistry," Part - I, 4<sup>th</sup> ed., (1<sup>st</sup> Indian ed.-Reprint), CBS Publishers & Distributors, 1999.
2. Vogel: "A Text-Book of Quantitative Inorganic Analysis (including Elementary Instrumental Analysis)," 3<sup>rd</sup> ed., ELBS-Longman, 1973.
3. Jeffery et al.: "Vogel's Text Book of Quantitative Chemical Analysis," 5<sup>th</sup> ed. (Reprint), ELBS, 1996.
4. Vogel: "A Text-Book of Practical Organic Chemistry (including Qualitative Organic Analysis)," 3<sup>rd</sup> ed., ELBS-Longman, 1975
5. Furniss et al.: "Vogel's Text Book of Practical Organic Chemistry," 5<sup>th</sup> ed. (Reprint), ELBS, 1996

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## **CS 2052 : PROGRAMMING USING C LANGUAGE(1.0 UNIT)**

Module – I

Problem solving using Algorithms and Flow Charts, Basic Structure and execution of C Programmes.

Module-II

Module-III

Module-IV

Module-V

Module-VI & VII



### **III. B. PHARM. : 3<sup>RD</sup> SEMESTER**

#### **PS 3102: MATHEMATICS -II**

- 1. Biometrics :** (20L)
- Definition of data. Data organization, diagrammatic representation of data, bar, Pie, 2-D and 3-D diagrams.
  - Measures of central tendency, measures of dispersion, standard deviation,
  - Coefficient of variation, kurtosis, skewness,
  - Correlation and regression analysis, method of least squares, statistical inference.
  - Probability and Events-Bayes's Theorem, Probability Theorems, Probability distributions.
  - Elementary ideas of binomial, Poisson and normal distribution.
  - Student's and paired t-test, F-test, elements of ANOVA.
  - Applications of Biometrics to Pharmaceutical Sciences.
- 2. Numerical Analysis:** (20L)
- Numerical solutions of simple algebraic and transcendental equations by Graphical and Newton-Raphson methods
  - Interpolation-Newton's forward and backward interpolation formula
  - Numerical differentiation & Integration by Trapezoidal and Simpson's 1/3<sup>rd</sup> rule
  - Solution of system of simultaneous linear equations by Gauss-Seidal Method

**Books Suggested :**

1. Bolton: "Pharmaceutical Statistics – Practical and Clinical Applications," 3<sup>rd</sup> ed., Marcel and Dekker,
2. Daniel: "Biostatistics – A Foundation for Analysis in Health Sciences," Willey,
3. Gupta and Kapoor : "Mathematical Statistics,"
4. Raju and Muthu : "Numerical Methods for Engineering Problems," Macmillan India Ltd.

## PS 3301: PHYSICAL PHARMACEUTICS

- I. STATES OF MATTER (6 hrs)
- 1. Intermolecular Forces**
  - 2. Gaseous State:**
    - i. Kinetic Molecular Theory & Molecular Weight
    - ii. Ideal Gas Law & vander Waals equation for Real Gases.
  - 3. Liquid State:**
    - i. Liquefaction of Gases- Theory & Methods
    - ii. Aerosols
    - iii. Vapour Pressure of liquids-
      - Clausius Clapeyron equation & Heat of Vaporization
      - Boiling Point.
  - 4. Solid State:**
    - i. Melting & Heat of Fusion
    - ii. Polymorphism
    - iii. Amorphous Solids.
  - 5. Liquid-Crystalline State:**
    - i. Structure & Properties
    - ii. Pharmaceutical Significance.
- II. PHASE EQUILIBRIA (6 hrs)
- 1. Phase Rule** in the light of Condensed Isothermal Systems.
  - 2. Two-Component Systems:**
    - i. Liquid-Liquid Systems & Critical Solution Temperatures (CST)
    - ii. Solid-Solid Systems:
      - Eutectics
      - Molecular Compounds
      - Solid Solutions.
  - 3. Three-Component Systems:**
    - i. Ternary Phase Diagram (TDP)
    - ii. One-, Two-, & Three- Pairs of Partially- Miscible liquids
    - iii. Interpretation of TPDs of Cosolvent- & Surfactant- based Pharmaceutical Products & their Importance.
- III. BUFFER SYSTEMS (6 hrs)
- 1. Buffer Equations:**
    - i. pH of Buffer Solution as influenced by Ionic Strength (including Common-ion Effect)
    - ii. Factors Influencing pH of Buffer Systems
    - iii. Drugs as Buffers.
  - 2. Buffer Capacity:**
    - i. Approximate & Actual Calculations
    - ii. Influence of Concentration
    - iii. Maximum Buffer Capacity
    - iv. Universal Buffer in the light of Titration Curves.
  - 3. Buffers in Pharmaceutical & Biological Systems:**
    - i. *In-Vitro* Biological Buffer Systems
    - ii. Pharmaceutical Buffers & their Preparation
    - iii. Influence of pH & Buffer Capacity on:
      - Tissue irritation

- Solubility
- Stability
- Optimum Therapeutic Response.

**IV. ISOTONIC SOLUTIONS** (5 hrs)

- 1. Isotonicity value**
- 2. Methods of adjusting Tonicity and pH:**
  - i. Class I Methods -
    - Cryoscopic Method
    - Sodium Chloride - Equivalent Method.
  - ii. Class II Methods -
    - White- Vincent Method
    - Sprowls Method.
  - iii. Measurement of Tonicity.

**V. INTERFACIAL PHENOMENA** (6 hrs)

- 1. Surface & Interfacial Tensions:**
  - i. Theoretical Background
  - ii. Significance in Pharmacy
  - iii. Experimental Evaluation.
- 2. Adsorption:**
  - i. Adsorption Isotherms -
    - Freundlich
    - Langmuir
    - Brunauer, Emmett & Teller (BET).
  - ii. Pharmaceutical Significance.

**VI. RED- OX PROCESSES:** (5 hrs)

- 1. Reduction / Oxidation Potential & Choice of Antioxidant**
- 2. Effect of pH on Red- Ox Potential**
- 3. Measurement of Oxidation/Reduction Potential.**

**VII. CHEMICAL KINETICS** (6 hrs)

- 1. Molecularity & Order of Chemical Reaction**
- 2. Basic Units of Rate Constants**
- 3. Reaction – Orders' Expressions:**
  - i. Zero order
  - ii. Pseudo- Zero order (Suspensions)
  - iii. First order
  - iv. Pseudo - first order
  - v. Second order.
- 4. Measurement of Reaction Order:**
  - i. Substitution Method
  - ii. Graphical Method
  - iii. Half-life Method.

(NB: Covering numerical wherever involved).

### **Books Recommended:**

1. Bahl & Tuli: "Essentials of Physical Chemistry," S. Chand & Co.
2. Mee: "Physical Chemistry," 6<sup>th</sup> ed., ELBS, 1971.
3. Atkins & de Poule: "Atkins Physical Chemistry," 7<sup>th</sup> ed., Oxford University Press, 2002.
4. Rackshit : "Physical Chemistry," 6<sup>th</sup> ed., Gayatri Rackshit, 2001.
5. Carstensen: "Theory of Pharmaceutical Systems," Vol. I (General Principles), Academic Press, 1972.
6. Carstensen: "Theory of Pharmaceutical Systems," Vol. II (Heterogeneous Systems), Academic Press, 1973.
7. Carstensen: "Pharmaceutics of Solids & Solid Dosage Forms," Wiley Inter-science, 1977.
8. Gennaro et al., Eds. : "Remington's The Science & Practice of Pharmacy," 20<sup>th</sup> ed., Lippincott Williams & Wilkins, 2000.
9. Martin: "Physical Pharmacy," 4<sup>th</sup> ed., Waverly, 1993.
10. Florence & Attwood: "Physicochemical Principles of Pharmacy," 3<sup>rd</sup> ed., MacMillan Press, 1998.
11. Banker & Rhodes, Eds. : "Modern Pharmaceutics," 3<sup>rd</sup> ed. (Revised & Expanded), Marcel Dekker (DPS Vol. 72), 1996.
12. Aulton, Ed.: "Pharmaceutics – The Science of Dosage Form Design," 2<sup>nd</sup> ed., Chirchill Livingstone, 2002.

## PS 3303: PHARMACY PRACTICE – I (PRESCRIPTION PHARMACY)

- I. PRESCRIPTION :** (4hrs)
1. Definition, Parts, Processing (including compounding accuracy), Pricing & Refilling
  2. Latin Terms in Common use
  3. Prescription Containers and Closures
  4. Labeling & Packaging.
- II. DISPENSING:** (14hrs)  
**Principles involved & Procedures adopted in Compounding of the following classes of extemporaneous pharmaceutical Preparations:**
1. Solid Dosage Forms -
    - Powders
    - Hard Gelatin Capsules
    - Tablet Triturates.
  1. Liquid Dosage Forms-
    - Mixtures
    - Emulsions (no details of emulsifiers & stability)
    - Lotions
    - Liniments
    - Applications
    - Throat Paints
    - Eye Drops & Lotions
    - Ear Drops
    - Gargles & Mouthwashes.
  2. Semi- Solid Dosage Forms-
    - i. Ointments & Creams--
      - Ointment Bases, their Ingredients & Compositions
      - Methods of Preparation & Evaluation
      - Compendial Examples.
    - ii. Pastes & Jellies.
    - iii. Suppositories & Pessaries.
- III. INCOMPATIBILITIES:** (12hrs)
1. Definition & Classification
  2. Identification & Handling of the following of types of Incompatibilities:
    - i. Inorganic Incompatibilities-
      - Metals & their Salts
      - Nonmetals, Acids & Alkalies
    - ii. Organic Incompatibilities-
      - Alkaloids, Purine bases, and Pyrazolone derivative
      - Surface- active agents including Quaternaries
      - Carbohydrates, Glycosides & Amino acids
      - Liquid Extracts, Anesthetics & Dyes.
- IV COMMUNITY PHARMACY:** (6hrs)
1. **Drug Stores (Retail as well as Wholesale):**
    - Organization, Structure, Design & Maintenance
    - Legal Requirements for Establishment including Categorization & Storage of Pharmaceuticals Product based on Legal Aspects of Labeling & Storage ( to be covered in Pharmaceutical- Jurisprudence)
    - Dispensing of Proprietary Products
    - Maintenance of Records.

2. **Patients' Counseling on:**
    - Rational Use of Drugs
    - Health Care Aspects.
  3. **Role of Pharmacist in Community Health -Care & Education.**
- V. **REVIEWS:** (4hrs)
- Prescription / Non –Prescription Products
  - Medical & Surgical Accessories
  - Diagnostic Aids
  - Appliances available in Market.

(NB: Covering numerical wherever involved).

**Books Recommended :**

1. Carter, Ed.: "Cooper & Gunn's Dispensing for Pharmaceutical Students," 12<sup>th</sup> ed., CBS Publishers, 1987.
2. Collet & Aulton, Eds.: "Pharmaceutical Practice," ELBS, 1991.
3. Sprowls, Ed.: "Prescription Pharmacy-Dosage Formulation & Pharmaceutical Adjuncts," 2<sup>nd</sup> ed., J.B.Lippincott Co., 1970.
4. Dittert : " Sprowl's American Pharmacy," J.B. Lippincott Co.
5. Martin: " Dispensing of Medication," Mack Publishing Co.
6. Sahu: "The Technology of Preparation & Distribution of Drugs & Cosmetics," 1<sup>st</sup> ed., Kislal Book House, 1990.
7. Aulton, Ed.: "Pharmaceutics – The Science of Dosage Form Design," ELBS, 1990.
8. Ansel et al.: "Pharmaceutical Dosage Forms & Drug Delivery Systems," 7<sup>th</sup> ed., Lippincott Williams & Wilkins, 2000.
9. Lund, Ed.: "The Pharmaceutical Codex – Principles & Practice of Pharmaceutics," 12<sup>th</sup> ed., The Pharmaceutical Press, 1994.
10. British National Formulary,
11. Hoover, Ed. : "Dispensing of Medication," Mac Publishing Co., 1976.

## PS3305: PHARMACEUTICAL CHEMISTRY-III

General discussion, nomenclature, chemistry and synthesis compounds under following categories.

- 1. Three and four membered ring with one heteroatom:** [03 Hrs]
  - Three member rings: Aziridine, Oxirane (ethylene oxide) and Thiirane (ethylene sulfide)
  - Four member ring: Azetidione (Trimethylene Imine), Oxetane (1,3-Epoxypropane) and Thietane (Trimethylene Sulfide)
- 2. Heterocyclic compounds with five membered ring (I):** [06 Hrs.]
  - Five membered rings with one heteroatom (Pyrrole, Furan, Thiophene) and fused rings systems (Indole, Isoindole, Indolizine, Cyclazine, Benzofuran, Dibenzofuran, Isobenzofuran, Thianaphthene).
- 3. Heterocyclic compounds with five membered ring (II):** [07 Hrs.]
  - Five membered rings with two heteroatoms (Imidazole, Pyrazole, Thiazole, Oxazole) and fused ring systems (Benzimidazole, Benzpyrazole, Benzothiazole, Benzoxazole).
  - Five membered rings with three heteroatoms (Triazoles)
- 4. Heterocyclic compounds with six membered ring (I):** [06 Hrs.]
  - Six membered rings with one heteroatom (Pyridine and Pyrans) and fused ring systems (Quinoline, Isoquinoline, Benzopyran, and Acridine)
- 5. Heterocyclic compounds with six membered ring (II):** [05 Hrs.]
  - Six membered rings with two heteroatoms (Pyridazine, Pyrimidine, Pyrazines, Oxazines, Thiazines) and fused ring systems (Quinazolines and others)
  - Six membered ring with three hetero atoms: Triazine.
- 6. Heterocyclic compounds with seven membered ring and Miscellaneous compounds:** [05 Hrs.]

Borepine, Azepine, Oxepine and Thiopins  
Purines, Pteridine, Phenanthridine and Phenothiazines
- 7. Polynuclear Hydrocarbons:** [04 Hrs.]

Napthalene, Anthracene and Phenanthrene

## PS 3307: HUMAN ANATOMY, PHYSIOLOGY & HEALTH EDUCATION– II

1. **Autonomic Nervous System (ANS) :** (6L)
  - Physiology and functions of the ANS
  - Mechanism of Neurohumoral transmission in the ANS.
2. **Central Nervous System:** (8L)
  - Functions of different parts of the brain and spinal cord
  - Neurohumoral transmission in central nervous system, Reflex action, EEG
  - Cranial nerves and their functions.
3. **Urinary System:** (6L)
  - Structure and functions of kidney and urinary tract
  - Physiology of urine formation and acid-base balance
  - Diseases of the urinary system.
4. **Reproductive System:** (5L)
  - Male and Female reproductive organs and their hormones
  - Physiology of menstruation, coitus and fertilization.
  - Sex differentiation, spermatogenesis & oogenesis
  - Pregnancy and its maintenance and parturition.
5. **Endocrine System:** (4L)

Basic anatomy and physiology of pituitary, thyroid, parathyroid, adrenals, pancreas, testis and ovary, their hormones and functions.
6. **Sense Organs:** (4L)

Basic anatomy and physiology of the eye (vision), ear (hearing), taste buds, nose (smell) and skin (superficial receptors).
7. **Concepts of Health & Disease:** (7L)
  - Balanced diet, Nutritional deficiency disorders, their treatment and preventions.
  - Demography and family planning: various methods of family planning.
  - Communicable disease: Brief outline, their Causative agents, modes of transmission and prevention of communicable diseases (like chicken pox, measles, influenza, diphtheria, tuberculosis, poliomyelitis, malaria, leprosy, AIDS, syphilis, gonorrhoea ).
  - First aid: emergency treatment of snake bite, burns, poisoning, fracture.

### **Books Recommended :**

1. Best & Taylor: "Best and Taylor's Physiological Basis of Medical Practice," William & Wilkins: Baltimore,
2. Chaurasia: "Human Anatomy - Regional & Applied," Part I, II, III, CBS Publishers & Distributors, New Delhi,
3. Chatterjee: "Human Physiology," Vols I & II, Medical Allied Agency, Calcutta,
4. Shalya: "Human Physiology", CBS Publishers & Distributors,
5. Edwards: "Davidson's Principles and Practice of Medicine," ELBS/ Churchill Livingstone,
6. Ganong: "Review of Medical Physiology", Prentice Hall International,
7. Guyton & Hall: "Textbook of Medical Physiology," WB Saunders Company,
8. Keele et al.: "Samson Wright's Applied Physiology," Oxford University Press,
9. McNaught & Callander: "Illustrated Physiology," Churchill Livingstone,
10. Parmer: "Health Education and Community Pharmacy," CBS Publishers,
11. Tortora & Anagnodokos: "Principles of Anatomy and Physiology," Harper and Row Publishers N.Y.,
12. Vander et.al.: "Human Physiology," Tata McGraw Hill Publishing Co., New Delhi,



## PS3309: PHYSIOLOGICAL CHEMISTRY

1. Bioenergetics: Concept of free energy, Redox potential, Electron transport system, High energy Phosphates, Oxidative phosphorylation. (4L)
2. Enzymes: Classification, Kinetics, Michaelis – Menton equation, and determination of  $K_m$  value, Mechanism of enzymes action, Inhibitors & Activators. (4L)
3. Co-enzymes: Vitamins as co-enzymes and their significance, metals as co-enzymes and their significance. (6L)
4. Carbohydrate Metabolism: Glycolysis, TCA cycle, HMP Shunt, Gluconeogenesis, Glycogenesis & Uronic acid pathway (all with their energetic), Regulation of blood sugar level, Carbohydrate metabolic disorders. (6L)
5. Lipid Metabolism: Oxidation of fatty acids,  $\beta$ -oxidation & energetic,  $\alpha$ -oxidation,  $\omega$ -oxidation, Biosynthesis of ketone bodies and their utilization, Biosynthesis of saturated and unsaturated fatty acids, control of lipid metabolism, Essential fatty acids & eicosanoids (prostaglandins, thromboxanes and leukotrienes), phospholipids and sphingolipids. Metabolism of Steroidal Vitamins. (7L)
6. Proteins & Nucleic acid Metabolism: Purines and Pyrimidines biosynthesis & degradation, Urea cycle, Creatine and Creatinine, Nitrogen balance, Diseases related with purines, pyrimidines and urea metabolism. (7L)
7. Principles of nutrition and dietetics; Diet and its significance, Minerals (Ca, P, Mg, Fe,  $Na^+$ ,  $K^+$ , Cl) & Water Metabolism. Deficiency disorders. (6L)

### Books Recommended:

1. Stryer: "Biochemistry," 4th ed., W.H. Freeman & company
2. Mussay et al.: "Harpers Biochemistry," Prentice Hall International,
3. Marlin et al.: "Harpers Biochemistry," 24th ed., Lange Medical publications
4. Lehninger: "Biochemistry," 3rd ed., Worth, CBS Publishers & Distributors
5. Conn & Stumpf: "Outline of Biochemistry," 5th ed., John Wiley & Sons.
6. Plumer: "An Introduction to Practical Biochemistry," Tata McGraw Hills,
7. Harrow & Mazur: "Text book of Biochemistry," W.B. Saunders, Philadelphia,
8. Jayaraman: "Laboratory Manual in Biochemistry," Wiley Eastern Ltd., New Delhi
9. Satyanarayana: "Biochemistry," Book & Allied (P) Ltd., Reprint.
10. Singh: "Practical Manual of Biochemistry," 4th ed., CBS Publishers & Distributors

## PS 3302: PHARMACEUTICAL MICROBIOLOGY LAB.

- 1 Preparation , Sterilization & Inoculation of Liquid media.
- 2 Preparation, Sterilization & Inoculation of Solid media
- 3 Motility test of different Microbes
- 4 Isolation of pure culture by Streak - Plate method.
- 5 Gram staining of Bacteria.
- 6 Acid-fast staining of Bacteria.
- 7 Practical applications of different techniques of Sterilization and their process validation.
- 8 Sterility testing of the given sample of Injection.
- 9 Viable count of the given sample of Bacterial cells.
- 10 Antibiotic assay of the given sample by Cup-Plate method.
- 11 Pyrogen testing of the given sample of Injection.

### **Books Recommended :**

1. Collee, Ed.: "Practical Medical Microbiology," 13<sup>th</sup> ed., Vol. 2, Churchill Livingstone, 1989.
2. Gunashekar: "A Laboratory Manual of Microbiology," New Age Int. Pvt. Ltd., 2001.
3. Pelczar et al.: "Microbiology," 5<sup>th</sup> ed., Tata McGraw Hill, 1993.
4. Hugo & Russel: "Pharmaceutical Microbiology," 1<sup>st</sup> ed., Blackwell Scientific, 1977.
5. Controller of Publications: "Pharmacopoeia of India," 4<sup>th</sup> ed., Vol I & II, 1996.

## PS3304: PHARMACEUTICAL ANALYSIS LAB. – III

- 1. Complexometric Titrations:**
  - Preparation and standardization of EDTA solution,
  - Some related experiments.
- 2. Non-aqueous Titrations:**
  - Preparation and standardization of Perchloric acid and Sodium/Potassium/Lithium methoxide solutions,
  - Some related experiments.
- 3. Analysis of Oils & Fats:**
  - Determination of Acid value,
  - Determination of Saponification value.
- 4. Functional Group Analysis:**

Estimation of groups in organic compounds-

  - Alcoholic,
  - Phenolic,
  - Amino.
- 5. Chromatography:**

Simple experiments.

### **List of Experiments:**

1. Preparation and Standardization of 0.05N Disodium EDTA Solution.
2. Determination of total hardness of water.
3. Assay of Calcium gluconate.
4. Preparation and Standardization of 0.1 N Perchloric acid.
5. Determination of the percentage of purity of Aniline by non aqueous method
6. Preparation and Standardization of 0.1 N Sodium Methoxide Solution.
7. Separation of a mixture of Amino acid by thin layer Chromatography Technique.
8. Separation of Amino acid by circular paper and paper Chromatography Technique.
9. Separation of Alkaloids by ascending and descending paper Chromatography Technique.
10. Preparation of column for column Chromatographic separation.
11. Determination of acid value of the given oil sample.
12. Determination of Saponification value of the given oil sample.
13. Determination of Acetyl value of the given oil sample.
14. Determination of Iodine value of the given oil sample.
15. Determination of Ester value of the given oil sample.
16. Estimation of Amino group present in the given sample by Acetylation Method.
17. Estimation of Phenolic hydroxyl group in the given sample by Bromate-Bromide Method.
18. Estimation of Phenolic hydroxyl group in the given sample by Acetylation Method.

### **Books Recommended:**

1. Beckett & Stenlake: "Practical Pharmaceutical Chemistry," Part - I, 4<sup>th</sup> ed., (1<sup>st</sup> Indian ed.-Reprint), CBS Publishers & Distributors, 1999.
2. Vogel: "A Text-Book of Quantitative Inorganic Analysis (including Elementary Instrumental Analysis)," 3<sup>rd</sup> ed., ELBS-Longman, 1973.
3. Jeffery et al.: "Vogel's Text Book of Quantitative Chemical Analysis," 5<sup>th</sup> ed. (Reprint), ELBS, 1996.
4. Furniss et al.: "Vogel's Text Book of Practical Organic Chemistry," 5<sup>th</sup> ed. (Reprint), ELBS, 1996.

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### **PS 3308: HUMAN ANATOMY,PHYSIOLOGY & health Education LAB.**

1. Qualitative examination of Urine.
2. Microscopical examination of Urine (Triple phosphate, Stellar phosphate, Calcium hydrogen phosphate, Calcium oxalate, Uric acid, Ammonium urate crystals).
3. Estimation of total count of RBC by Hemocytometer.
4. Estimation of total count of WBC by Hemocytometer.
5. Estimation of Differential count of WBC.
6. (a) Estimation of Hemoglobin by Sahli's method.  
(b) Hemoglobin crystal- and Hemin crystal- tests.
7. Determination of Blood Groups.
8. Estimation of Human Blood Pressure
9. Estimation of coagulation time of Whole Blood.
10. Estimation of bleeding time of Blood.
11. Estimation of Erythrocyte Sedimentation Rate (ESR).
12. Estimation of Salivary Amylase.
13. Histological slides (ovary, testis, thyroid, lungs, liver, intestine, kidneys, pancreas, skeletal muscles, and smooth muscles).
14. To study the simple Muscle curve.
15. To study the effect of load on Contraction of Muscle.
16. To study the effect of Temperature on Muscle Contraction.
17. To study the effect of two stimuli on the Muscle of Frog.
18. To study the genesis of Tetanus.
19. To study the normal heart curve on Frog's Heart.
20. To study the effect of temperature & chemicals on the Frog's Heart.

#### **Books Recommended :**

1. Ranade: "Text Book of Practical Physiology," Pune Vidyarthi Griha Prakashan, Pune,
2. Robbins & Kumar: "Basic Pathology," WB Saunders Company,

### **PS 3310: PHYSIOLOGICAL CHEMISTRY LAB.**

#### List of Experiments:

1. Qualitative & Quantitative estimation of normal and abnormal constituents of Blood and Urine.
2. Isolation of Enzyme, study of Kinetic parameters (Km value) and determination of specific activity.
3. Separation of Serum Protein by Gel Electrophoresis.
4. Isolation and evaluation of RNA / DNA.
5. Effect of pH and temperature on the activity of  $\alpha$ -amylase.
6. Estimation of SGOT, SGPT, Alkaline Protease and Bilirubin.

#### **Books Recommended :**

1. Hawk's Physiological Chemistry, Tata McGraw Publication.
2. Varley's Practicle Biochemistry

# **1. IV. B. PHARM. : 4<sup>TH</sup> SEMESTER**

## **PS 4301: PHARMACEUTICAL SYSTEMS – I**

1. **Solubility of Drugs:**  
Solubility expressions, Mechanisms of solute-solvent interactions, Ideal solubility and Scatchard-Hildebrand equation, solubility parameter, solvation and association, Quantitative approach to the factors influencing solubility of drugs.
2. **Distribution Phenomena:**  
Introduction, Effect of ionic dissociation and molecular association on partition, Application of distribution phenomenon in important pharmaceutical processes like extraction, preservation of emulsions, drug action etc.
3. **Interfacial Phenomena:**
  - A. Classification of interfaces
  - B. Liquid interface: Surface, interfacial tensions and their measurements, adhesion, Cohesion and spreading.
  - C. Adsorption at solid interfaces: Adsorption isotherms.
  - D. Adsorption in medicine and pharmacy.
  - E. Electrical properties of interface. Origin of charge, Electrical double layer and concept of Beta potential, Measurement of Beta potential, bulk stress effect.
4. **Micromeritics:**
  - A. Introduction: Definition, Applications, and Classification of properties of powders.
  - B. Fundamental Properties of Powders:
    - (i). Particle size and size distribution-Equivalent spherical diameters, Average particle size, size-frequency distribution, Number and weight distribution, Number and weight distribution, Particle number, Determination of particle size.
    - (ii). Particle shape, surface area and its measurement.
  - C. Derived Properties of Powders: Packing arrangements, Densities and Porosities, Bulkness, Flow properties and their influence on processing of solid dosage forms.
5. **Rheology:**
  - A. Types of flow: Newtonian flow, Viscosity Coefficients, Effect of temperature on viscosity, Non-Newtonian flows and their mechanisms.
  - B. Rheological structures (Time dependant flow properties): Thixotropy, Bulges and spurs, Antithixotropy, Rheopexy.
  - C. Determination of Flow Properties:  
Choice of Viscometer, Principle and Theory underlying capillary Falling sphere, Cup and Bob (with operational details of Brooke field Viscometer) and Cone and Plate Viscometers.
  - D. Plug Flow.
  - E. Applications of Rheology in the formulation of dispersed systems.

### **BOOKS RECOMMENDED:**

1. Physical Pharmacy – Martin et al.,
2. Physical & Technical Pharmacy.
3. Bentleys Pharmaceutics – Davis
4. Physical Pharmaceutics – Shotton
5. Remington Practice of Pharmacy – Martin
6. Tutorial Pharmacy – Cooper & Gunn.

**PS 4303: PHARMACY PRACTICE -II**  
(HOSPITAL PHARMACY & PHARMACEUTICAL ADMINISTRATION)

- I. FUNDAMENTALS** (8 hrs)
1. Definition, Goals & Advantages, and
  2. Detailed Study with respects to:
    - i) Hospital Pharmacy Organization-
      - Organizational Structure of Hospital Pharmacy, and
      - Responsibilities of various Divisions of Hospital Pharmacy.
    - ii) Hospital Pharmacy Policies.
    - iii) Hospital Pharmacy Personnels-
      - Determination of Requirements of Hospital Pharmacy Personnel,
      - Abilities Required of Hospital Pharmacists, and
      - Responsibilities of Personnel.
    - iv) Hospital Pharmacy Facilities.
    - v) Hospital Formulary.
    - vi) Pharmacy & Therapeutic Committee.
- II. PURCHASE & INVENTORY CONTROL** (6 hrs)
1. Modes of Drug Purchases.
  2. Procedures of Drug Purchases by Hospital Pharmacy.
  3. Control of Purchases :
    - Calculations of Reorder Quantity Level,
    - Economic Order Quantity, and
    - Inventory Turnover & Inventory Control ( Annual and Perpetual).
- III. DISPENSING OF MEDICATIONS & Their Distribution w.r.t. :** (4 hrs)
1. In – patients,
  2. Ambulatory,
  3. Out – Patients, and
  4. Controlled Drugs.
- IV. BULK MANUFACTURE :** (3 hrs)
1. Advantages,
  2. Policy Making, and
  3. Good Manufacturing Regulations (GMR)
- V. PRE – PACKAGING IN HOSPITALS :** (3 hrs)
1. Pre – packaging policy,
  2. Pre-packaging Operations, and
  3. Labeling of Pre-packaged Products.
- VI. CENTRAL STERILE UNIT & IT'S MANAGEMENT :** (4 hrs)
1. Types of Materials for Sterilization.
  2. Packaging of Materials prior to Sterilization.
  3. Sterilization Facilities, Equipments & Methods.
  4. Distribution of Sterile Materials.
- VII. HOSPITAL PHARMACY LAY-OUT** (2 hrs)

## VIII. RADIO –PHARMACY

(10 hrs)

1. Introduction to Radio-pharmaceuticals
2. Production of Radio-pharmaceuticals (including Units of Radioactivity & Radioactive Half-life):
  - i) Methods of Isotopic Tagging.
  - ii) Preparation of Radio-Isotopes in laboratory using Radiation Dosimetry.
  - iii) Radio – Isotope Generators.
  - iv) Quality Control of Radio – pharmaceuticals.
3. Radiation Detection Instruments
4. Permissible Radiation Dose, Hazards of Radiations & Prevention of Exposure to Radiations
5. Specifications for Radio- active Laboratory.

### Books Recommended :

1. Hassan: "Hospital Pharmacy," 4<sup>th</sup> ed., Lea & Febiger, (3<sup>rd</sup> ed., 1974).
2. Gennaro et al., Ed. : "Remington: The Science & Practice of Pharmacy," 20<sup>th</sup> ed., Lippincott Williams & Wilkins, 2000.
3. Collet & Aulton, Eds. : "Pharmaceutical Practice," ELBS, 1991.
4. Taylor & Harding : "Pharmacy Practice," Taylor & Francis, 1996.
5. Owunwanne, Patel, and Sadek : "The Hand Book of Radiopharmaceuticals," Chapman & Hall, 1995.
6. Shroff : "Professional Pharmacy," 1<sup>st</sup> ed., Part I (Ethics) & Part III (Hospital Pharmacy), Five Star Enterprises,
7. Aulton, Ed. : "Pharmaceutics – The Science of Dosage Form Design," ELBS, 1990.
8. Ansel et al. : "Pharmaceutical Dosage Forms & Drug Delivery Systems," 7<sup>th</sup> ed., Lippincott Williams & Wilkins, 2000.
9. Merchant & Qadry : "Text Book of Hospital Pharmacy," Shah Prakashan.
10. Chittion & Witcofski : "Nuclear Pharmacy," Lea & Febiger. Aiiwodd & Fell : "Text Book of Hospital Pharmacy," Blackwell Scientific Publications.

## PS 4305: PHARMACEUTICAL ENGINEERING -I

- 1. Introduction of Unit Operations :**
  - Units and Dimensions.
  - Material and energy balance, molecular units, mole fraction, gas laws, molar volume,
  - Primary and secondary quantities, equilibrium state, rate process, steady and unsteady states, Dimensionless equation, dimensionless groups, dimensionless formulae,
  - Mathematical problems.
- 2. Heat Transfer :**
  - Laws of conduction, convection and radiation, Heat transfer coefficient.
  - Batch heating and cooling system.
  - Different types of heat exchangers, double pipe, shell and tube, plate type, Spiral heat exchanger.
  - Insulating material
  - Mathematical problems
- 3. Evaporation:**
  - Basic concept of phase equilibrium,
  - Types of evaporators, operation of evaporation units, factors affecting evaporation, single effect and multiple effect evaporators,
  - Mathematical problems on evaporation.
- 4. Fluid Flow:**
  - Types of flow, Reynold's number, viscosity, concept of boundary layer, basic equation of fluid flow,
  - Valves, flow meters, manometers and measurement of flow and pressure, and
  - Related problems.
- 5. Fluid Handling Systems:**
  - Liquid Handling - Different types of pumps.
  - Gas Handling - Various types of fans, blowers and compressors.
- 6. Materials of Construction:**
  - General study of corrosion, measures to avoid corrosion, surface preparation, surface coatings- metallic and organic,
  - Selection of lining material for pharmaceutical plant and equipment, and
  - Properties and applications of different materials of construction with special reference to stainless steel, glass and different alloys.
- 7. Introduction to Environmental Engineering:**

Pollution control, Hazards and safety measures in pharmaceutical industry.

### **Books Recommended :**

1. McCabe & Smith: "Unit Operations of Chemical Engineering," McGraw Hill, 1993.
2. Badger & Banchero: "Introduction to Chemical Engineering," 5<sup>th</sup> Reprint, McGraw Hill, 1997.
3. Sambamurthy: "Pharmaceutical Engineering," New Age Int. Pvt. Ltd., 1998.
4. Aulton, Ed.: "Pharmaceutics- The Science of Dosage Form Design," ELBS, 1990.
5. Carter, Ed.: "Cooper & Gunn's Tutorial Pharmacy," 6<sup>th</sup> ed., CBS Publishers, 1972.
6. Brown: "Unit Operations," Indian edition, Asian Publishing House,
7. Hallman, Heat Transfer, 8<sup>th</sup> Ed.



## PS4307: INORGANIC MEDICINALS

1. Impurities in pharmaceutical, Limit tests of Cationic and anionic impurities of pharmacopoeal substance. [06 Hrs.]  
Systematic study of the official inorganic medicinal compounds (I.P.) with special reference to preparation, tests for purity, storage, assay, category and uses of the compounds belonging to the following groups.
2. Group I A : Alkaline Metals – Compounds of Sodium and Potassium which are official in IP/BP. [08 Hrs.]  
Group II A: Alkaline Earth Metals – Compounds of Magnesium, Calcium and Barium that are official in IP/BP.
3. Group I B: Transition Metals – Compounds of Copper, Silver & Gold that are official in IP/BP. [05 Hrs.]  
Group II B: Transition Metals - Compounds of Zinc, Mercury that are official in IP/BP.
4. Group III B: Main Group Metals – Compounds of Boron and Aluminium that are official in IP/BP. [03 Hrs.]  
Group IV B: Main Group Metals – Compounds of Tin, Lead that are official in IP/BP.
5. Group V B: Compounds of Nitrogen, Phosphorus, Arsenic, Antimony & Bismuth that are official in IP/BP. [05 Hrs.]
6. Group VI B: Compounds of Oxygen, Sulphur and Selnium that are official in IP/BP.
7. Group VII B: Compounds of Chbrine and Iodine that are official in IP/BP. [05 Hrs.]
8. Radiopharmaceuticals: Introduction and unit of radio-activity. Handling, Hazards and Precutions of radiopharmaceuticals. Applications of radioisotopes as diagnostic and therapeutic agents. [04 Hrs.]

### Books Recommended

1. Bentley and Driver's Textbook of Pharmaceutical Chemistry.
2. Inorganic Medicinal and Pharmaceutical Chemistry by J.H. Block, E.B. Roche, T.O. Soine and C.O. Wilson.
3. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake Vol. I.
4. Pharmaceutical Chemistry by M.L. Schroff.
5. Indian Pharmacopoeia 1996.

**PS 4309: PHARMACOLOGY - I (General Pharmacology, Toxicology & Bioassay)**

**1. General Pharmacology:**

**Module I**

(5L)

- (i) Introduction to Pharmacology, Sources of Drugs, historical development with special reference to India, various relevant terminologies
- (ii) Routes of administration and drug delivery system

**Module II**

(6L)

- (iii) Mechanism of action & Combined effect of Drugs,
- (iv) Factors modifying drug action, Tolerance and Dependence, Pharmacogenetics,

**Module III**

(6L)

- (v) Absorption, Distribution, Metabolism and Excretion of Drugs,
- (vi) Principles of Basic and Clinical Pharmacokinetics,
- (vii) Adverse Drug Reactions.

**Module IV**

(6L)

**2. Bioassay:**

- (i) Principles of Bioassay and Biological Standardization,
- (ii) Bioassay of Acetylcholine, Histamine, Oxytocin, Digitalis and Insulin.

**3. Principles of Toxicology:**

**Module V**

(4L)

- (i) Definition of Poison, scope and its branches
- (ii) Acute, subacute and chronic toxicity, teratogenicity, mutagenicity

**Module VI**

(5L)

- (iii) Mechanisms of the Antidotal Treatment,
- (iv) Heavy Metals (e.g. Leads, Arsenic, Antimony) Poisoning and their Antagonists, management of poisoned patients.
- (v) General principles of treatment of Poisoning with particular reference to Barbiturates, Opioids, Organophosphorus and Atropine Poisoning,

**Module VII**

(6L)

**Clinical Evaluation:**

- (i) Brief overview of Discovery and Development of New Drugs,
- (ii) Evaluation of Drugs in Man.

**Books Recommended:**

1. Bhattacharya et al. : "Pharmacology," 2<sup>nd</sup> ed., Elsevier,
2. Seth: "Text Book of Pharmacology," Elsevier,
3. Goodman & Gilman: "The Pharmacological Basis of Therapeutics," Pergamon Press,
4. Crossland : "Lewis Pharmacology," Churchill Livingstone,
5. Katzung: "Basic and Clinical Pharmacology," Prentice Hall,
6. Tripathi: "Essentials of Medical Pharmacology," Jaypee Brothers,
7. Satoskar: "Pharmacology & Pharmacotherapeutics," Popular Prakashan,

## PS4311: PHARMACOGNOSY - I

1. **Pharmacognosy:** (2L)  
Definition, History, Scope and Development
2. **Sources and Classification of Drugs:** (3L)  
A) Biological, marine, mineral and plant tissue culture .  
B) Alphabetical, morphological, taxonomical, chemical and pharmacological.
3. **Plant Taxonomy:** (3L)  
Study, of the following families (with special reference to medicinally important plants)-  
Apocynaceae, Solanaceae, Rutaceae, Umbelliferae, Leguminosae, Gramineae and Labiatae.
4. **Cultivation, Collection, Processing and Storage of Crude Drugs:** (7L)
  - Factors influencing cultivation of medicinal plants
  - Types of soils and fertilizers of common use
  - Pest management and natural pest - control agents
  - Plant hormones and their applications
  - Polyploids, mutation and hybridization with reference to medicinal plants.
5. **Quality Control of Crude Drugs:** (3L)
  - Adulteration of crude drugs
  - Their detection by organoleptic, microscopic, physical, chemical and biological methods of evaluation.
6. **Systematic Pharmacognostic Study of the Followings:** (8L)
  - i. Carbohydrates & derived products – Agar, Guar gum, Acacia, Honey, Isabgol, Pectin, Sterculia and Tragacanth.
  - ii. Lipids- Bees wax, Castor oil, Cocoa butter, Cod-liver oil, Hydnocarpus oil, Kokum butter, Lard, Linseed oil, Rice-bran oil, Shark - liver oil and Wool fat.
7. **Tannins and Volatile Oils** (3+8L)
  - A) Study of Tannins and Tannin- containing Drugs like: Gambir, Black Catechu, Gall and Myrobalan. (3L)
  - B) Volatile Oils: (8L)
    - General methods of obtaining volatile oils from plants, and
    - Pharmacognosy of the volatile oil containing drugs:  
Mentha, Cinnamon, Cassia, Lemon peel, Orange peel, Lemon grass, Citronella, Caraway, Dill, Spearmint, Clove, Fennel, Nutmeg, Eucalyptus, Chenopodium, Cardamom, Valerian, Musk, Palmarosa, Gaultheria, Sandal wood.

### Books recommended:

- 1) A.N. Kalia, A textbook of Industrial Pharmacognosy, CBS Publishers and Distributors.
- 2) AC. Dutta: Botany for Degree students, Oxford University Press, New Delhi
- 3) Ashutosh Kar, Pharmacognosy and Biotechnology, New Age Publishers.
- 4) Ayurvedic Formulary of India, Govt. of India, New Delhi
- 5) Ayurvedic Pharmacopoeia of India, All Volumes.
- 6) British Herbal Pharmacopoeia
- 7) Harborne J. B. Phytochemical methods, Chapman and Hall, International Edition, London
- 8) Henry T. A., The plant alkaloids, McGraw Hill, New York
- 9) Herbal Pharmacopoeia, IDMA, Mumbai
- 10) Iyengar M.A., Study of Crude Drugs, Manipal Power Press, Manipal
- 11) Jean Bruneton: Pharmacognosy and Phytochemistry, Medicinal Plants, Springer Verlag
- 12) Kokate C. K. Purohit A. P. and Gokhale S. B., Pharmacognosy , Nirali Prakashan
- 13) Manitto P. The biosynthesis of natural products, Ellis Harwood, Chichester
- 14) Manske RHF, The alkaloids, Academic press, New York

- 15) Medicinal Plants of India, Indian Council of Medical Research, New Delhi
- 16) Peach K, and Tracey M. V., Modern methods of plant analysis, 1-4, Narosa Publishing house, New Delhi
- 17) Pharmacopoeia of India, 1985,1996,2007 Govt. of India, Ministry of Health and Family Welfare
- 18) Pulok Mukherjee, Quality control of Herbal drugs, Business Horizons Pharmaceutical Publishers.
- 19) Robinson, T., The biochemistry of alkaloids, Springer- Verlag, New York
- 20) Trease, G.E. and Evans, W.C. Pharmacognosy, 12th Edition, Bailliere Tindall, Eastbourne, U.K
- 21) Tyler, V.E., Brady, R., Pharmacognosy, Lea & Febiger
- 22) Wallis, T.E. Textbook Of Pharmacognosy, J.A. Churchill Limited, London

## 11. PS 4302: PHYSICAL PHARMACEUTICS LAB.

1. To determine molecular weight of polymer (hydrophilic/lipophilic) by viscosity method.
2. To study the influence of the nature of electrolyte on the stability of lyophobic (hydrate ferric oxide) solution & to test / verify the validity of Schulze Hardy Rule.
3. To determine the CMC of the surfactant by surface tension method.
4. To examine the effect of an added electrolyte (specific strength) on the CMC of the above surfactant.
5. To examine the effect of nature of surfactant on CP of POE-nonionics.
6. To evaluate an effect of concentration of surfactant on the cloud point (CP) of POE-nonionic.
7. To study the effect of concentration of the electrolyte on CP of the POE-nonionic.
8. To determine the interfacial tension between a pair of immiscible liquids & to calculate spreading coefficient.
9. To examine the effect of added surfactant on interfacial tension of the pair of immiscible liquids (used above) & to calculate the changes in spreading coefficient.
10. To study the effect of concentration of surfactant on particle size of O/W emulsion & to examine its relationship with interfacial tension / spreading coefficient.
11. To calculate volume number diameter (d<sub>vn</sub>), Volume surface diameter (d<sub>vs</sub>), particle number (N) and specific surface (S<sub>v</sub>) of O/W emulsion through particle -size analysis by microscopy.
12. To determine Zeta Potential of the prepared O/W emulsion.
13. To evaluate the influence of temperature on the solubility of weakly electrolytic drug & to report the solubility at specified temperature & heat of solution by graphic method.
14. To study the effect of dielectric constant (DEC) of solvent / solvent blend on the solubility of weakly electrolyte drug (used above).

## PS 4304: PHARMACY PRACTICE LAB –I

(PRESCRIPTION PHARMACY LAB)

Dispensing of prescriptions belonging to the following Dosage Forms:

Dosage Forms	Number of Prescription
1. Mixtures	20
2. Emulsions	10
3. Powders	10
4. Incompatibility Illustration	10

Books Recommended:

1. Cooper & Gunn's Dispensing for Pharmaceutical Studies, Ed S.J. Carter, CBS Publications and Distributors, Delhi.
2. Pharmaceutical Practice, Ed; D.M. Collett, M.F. Aulton, ELBS, Longman Singapore Publications, Singapore.
3. S.N. Merchant & Dr. J.S. Qadry's Text Book of Hospital Pharmacy, Revised by R.K. Goyal & P.K. Parikh, B.S.Sah Prakashan, Ahmedabad.
4. Indian Pharmacopoeia.

## **PS 4306: PHARMACEUTICAL ENGINEERING DRAWING**

**LETTERING:** Concept of first and third angle projection: Orthographic projections, Isometric projection and section of simple solids: Free hand sketches of Bolted joints, Riveted joints, Welded joints, Pipe joints and fittings, Free hand sketches of pressure vessels and their supports – skirt, lug, saddle, Free hand sketches of mixers, blenders, agitators, crushers, flow sheet symbols.

Books Recommended:

1. Machine Drawing – N.D.Batt
2. Machine Drawing- P.S. Gill

## **PS4308: INORGANIC MEDICINAL LAB.**

### **List of Experiments:**

Preparation and characterization of following inorganic medicinals.

1. Preparation of Sod. Citrate.
2. Preparation of Sod. Salicylate.
3. Preparation of precipitated Calcium Carbonate.
4. Preparation of Sod. Phosphate.
5. Preparation of Ammonium Chloride.
6. Preparation of precipitated Sulphur.
7. Preparation of Sod. Benzoate from Benzoic Acid.
8. Limit test for Chloride in Sod. Citrate.
9. Limit test for Sulphate in Boric Acid.
10. Limit test for Sulphate in Sod. Phosphate.
11. Limit test for Iron in Amm. Chloride.
12. Limit test for Iron in Calcium Carbonate.

## V. B. PHARM. : 5<sup>TH</sup> SEMESTER

### PS 5301: PHARMACEUTICAL SYSTEMS – II

1. **Surface – active agents:**
  - A. Classification based on chemical nature and HLB scale, Determination of HLB, Surface activity and Mechanism of formation of micelles, Structure of micelle and Liquid crystal, Factors influencing CMC and Aggregation number, Life of micelle, Bulk properties of surface solution.
  - B. Micellar solubilization: Mechanism of solubilization, Factors influencing the choice of solubilizing agents, Ternary phasediagram in the formulation of solubilized systems.
  
2. Colloidal dispersions:
  - A. Classification of dispersed systems and their general characteristics, size and shapes of colloidal particles, Classification of colloids and comparative account of their general properties.
  - B. Properties of Colloids:
    - (i) Optical and Kinetic properties and their applications in determining molecular weight of polymers.
    - (ii) Electrical properties: Electrokinetic phenomena, Donnan membrane equilibrium.
  - C. Stability of Colloidal Systems:  
Mechanism, Effect of electrolytes, Coacervation, Peptization and protective action.
  
3. **Emulsions:**
  - A. Definition, thermodynamic consideration, Classification, Transparent emulsions, Pharmaceutical applications.
  - B. Emulsion types: Empirical rules governing emulsion types, Methods for determination of type of emulsions (only principle) and their limitations.
  - C. Mechanisms of Emulsion (droplet) stabilization: Monomolecular and particulate orientation, Mixed emulsifiers, Critical HLB concept.
  - D. Theories of Emulsifications: Non-electrical and electrical theories, Detailed account of non-electrical theories and advanced electrical theories like Schulman and Cockbain molecular complex formation, DLVO and Davies theories.
  - E. Stability of Emulsions, Factors influencing stability of emulsions.
  - F. Factors influencing rheological properties of emulsions.
  
4. **Suspensions:**
  - A. Definition, Application & solid content.
  - B. Theoretical concepts in the formulation of suspensions: Wetting and Dispersion, Particle-particle interaction and particle behaviour, Controlled flocculation, sedimentation concepts, Rheological considerations, and Formulation in structure vehicle.
  
5. **Drug Stability:**
  - A. Reaction Kinetics: Zero, Pseudo-Zero, First & Second order, Units of basic rate constants, Determination of Reaction order.
  - B. Physical and Chemical factors influencing the chemical degradation of pharmaceutical product: temperature, solvent, Ionic strength, Dielectric constant, specific & general acid base Catalysis light.
  - C. Stabilization of medicinal agents against common reactions like hydrolysis & Oxidation.
  - D. Accelerated stability testing in dating of Pharmaceutical dosage forms.

**BOOKS RECOMMENDED:**

1. Physical Pharmacy – Martin et. al.

**PS 5303: PHARMACEUTICAL BIOTECHNOLOGY AND BIOINFORMATICS**

1. **Introduction to Molecular Biology & Protein Engg.:** Genetic code, Transcription, component of protein synthesis, inhibition of protein synthesis, regulation of gene expression.
2. **Recombinants DNA Technology:**
  - Restrictions, Enzymes, Vectors, Gel electrophoresis, Molecular probes, Blotting techniques,
  - Construction and Screening of DNA libraries, PCR,
3. Isolation of gene, Sequencing of gene, DNA finger printing,
  - Transformation of bacterial cell,
  - Products from recombinant DNA technology such as Hepatitis B, Insulin
  - Interferons and Growth Hormones.
4. **Monoclonal Antibodies & Hybridoma Technology.**
5. **Plant Tissue Culture:**
  - Principles of tissue & cell culture,
  - Tissue culture techniques, nutrient media, culture techniques,
  - Cytology of cultured cells, protoplast fusion & culture.
6. **Bioinformatics:**
  - Meaning, scope and areas of Bioinformatics,
  - Biological information recourses on internet and their retrieval systems,
  - Common Bioinformatics softwares and their applications: FASTA, BLAST, Rasmol, Tree View, Oligo, etc,
7. Pharmacogenomics and related Drug Design.

**Books Recommended :**

1. Vyas & Dixit : “Pharmaceutical Biotechnology,”1<sup>st</sup> ed. (Reprint),CBS Publisher, 1996.
2. Old & Primrose: “Principles of Gene Manipulation,” 5<sup>th</sup> ed. (Reprint), Blackwell Science Ltd., 1996.
3. Gupta: “Elements of Biotechnology,”1<sup>st</sup> ed. (Reprint), Rastogi Publisher, 2001.
4. Baxevanis & Oulette: “Bioinformatics- A Practical Guide to Analysis of Genes and Proteins,” John Wiley, 1998.
5. Attwood & Parry-Smith: “Introduction to Bioinformatics,” Indian Reprint, Person Education (LPE), 2003.
6. Baldi & Brunak: “Bioinformatics-The Machine Learning (Adaptive Computation and Machine Learning),” Indian Reprint, MIT Press, New Age International , 2003.
7. Benjamin: “Gene VII,” Oxford Press, Reprint, 2002.
8. Gibas and. Jambeck: “Developing Bioinformatics Computer Skills,” Indian Reprint, Shroff Publisher &Distributors, 2001.



## PS 5305: PHARMACEUTICAL ENGINEERING – II

1. **Size Reduction:**
  - Definition, objectives of size reduction, factors affecting size reduction,
  - Mechanism of size reduction, Laws of size reduction, Size reduction in pharmaceutical industry.
  - Classification of size reduction equipments, operation and energy aspects of various types of crushing and grinding machinery used in pharmaceutical industry, Selection of equipment,
  - Mathematical problems.
2. **Size Separation:**
  - Screen, standard screen, screen analysis, material balances, over all screen effectiveness,
  - Types of screening equipments, selection of screening equipments,
  - Classifiers - Laws of settling, sedimentation, principles of centrifugal sedimentation, centrifugal settling process,
  - Equipments used in solid-gas, solid-liquid and liquid-liquid systems.
3. **Filtration:**
  - Theory of filtration, filter aid, filter media,
  - Theory of filtration.
  - Types of industrial filters and their operation
  - Mathematical problems.
4. **Mixing :**
  - Theory of mixing,
  - Solid-solid, solid-liquid and liquid-liquid mixing equipments.
5. **Solid Handling:**
  - Handling of solids in pharmaceutical plants,
  - Storage and weighing of solids,
  - Types of conveyors, their operation, and uses.
6. **Basic Reaction Engineering:**
  - Classification of reaction, reaction rate, speed of reaction, rate equation, rate constant,
  - order, molecularity,
  - Zero, first, second order reaction, half life period, activation energy and temperature dependency. Single ideal reactor (CSTR and Plug Flow).
7. **Bioreactors:**
  - Fundamentals of bioreactor design for pharmaceutical operation.

### Books Recommended :

1. McCabe & Smith: "Unit Operations of Chemical Engineering," McGraw Hill, 1993.
2. Badger & Banchero: "Introduction to Chemical Engineering," 5<sup>th</sup> Reprint, McGraw Hill, 1997.
3. Sambamurthy: "Pharmaceutical Engineering," New Age Int. Pvt. Ltd., 1998.
4. Shreve: "Chemical Process Industry," 4<sup>th</sup> ed., McGraw Hill, 1997.
5. Carter, Ed.: "Cooper & Gunn's Tutorial Pharmacy," 6<sup>th</sup> ed. CBS Publishers, 1972.
6. Brown: "Unit Operations," Indian Edition, Asian Publishing House,
7. Rawlins, Ed.: "Bentley's Text Book of Pharmaceutics," 8<sup>th</sup> ed. (Reprint), All India Traveller Book Seller, 2002.
8. Levenspille. O. Chemical Reaction Engineering Ed3, John Wiley and Sons (Asia)

## PS5307: NATURAL MEDICINALS - I

- 1. Carbohydrates:** [07 Hrs.]
- i. Monosaccharides-
    - Structure elucidation of glucose & Fischer's proof
    - Killiani-Fischer's synthesis for lengthening the chain
    - Ruff's degradation for shortening the chain
    - Cyclic structure of glucose
    - Anomers, epimers and muta-rotation.
  - ii. Disaccharides-  
General method of structure elucidation with specific examples (Lactose, Maltose, and Sucrose)
  - iii. Polysaccharides-  
Starch and Glycogen.
- 2. Lipids :** [04 Hrs.]
- Oils and Fats
  - Synthesis of glycerides
  - Classification of lipids and their uses.
- 3. Amino acids & Proteins:** [05 Hrs.]  
Amino acid synthesis & properties, Structure and synthesis of peptides, End group analysis of proteins.
- 4. Terpenes:** [07 Hrs.]  
Introduction, Classification, Isolation, general methods of determining structure, Chemistry of monoterpenoids (Citral), Monocyclic monoterpenoids (alpha-terpineol Menthol) Bicyclic monoterpenoids (alpha-pinene, Camphor) Wagner – Mearwin rearrangement, Sesquiterpenoids (Farnesol) Diterpenoids (Phytol)
- 5. Alkaloids(I):** [05 Hrs.]  
Definition, extraction of alkaloids, general properties, general method of structure determination, classification of alkaloids, Phenylethylamine group- Ephedrine, Pyridine & Piperidine group – Piperine, Pyrrolidine – Pyridine group – Nicotine, Tropane alkaloids, Atropine, Stereochemistry of tropines.
- 6. Alkaloids(II):** [05 Hrs.]  
Extraction, general properties, general method of structure determination of the following alkaloids: Quinoline group – Cinchona alkaloids with special reference to Cinchonine and Quinine, Quinidine, Cinchonidine & their stereochemistry. An elementary treatment of the alkaloids of isoquinoline, Phenanthrene & indole group.
- 7. Purines:** [03 Hrs.]  
Uric acid, Caffeine, Theophylline & theobromine.

### **Books Recommended:**

1. I.L. Finnar, Organic Chemistry Vol. II

## PS 5309: PHARMACOLOGY - II (Neuropharmacology)

### 1. Autonomic Nervous System:

- Module I (5L)
- i. Neurohumoral transmission (Autonomic and Somatic),
  - ii. Parasympathetics - Parasympathomimetics, Parasympatholytics, Cholinesterase & Anticholinesterases, Cholino receptors,
- Module II (3L)
- iii. Neuromuscular blocking agents,
  - iv. Ganglionic stimulants and blocking agents,
- Module III (5L)
- v. Sympathetics - Sympathomimetic & Sympatholytic agents,
  - vi. Adrenergic receptors,
  - vii. Alpha - Adrenergic and Beta - Adrenergic blocking agents.

### 2. Central Nervous System:

- Module IV (7L)
- i. Neurotransmitter Systems,
  - ii. General Anesthetics,
  - iii. Alcohol and Antabuse,
- Module V (7L)
- iv. Sedatives, Hypnotics and Tranquillizers, Antipsychotic Agents. Antidepressant Agents.(classification, mechanism of action)
- Module VI (7L)
- Analgesics, Antipyretics, Anti-inflammatory and antirheumatic and Antigout drugs, (classification, mechanism of action)
- Convulsants and Anticonvulsants(classification, mechanism of action),
- Module VII (5L)
- Autacoids:**
- i. Histamine and Serotonine,
  - ii. Prostaglandins, thromboxanes and leukotriens,
  - iii. Pentagastrin, Cholecystokinin, Angiotensin, Bradykinin and Substance P.

#### **Books Recommended:**

1. Bhattacharya et al. : "Pharmacology," 2<sup>nd</sup> ed., Elsevier,
2. Seth: "Text Book of Pharmacology," Elsevier,
3. Goodman & Gilman: "The Pharmacological Basis of Therapeutics," Pergamon Press,
4. Crossland : "Lewis Pharmacology," Churchill Livingstone,
5. Katzung: "Basic and Clinical Pharmacology," Prentice Hall,
6. Tripathi: "Essentials of Medical Pharmacology," Jaypee Brothers,
7. Satoskar: "Pharmacology & Pharmacotherapeutics," Popular Prakashan,

## PS5311: PHARMACOGNOSY - II

1. **Resins:** (5L)  
Study of Drugs Containing Resins and Resin Combinations like: Colophony, Podophyllum, Jalap, Cannabis, Capsicum, Myrrh, Asafoetida, Balsam of Tolu, Balsam of Peru, Benzoin, Turmeric and Ginger.
2. **Phytochemical Screening:** (7L)
  - Preparation of extracts, and
  - Screening of alkaloids, saponins, cardenolides and bufadienolides, flavonoids and leucoanthocyanidins, tannins and polyphenols, anthraquinones, cynogenetic glycosides, amino acids in plant extracts.
3. **Fibers and Pharmaceutical Aids::** (5L)
  - A) Study of fibers used in pharmacy such as cotton, silk, wool, nylon, glass wool, polyester and asbestos.
  - B) Study of pharmaceutical aids like: Talc, Diatomite, Kaolin, Bentonite, Gelatin and natural Colours.
4. **Enzymes:** (3L)  
Biological sources, preparation, identification tests and uses of the following enzymes – Diastase, Papain, Pepsin, Trypsin and Pancreatin.
5. **Traditional System of Medicine:** (3L)  
The holistic concept of drug administration in traditional systems of medicine, and Introduction to Ayurvedic preparations like Arishtas, Asavas, Gutikas, Tailas, Churnas, Leha and Bhasmas.
6. Study of traditional drugs, common vernacular names, botanical sources, morphology, chemical nature of chief constituents, pharmacology, categories, common uses and marketed formulations of following indigenous drugs: (10L)
  - A) Shankhpushpi, Brahmi, Adusa, Arjuna, Ashoka, Methi, Lahsun, Palas, Guggul, Gymnema, Shilajit, Nagarmotha and Amla,
  - B) Kantkari, Satavari, Tylophora, Bhilawa, Kalijiri, Vajach, Rasna, Punarnava, Chitrak, Apamarg, Gokhuru and Neem.
8. A brief introduction to plant toxins, allergens and antibiotic drugs from marine sources. (2L)

### Books recommended:

- 1) Ayurvedic Formulary of India, Govt. of India, New Delhi
- 2) Ayurvedic Pharmacopoeia of India, All Volumes.
- 3) British Pharmacopoeia
- 4) Harborne J. B. Phytochemical methods, Chapman and Hall, International Edition, London
- 5) Herbal Pharmacopoeia, IDMA, Mumbai
- 6) Herbal Product Volume I & II, NISCAIR, New Delhi
- 7) Horborne J. B. Phytochemical methods, Chapman and Hall, International Edition, London
- 8) Iyengar M.A., Study of Crude Drugs, Manipal Power Press, Manipal
- 9) Jean Brunet: Pharmacognosy and Phytochemistry, Medicinal Plants, Springer Verlag
- 10) Kokate C. K. Purohit A. P. and Gokhale S. B. , Pharmacognosy (degree ) Nirali Prakashan
- 11) Manitto P. The biosynthesis of natural products, Ellis Harwood, Chichester
- 12) Manske RHF, The alkaloids Academic press, New York
- 13) Medicinal Plants of India, Indian Council of Medical Research, New Delhi
- 14) Peach K, And Tracey M. V., Modern Methods Of Plant Analysis, 1-4, Narosa Publishing House, N.Delhi

- 15) Pharmacopoeia of India, 1985,1996, Govt. of India, Ministry of Health and Family Welfare
- 16) Pulok Mukherjee, Quality control of Herbal drugs, Business Horizons Pharmaceutical Publishers
- 17) Raphael Ikan, Natural products a laboratory Guide, Academic Press.
- 18) Robinson, T., The biochemistry of alkaloids, Springer- Verlag, New York
- 19) Stahl, E., Thin Layer Chromatography- A Laboratory handbook, Springer-Verlag, Berlin
- 20) Trease, G.E. and Evans, W.C. Pharmacognosy, 12th Edition, Bailliere Tindall, Eastbourne, U.K
- 21) Tyler, V.E., Brady, R., Pharmacognosy, Lea & Febiger
- 22) V.D.Rangari, Pharmacognosy and Phytochemistry Volume I & II
- 23) Wagner, S.B., Zgainsky, Plant drug Analysis
- 24) Wallis, T.E. Textbook Of Pharmacognosy, J.A. Churchill Limited, London

**PS 5302 : PHARMACY PRACTICE LAB - II**  
(Prescription Pharmacy II including Hospital Training)

I. Dispensing of prescriptions belonging to the following Dosage Forms:

Dosage Forms	Number of Prescription
a. Lotions	04
b. Liniments & Applications	05
c. Enemas	03
d. Ointments & Creams	10
e. Pastes	05
f. Ophthalmic preparations	03
g. Prescriptions requiring isotonicity requirement	06
h. Jelly	01
i. Suppositories	05

II. Filing of Drug – Drug Interactions & Drug-Food interactions and applying them during Hospital Training (Prepare and give warning cards)

III. Preparation of Drug-History File of Patients.

IV. Sterilization of absorbent cotton-wool, bandages, gauzes etc.

V. Quality control of the above mentioned items.

**Books Recommended:**

1. Cooper & Gunn's Dispensing for Pharmaceutical Studies, Ed S.J. Carter, CBS Publications and Distributors, Delhi.
2. Pharmaceutical Practice, Ed; D.M. Collett, M.F. Aulton, ELBS, Longman Singapore Publications, Singapore.
3. S.N. Merchant & Dr. J.S. Qadry's Text Book of Hospital Pharmacy, Revised by R.K. Goyal & P.K. Parikh, B.S.Sah Prakashan, Ahmedabad.
4. Indian Pharmacopoeia.

**PS5308: NATURAL PRODUCT LAB.**

List of Experiments:

1. Isolation & Characterization of Starch from Potatoes.
2. Isolation & Characterization of Caffeine from Tea Leaves.
3. Isolation & Characterization of Piperine from Black Pepper.
4. Preparation of Ricinolic acid from Caster Oil.
5. Preparation of Azelaic acid from Castor Oil.
6. Isolation & Characterization of Hesperidine from Orange peels.
7. Isolation & Characterization of Lycopene from Tomatoes.
8. Isolation of Alkaloids from Nux-Vomica Seeds.
9. Isolation of Crude Alkaloids from the supplied Plant species.
10. Isolation of Glycosides from supplied Plant species

**Books Recommended:**

1. Raphael Ikan, Practical Guide Natural Products.
2. J.B. Harborne, Phytochemical Methods.

### PS 5310: PHARMACOLOGY LAB. - I

1. Study of various apparatus and recording devices used in experimental pharmacology.
2. Setting & operation of isolated organ bath including application of load, smoking of Kymograph, fixing of the tracing-contact time, time cycle, etc.
3. Preparation of physiological salt solution, drug solution, storage of drug solution.
4. Handling, weighing, injecting, anaesthetizing and numbering of experimental animals.
5. To study the relative rate of absorption of drug administered by various routes in mice.
6. To study the site of action of Strychnine and Picrotoxin in frog.
7. To study the effect of Physostigmine and Atropine on ciliary movement in frog buccal cavity.
8. To study the effect of saline purgative.
9. To study the effect of Atropine and Eserine on the rabbit eye.
10. To study the mydriatic effect of topically applied Atropine in rabbit eye.
11. To determine the writhing effect in mice.
12. To study the behavioural effects of CNS-depressant and CNS-stimulant drugs in mice.
13. Effect of Acetylcholine on frog rectus abdominis muscle.
14. Effect of Acetylcholine on guinea pig ileum.

#### **Books Recommended:**

1. Kulkarni: "Hand Book of Experimental Pharmacology," Vallabh Prakashan,
2. Pillai: "Experimental Pharmacology," CBS Publishers & Distributors,
3. Prakash: "Experimental & Clinical Physiology," MacMillan,

### PS5312: PHARMACOGNOSY LAB - I

1. Identification of traditional drugs mentioned in the theory.
2. Preparation of herbarium.
3. Study of fibers and pharmaceutical aids.
4. Microscopic studies of selected crude drugs and their powders mentioned under the category of volatile oils (in theory) and their chemical tests.
5. Identification of crude drugs listed in theory.
6. Demonstration of percolation and continuous extraction technology (Soxhlet apparatus)
7. Extraction of Eucalyptus and clove oil by using clavenger apparatus.
8. Isolation of Eugenol in essential oils.
9. Estimation of aldehydes in volatile oils.
10. Chemical test of resinous crude drugs. Asafoetida, Benzoin, Colophony,
11. Chemical test of drugs under carbohydrates Agar, acacia, tragacanth,.
12. Paper or TLC chromatography profile of any two volatile oil drugs mentioned in theory.

#### **Books recommended:**

1. A.N. Kalia, A textbook of Industrial Pharmacognosy, CBS Publishers and Distributors.
2. AC. Dutta: Botany for Degree students, Oxford University Press, New Delhi
3. Ashutosh Kar, Pharmacognosy and Biotechnology, New Age Publishers.
4. Ayurvedic Formulary of India, Govt. of India, New Delhi
5. Ayurvedic Pharmacopoeia of India, All Volumes.
6. British Herbal Pharmacopoeia
7. Harborne J. B. Phytochemical methods, Chapman and Hall, International Edition, London
8. Henry T. A., The plant alkaloids, McGraw Hill, New York
9. Herbal Pharmacopoeia, IDMA, Mumbai
10. Iyengar M.A., Study of Crude Drugs, Manipal Power Press, Manipal
11. Kokate C. K., Practical Pharmacognosy, Nirali Prakashan

# VI. B. PHARM. : 6<sup>TH</sup> SEMESTER

## PS 6301: INDUSTRIAL PHARMACY-I

1. **Preformulation:**  
Dosage form Design, Methodology, Physico-chemical considerations of a new medicinal agent involved in formulation of dosage form.
2. **Tablets:**
  - I. Oral Tablets:
    - A. Product Development – Formulation Additives, Methods of preparation (wet granulation, Dry granulation, Direct compression, Sheronization, Spray drying, Spray congealing).
    - B. production – Tablet machines, processing problems.
  - II. Product development aspects of other forms of compressed tablets including Chewable, soluble, effervescent, Buccal & Sublingual, Implants, Compression coated tablets, multi-layer tablets etc.
  - III. Evaluation (including official procedures).
  - IV. Critical study of selected pharmacopoeial (IP/BP) monograph in the light of (i) Forms of tablets (uncoated), and (ii) Deviation from normal official limits.
3. **Tablet Coating:**
  - A. Sugar, Film, Enteric, Fluid bed coating, Coating Materials, solvents, processing problems.
  - B. Evaluation of coated tablets (including official procedures).
  - C. A critical study of selected Pharmacopoeial (IP/BP) monographs based on (i) coating types, and (ii) Deviations from normal official limits.
4. **Capsules:**  
Hard and soft gelatin capsules, Capsule filling equipments and operation, Finishing & Formulation, Quality control (including official tests). A critical study of selected Pharmacopoeial (IP/BP) monographs based on (i) Capsule types (ii) Equivalence considerations (iii) Deviations from normal official limits.
5. **Microencapsulation:**
  - A. Fundamental Considerations: Core material, Coating material, Selected stability and release properties, Equipment & processing.
  - B. Preparation of Microcapsules: Air suspension, Coacervation-phase separation, Mechanical and insitu methods.
6. **Sustained Release Dosage Forms:**  
Terminologies, Factors in design and Efficiency-Drug elimination rate, Estimation of initial and maintenance dose. Formulation, in-vivo and in-vitro evaluation.
7. **Medicated Applications:**
  - A. Dermatological Preparations: Percutaneous absorption, ointment bases, production and preservation.
  - B. Ophthalmic Preparation: i) Ophthalmic Solution: Desirable properties, preparation, sterilization & preservation (ii) Ophthalmic Ointments: Bases industrial processing, Sterilization and preservation.



**BOOKS RECOMMENDED:**

1. Lachman et al : Theory and Practice of Industrial Pharmacy
2. Remington Pharmaceutical Sciences.
3. Carstensen : Pharmaceutics of Solids and Solid Dosage Forms.
4. Banker and Rhodes : Modern Pharmaceutics (Revised & Expanded).
5. Ansel et. al. : Pharmaceutical Dosage Forms and Drug Delivery System.
6. Chien : Novel Drug Delivery System (Fundamental, Developmental Concepts and Biomedical Assessments).
7. Robinson and Lee : Controlled Drug Delivery : Fundamental and Applications.
8. Jain Ed.: Advances in Controlled & Novel Drug Delivery.
9. Lachman et. al. : Pharmaceutical Dosage Forms : Tablets Vol. 1-3.

## PS6305: NATURAL MEDICINALS-II

1. **Steroids:** [07 Hrs.]  
Introduction, nomenclature, classification, Structure elucidation of cholesterol excepting the stereochemistry and involving ring systems, position of hydroxyl group, double bond, Side chain and angular methyl groups.
2. **Steroidal Hormones: Corticosteroids:** [04 Hrs.]  
Source, extraction, structure elucidation, synthesis and medicinal uses corticosteroids: hydrocortisone and hydrocortisol
3. **Steroidal Hormones: Sex hormones:** [04 Hrs.]  
Source, extraction, structure elucidation, synthesis and medicinal uses of the following
  - i. Estrogens: Estradiol, Estrone and Estriol
  - ii. Progesterones.
  - iii. Androgens: Androsterone and testosterone.Structure, nomenclature, synthesis and medicinal uses for synthetic analogs of estrogens, progesterones and testosterone.
4. **Non-steroidal Hormones:** [05 Hrs.]  
Source, extraction, structure elucidation, synthesis and medicinal uses of the following
  - i. Adrenaline and Noradrenaline,.
  - ii. Thyroxine.An elementary treatment of oxytocin and Insuline.
5. **Glycosides:** [04 Hrs.]
  - Introduction
  - Synthesis of glycosidesStructure elucidation of Ruberythric acid, Amygdalin and salicin.
6. **Steroidal Glycosides:** [04 Hrs.]  
Chemistry of digitoxin, diosgenin and sarsasapogenin.
7. **Vitamins:** [08 Hrs.]  
Source, extraction, structure elucidation, synthesis and medicinal uses of the following
  - i. Fat soluble vitamins- A, D, E & K.
  - ii. Water soluble vitamins- B<sub>1</sub>, B<sub>2</sub>, B<sub>6</sub>, and C.

### BOOKS RECOMMENDED:

1. I.L Finnar, Organic Chemistry Vol. II
2. Fieser and Fieser, Steroids.

## PS6307: CHEMOTHERAPEUTIC AGENTS

Classification, Structure, nomenclature, mode of action, uses and SAR of following categories of drugs along with synthesis (\*) and assay (\*) of official (IP/BP) compounds.

**1. Antibiotics:** [06 Hrs.]  
History, background, current status of Penicillins and Cephalosporins, Aminoglycosides, Tetracyclines, Macrolides and Chloramphenicol.

**2. Antibacterials:** [06 Hrs.]  
**A: Sulphonamides and Sulphones:** Historical development, sulfonamides and folate reductase inhibitors, sulphamethizole\*, sulfacetamide sodium\*, sulfamethoxazole\*, silver sulfadiazine\*, sulfasalazine, dapsone\*, solapsone and related drugs.  
**B: Nitrofurans derivatives:** Nitrofurazone, nitrofurantoin\* and furazolidone\*.  
**C: Fluroquinolones:** Nalidixic Acid\*, Norfloxacin, Ciprofloxacin and related drugs.

**3. Antiparasitic Agents:** [05 Hrs.]  
**A: Anti-Protozoal Agents:** Metronidazole\*, Diloxanide\*, Iodoquinol, Dimercaprol\* and related drugs.  
**B: Antimalarials:** History and development of Quinine sulphate, Chloroquine phosphate\*, Amodiaquine hydrochloride\*, Primaquine phosphate, Quinacrine hydrochloride, Pyrimethamine, Trimethoprim and related drugs.  
**C: Antileishmanial and Antitrichomonal agents.**

**4. Antimycobacterial and Antifungal Agents:** [05 Hrs.]  
**A: Anti-tubercular agents:** INH\*, Ethionamide, Ethambutol, Pyrazinamide, Para amino salicylic acid\*, Rifampicin, Cycloserine\* and others.  
**B: Antileprotic:** Dapsone, solopsone and clofazimine.  
**A: Anti-Fungal Agents:** Clotrimazole, Econazole nitrate, Butoconazole, Oxyconazole nitrate, Tioconazole, Miconazole\*, Ketoconazole\*, Fluconazole, Tolnaftate\*, Amphotericin-B, Nystatin, Griseofulvin and related drugs.

**5. Antiviral Agents:** [06 Hrs.]  
Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridine trifluoride, Acyclovir\*, Zidovudine, Ribavirin, Indinavir and related drugs.

**6. Anti-neoplastic Agents:** [06 Hrs.]  
Melfalan, Chlorambucil, Busulfan, Thiotepa, Mercaptopurine\*, Floxuridine, Methotrexate\*, Dactinomycin, Doxorubicin hydrochloride, Idarubicin hydrochloride, Etoposide, Vinblastin sulphate, Vincristin sulphate and related drugs.

**7. Immunosuppressants and Immunostimulants:** [02 Hrs.]  
Thalidomide, lenalidomide

### **BOOKS RECOMMENDED:**

1. Wolf, Burgers Medicinal Chemistry Vol. II.
2. Wilson, Gesvold & George – A Textbook of Organic, Pharmaceutical & Medicinal Chemistry.
3. Foye, Elements of Medicinal Chemistry.

**PS 6309: PHARMACOLOGY - III (Systemic Pharmacology)**

Module I	(4L)
<b>Local Anaesthetics:</b>	
I. Classification on the basis of site of action and chemical nature,	
II. Mechanism of action.	
Module II	(7L)
<b>Drugs acting on GIT:</b>	
i. Antacid, Antisecretory and Anti-ulcer drugs,	
ii. Emetics and Antiemetics,	
iii. Laxatives and Antidiarrhoeal drugs.	
Module III	(5L)
<b>Drugs acting on Hemopoietic System :</b>	
i. Coagulants and Anticoagulants,	
ii. Fibrinolytic and Anti-platelet drugs,	
iii. Hematinics,	
iv. Blood and Plasma volume expanders.	
Module IV	(7L)
<b>Drugs acting on Cardiovascular System:</b>	
v. Digitalis and Cardiac Glycosides,	
vi. Antihypertensive agents,	
vii. Antihyperlipedemic drugs,	
Module V	(6L)
viii. Antianginal and Vasodilator agents,	
ix. Antiarrhythmic agents,	
x. Drugs used in the therapy of shock.	
Module VI	(5L)
<b>Drugs acting on Urinary System:</b>	
xi. Fluid & electrolyte balance,	
xii. Diuretics.	
Module VII	(6L)
<b>Drugs acting on Respiratory System :</b>	
i. Anti-asthmatic drugs including bronchodialators,	
ii. Anti-tussive and expectorants, drugs used in common cold	
iii. Respiratory stimulants.	
<b><u>Books Recommended :</u></b>	
1. Bhattacharya et al.: "Pharmacology," 2 <sup>nd</sup> ed., Elsevier,	
2. Seth: "Text Book of Pharmacology," Elsevier,	
3. Goodman & Gilman: "The Pharmacological Basis of Therapeutics," Pergamon Press,	
4. Crossland : "Lewis Pharmacology," Churchill Livingstone,	
5. Katzung: "Basic and Clinical Pharmacology," Prentice Hall,	
6. Tripathi: "Essentials of Medical Pharmacology," Jaypee Brothers,	
7. Satoskar: "Pharmacology & Pharmacotherapeutics," Popular Prakashan,	

### PS6311: PHARMACOGNOSY - III

1. Pharmacognosy of drugs containing Glycosides under the category (10L)  
A) **Saponins:** Liquorice, Ginseng, Dioscorea, Sarsaparilla and Senega.  
B) **Cardioactive glycosides:** Digitalis, Squill, Strophanthus and Thevetia.  
C) **Anthraquinone glycosides:** Aloe, Senna, Rhubarb and Cascara.  
D) **Bitter Glycosides:** Gentian, Saffron, Chirata, Kalmegh and Quassia.
2. Pharmacognosy of drugs containing **Pyridine-piperidine and Tropane alkaloids:** (4L)  
A) Tobacco, Areca and Lobella.  
B) Belladonna, Hyoscyamine, Datura, Duboisia.
3. Pharmacognosy of drugs containing **Quinoline isoquinoline and Indole alkaloids:** (3L)  
A) Cinchona, Ipecac, Opium.  
B) Ergot, Rauwolfia, Catharanthus, Nux Vomica and Physostigma.
4. Pharmacognosy of drugs containing **Imidazole alkaloids:** Pilocarpus. (1L)
5. Pharmacognosy of drugs containing **Steroidal alkaloids:** Veratrum and Kurchi, Withania. (3L)
6. Pharmacognosy of drugs containing protoalkaloids (3L)  
A) **Alkaloidal amines:** Ephedra and Colchicum.  
B) **Glycoalkaloids :** Solanum.  
C) **Purines alkaloids:** Coffee, Tea and Cola.
7. **Chromatography methods and Isolation of Phytopharmaceuticals:** (10L)  
A) Introduction, classification and study of different chromatographic methods and their applications in evaluation of herbal drugs  
B) Isolation, characterisation and estimation of Caffeine, Eugenol, Pectin, Solanine, Piperine, Tannic acid, Diosgenin, Berberine, Calcium sennosides, Rutin, Glycyrrhizin, Menthol, Ephedrine, Quinine, Andrographolides, Rhein, Lycopene, Vincristine, Vinblastine.

#### Books recommended:

1. A.N. Kalia, A textbook of Industrial Pharmacognosy, CBS Publishers and Distributors.
2. Harborne J. B. Phytochemical methods, Chapman and Hall, International Edition, London.
3. Iyengar M.A., Study of Crude Drugs, Manipal Power Press, Manipal
4. Jean Bruneton: Pharmacognosy and Phytochemistry, Medicinal Plants. Springer Verlag
5. Kokate C. K. Purohit A. P. and Gokhale S. B. , Pharmacognosy (degree ) Nirali Prakashan
6. Manitto P. The biosynthesis of natural products, Ellis Harwood, Chichester
7. Manske RHF, The alkaloids Academic press, New York
8. Medicinal Plants of India, Indian Council of Medical Research, New Delhi
9. Peach K, And Tracey M. V., Modern Methods Of Plant Analysis, 1-4, Narosa Publishing House, N.Delhi
10. Pharmacopoeia of India, 1985,1996, Govt. of India, Ministry of Health and Family Welfare
11. Pulok Mukherjee, Quality control of Herbal drugs, Business Horizons Pharmaceutical Publishers
12. Raphael Ikan, Natural products a laboratory Guide, Academic Press.
13. Robinson, T., The biochemistry of alkaloids, Springer- Verlag, New York
14. Stahl, E., Thin Layer Chromatography- A Laboratory handbook, Springer-Verlag, Berlin
15. Trease, G.E. and Evans, W.C. Pharmacognosy, 12th Edition, Bailliere Tindall, Eastbourne, U.K
16. Tyler, V.E., Brady, R., Pharmacognosy, Lea & Febiger
17. V.D.Rangari, Pharmacognosy and Phytochemistry Volume I & II
18. Wagner, S.B., Zgainsky, Plant drug Analysis
19. Wallis, T.E. Textbook Of Pharmacognosy, J.A. Churchill Limited, London

## PS 6303: PHARMACEUTICAL ENGINEERING – III

1. **Absorption and Extraction:**
  - 1) Gas Absorption:
    - Gases in liquid, Henry's law, gas - absorption equipments,
    - Numerical problems.
  - 2) Liquid-Liquid Extraction and Solid- Liquid Extraction (Leaching):
    - Distribution law, principles of extraction, extraction equipments, selection of solvents for extraction,
    - Numerical problems.
2. **Drying:**
  - Moisture content and mechanism of drying,
  - Calculation of rate of drying and time of drying,
  - Classification and types of dryers, dryers used in pharmaceutical industries and special drying methods,
  - Mathematical problems.
3. **Crystallization:**
  - Characteristics of crystals like-purity, size, shape, geometry, habit, form size and factors affecting them,
  - Solubility curves and calculation of yield,
  - Super-saturation theory, nucleation mechanism, crystal growth,
  - Study of various types of crystallizers - tank, agitated batch, Swenson – Walker, Vacuum crystallizer, crystal crystallize
  - Numerical problems on yield.
4. **Distillation:**
  - Binary liquid mixture, Raoult's law, phase diagram, volatility, simple steam and flash distillation, principles of rectification,
  - McCabe Thiele method for calculation of number of theoretical plates,
  - Azeotropic and extractive distillation,
  - Mathematical problems on distillation.
5. **Dehumidification and Humidity Control :**
  - Basic concepts and definition, wet bulb and adiabatic saturation temperature,
  - Psychometric chart and measurement of humidity, application of humidity measurement in pharmacy,
  - Equipments for dehumidification operation,
  - Related mathematical problems.
6. **Refrigeration and Air Conditioning:**

Principles and applications of –

  - Refrigeration,
  - Air conditioning.
7. **Automated Process - Control System:**
  - Process variables, temperature, pressure, flow level and their measurements, and
  - Elements of automatic process control and introduction to automatic process control system, Feed back control system, Feed forward control system.

**Books Recommended :**

1. Treybal : "Mass Transfer Operation," 3<sup>rd</sup> ed., McGraw Hill, 1981.
2. McCabe & Smith: "Unit Operations of Chemical Engineering," McGraw Hill, 1993.
3. Badger & Banchero : "Introduction to Chemical Engineering," 5<sup>th</sup> Reprint,. McGraw Hills, 1997.
4. Sambamurthy : "Pharmaceutical Engineering," New Age Int. Pvt. Ltd.,1998.
5. Shreve : "Chemical Process Industry," 4<sup>th</sup> ed., McGraw Hill,1997.
6. Ansel & Stocklosa : "Pharmaceutical Calculations," 10<sup>th</sup> ed.(1st Indian ed.), Waverly, 1996.
7. Parry and Chilton : "Chemical Engineer's Handbook," McGraw Kogakusha,
8. Coughanouer and Koppel, Process System analysis and Control

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## PS 6302 : PRODUCT DEVELOPMENT & FORMULATION LAB.1

Experiments based on the formulation development procedures.

1. Bulk density determinations. - 2 Experiments.
2. Flow property determination. - 4 Experiments.
3. Evaluation and choice of wetting agents. - 2 Experiments.
4. Evaluation and choice of flocculating agents. - 2 Experiments.
5. Evaluation and choice of emulsifying agents. - 2 Experiments.
6. Study of the effect of Phase volume ratio on the rheological properties of emulsion.

## PS 6304: PHARMACEUTICAL ENGINEERING LAB .II

1. Determination of rate of drying, free moisture content and bound moisture of solids of Pharmaceutical interest.
2. Experiments to illustrate the effects various parameters on rate of drying.
3. Distillation study and Boiling point diagram.
4. Determination of calorific value of Solids.
5. Determination of calorific value of Laboratory Gases.
6. Determination of flash point of Oils and Solvents.
7. Determination of overall heat-transfer coefficient of Gases.
8. Measurement of rate of flow of fluids.
9. Construction of calibration curve of Rotameter.
10. Uses of different commercial viscometers.
11. Sketch work of different process equipments like evaporative crystallizer, fluidized bed drier, etc.

### **Books Recommended :**

1. Treybal : "Mass Transfer Operation," 3<sup>rd</sup> ed., McGraw Hill, 1981.
2. McCabe & Smith: "Unit Operations of Chemical Engineering," McGraw Hill, 1993.
3. Badger & Banchero: "Introduction to Chemical Engineering," 5<sup>th</sup> Reprint, McGraw Hill, 1997.
4. Sambamurthy: "Pharmaceutical Engineering," New Age Int. Pvt. Ltd., 1998.
5. Shreve: "Chemical Process Industry," 4<sup>th</sup> ed., McGraw Hill, 1997.
6. Brown: "Unit Operations," Indian Edition, Asian Publishing House,

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## PS 6310: PHARMACOLOGY LAB. – II

### I. Isolated Skeletal Muscle :

1. To record a Concentration Response Curve (CRC) or Dose Response Curve (DRC) of Acetylcholine using rectus abdominis muscle preparation of frog.
2. a) To record the effect of Physostigmine (Eserine) on the CRC of Acetylcholine using rectus abdominis muscle preparation of frog.  
  
b) To calculate the dose ratio (EC<sub>50</sub>) of Acetylcholine in the presence as well as absence of Acetylcholine.
3. To record the effect of d – tubocurarine on the CRC of acetylcholine using rectus abdominis muscle preparation of frog.

### II. Isolated Smooth Muscle :

4. To study the CRC of Acetylcholine using rabbit intestine.
5. To study the antagonistic and synergistic action of Atropine and Eserine in rabbit intestine.
6. To study the CRC of Acetylcholine using guinea pig ileum.
7. To study the antagonistic and synergistic actions of Atropine and Eserine in guinea pig ileum.
8. To study the CRC of Histamine using rabbit intestine.
9. To study the antagonistic action of Diphenhydramine on CRC of Histamine in rabbit intestine.
10. To study the CRC of Histamine using guinea pig ileum.
11. To study the antagonistic action of Diphenhydramine on CRC of Histamine in guinea pig ileum.
12. To study the CRC of 5 – HT in guinea pig ileum.
13. To study the antagonistic action of Cyproheptadine in guinea pig ileum.
14. Cumulative dose response curve of Acetylcholine, Histamine and 5 HT in rabbit intestine.
15. To study the effect of Drugs on isolated uterus.

### **Books Recommended:**

1. Kulkarni: “Hand Book of Experimental Pharmacology,” Vallabh Prakashan,
2. Pillai: “Experimental Pharmacology,” CBS Publishers & Distributors,
3. Prakash: “Experimental & Clinical Physiology,” MacMillan,

## PS6312: PHARMACOGNOSY LAB - II

1. Determination of moisture content, ash value, extractive value, foreign organic matter and swelling index of crude drugs.
2. General phytochemical tests for identification of Alkaloids, Glycosides, Steroids, Flavonoids and Tannins.
3. Identification of Crude Drugs listed in theory.
4. Microscopic study of some important of Alkaloids, Glycosides, Steroids, Flavonoids, a- containing Crude (powdered) Drugs covered in the theory.
5. Microscopic measurements of cells and cell contents: Starch grains, Calcium oxalate crystals and Phloem fibers.
6. Determination of leaf constants: such as stomatal index, stomatal number, vein-islet number, vein-termination number and palisade ratio.
7. Chromatographic Finger printing of some crude mentioned in theory.
8. Isolation of some phyto constituents
9. TLC chromatography profile of drugs of each category mentioned in theory.
10. Demonstration of HPTLC/HPLC / GC few Drugs of Natural Origin
11. Visit to medicinal and aromatic plants garden.
12. Preparation of herbarium sheets and monograph on one of the collected plant during tour.

### **Books recommended:**

1. A.N. Kalia, A textbook of Industrial Pharmacognosy, CBS Publishers and Distributors.
2. AC. Dutta: Botany for Degree students, Oxford University Press, New Delhi
3. Ashutosh Kar, Pharmacognosy and Biotechnology, New Age Publishers.
4. Ayurvedic Formulary of India, Govt. of India, New Delhi
5. Ayurvedic Pharmacopoeia of India, All Volumes.
6. British Herbal Pharmacopoeia
7. Harborne J. B. Phytochemical methods, Chapman and Hall, International Edition, London
8. Henry T. A., The plant alkaloids, McGraw Hill, New York
9. Herbal Pharmacopoeia, IDMA, Mumbai
10. Iyengar M.A., Study of Crude Drugs, Manipal Power Press, Manipal
11. Kokate C. K, Practical Pharmacognosy , Nirali Prakashan
12. Central council of Research in Ayurveda and Siddha (CCRAS) Guidelines

## **VI. B. PHARM. : 7<sup>TH</sup> SEMESTER**

### **PS 7301: INDUSTRIAL PHARMACY – II**

1. **Liquid Orals:**
  - A. Formulation Considerations: Solubility, stability and Organoleptic properties.
  - B. Manufacturing Considerations: Raw materials, Equipments, Compounding & Packaging.
2. **Emulsions:**
  - A. Product Development:
  - i). Formulation Factors: Choice of lipid phase, surface-active agents, auxiliary emulsifiers, antimicrobial preservatives, antioxidants, Special formulation considerations with respect to consistency.
  - ii). Processing Factors: Temperature, Agitation, Placement of emulgents, Mode of blending the phases, Rate of Cooling etc.
    - B. Mechanical Equipments and Production Aspects.
    - C. Processing of Emulsions.
    - D. Illustrative examples with a reference to official products.
3. **Suspensions:**
  - A. Preparation of Insoluble Phase: Preparative methods, Crystal structure factors in relation to physical stability and bioavailability.
  - B. Formulation of suspensions: Deflocculated and Flocculated systems, Formulation adjuvants, preparative techniques.
  - C. Illustrative examples with a reference to official products.
4. **Parenteral Products:**
  - i). Small Volume Parenterals:
    - A. Product Development: Classification, General and specific formulation requirements, selection of parenteral components like vehicles, solutes (active ingredients) additives, containers and closures.
    - B. Formulations: Solutions, suspensions, Emulsions, Freezedried products, Sustained release formulations.
    - C. Production: Production facilities and production procedures.
    - D. Quality control (inclusive of official tests & their limits).
    - E. A Critical study of selected official (IP/BP) monographs based on physical; nature of formulation, Route of administration etc.
  - ii). Large Volume Parenterals (LVPS):
    - A. Specific Formulation Aspects.
    - B. Packaging systems.
    - C. Administration procedures.
    - D. Quality control.
    - E. A Critical study of selected official (IP/BP) monographs.
5. **Aerosols:**
  - A. Introduction: Definition, Historical developments, Relative merits/demerits.
  - B. Components of Aerosol package: Propellants, Containers, Valves & Actuators.
  - C. Formulation of Pharmaceutical Aerosols, Classification, Formulation details, Selection of components.
  - D. Testing of Pharmaceutical Aerosols.
6. **Packaging:**

Function of package, classification of packaging materials and their composition, Factors governing the selection of packaging materials, Unit dose packing, Evaluation of packaging materials (including methods).

**BOOKS RECOMMENDED:**

1. Lachman et al : Theory and Practice of Industrial Pharmacy
2. Remington Pharmaceutical Sciences.
3. Carstensen : Pharmaceutics of Solids and Solid Dosage Forms.
4. Banker and Rhodes : Modern Pharmaceutics (Revised & Expanded).
5. Ansel et. al. : Pharmaceutical Dosage Forms and Drug Delivery System.
6. Jain Ed.: Advances in Controlled & Novel Drug Delivery.
7. Lachman et. al. : Pharmaceutical Dosage Forms : Parenterals Vol. 1-2.

## PS 7303: BIOPHARMACEUTICS & PHARMACOKINETICS

### I. BIOPHARMACEUTICS :

#### 1. INTRODUCTION

- i) Biopharmaceutics & Pharmacokinetics : Definitions, and  
Role in Product Development
- ii) Explanation of the Terms:
  - Bioavailability, and
  - Bioequivalence
- iii) Equivalence Types :
  - Chemical,
  - Clinical,
  - Therapeutic,
  - Generic, and
  - Pharmaceutical Alternatives

#### 2. PRINCIPLES OF DRUGS DISSOLUTION RELATED TO BIOAVAILABILITY

##### i) Tablets & Capsules.

- ii) Disintegration & Factors affecting DT
- iii) Dissolution of solids:
  - Mechanisms & Models of Dissolution
  - Factors influencing Dissolution Rate (*in vitro* Release)
  - Quantitative Study of Dissolution- Methods
  - *In-vitro* Dissolution & Interpretation of Dissolution Data.

#### 3. PRINCIPLES OF DRUG ABSORPTION RELATED TO BIO-AVAILABILITY(15 hrs)

- i) Biological Factors:
  - Passage of Drugs through Natural Membranes.
  - Gastric Emptying & Intestinal Transition.
  - Blood Flow, G.I. –Metabolism & -Degradation.
  - Interactions with Food & Co-administered Drugs.
  - Disease State, and
  - Route of Administration.
- ii) Physico – Chemical Factors :
  - Lipid Solubility,
  - Dissociation & pH,
  - Complexation & Surface –active agents, and
  - Donnan Membrane Equilibrium.
- iii) Pharmaceutical Factors :
  - Dosage Form Types, and
  - Formulation Variables

### II. PHARMACOKINETICS :

1. Principles of Pharmacokinetics,
2. Concepts of Compartmental Model,
3. Characteristics of One Compartment Model, and
4. One Compartment Model – based Pharmacokinetic Derivations (involving the concepts of (a.) Experimentally Determined Rates, (b.) Methods of Residuals, and (c.) Trapezoidal Rule) for the following modes of Drug Administration :
  - i) Intra-Venous Administration (Plasma Level & Urinary Excretion Data)-
    - Single Dose
    - Repeated / Multiple Dosing (Plasma Data)
    - Continuous /Constant Rate Administration (Infusion).

- ii) Absorption – Related /Based Administration (Single Dose) -
  - Absorption Rate Constant ( $k_a$ )
  - Elimination Rate Constant ( $K$ ) & Elimination Half - life ( $t_{1/2}$ ).
  - AUC,  $C_{max}$ , and  $t_p$ .
- iii) Apparent Volume of Distribution ( $V_d$ ) & Renal Clearance ( $Q$ )-  
- Pharmacokinetic expressions for the above Administration situations.

**Books Recommended :**

1. Gibaldi : “Biopharmaceutics & Clinical Pharmacokinetics,” 3<sup>rd</sup> ed., Lea Febiger, 1984.
2. Swarbrick, Ed., : “Current Concepts in Pharmaceutical Sciences ( Biopharmaceutics),” Lea & Febiger, 1970.
3. Swarbrick, Ed.: “Current Concepts in Pharmaceutical Sciences ( Dosage Form Design & Bioavailability),” Lea & Febiger, 1973.
4. Rowland & Tozer: “Clinical Pharmacokinetics (Concepts & Applications),” 3<sup>rd</sup> ed., Lea & Febiger – Waverly, 1995.
5. Mancheras et al : “Biopharmaceutics of Orally Administered Drugs,” Ellis Horwood (series in Pharmaceutical Technology ), 1995
6. Niazi : “Biopharmaceutics & Clinical Pharmacokinetics,” Appleton- Century Crofts , 1979.
7. Notari : “Biopharmaceutics & Clinical Pharmacokinetics ( an introduction),” 4<sup>th</sup> ed. ( Revised & Expanded), Marcel Dekker, 1987.
8. Shargel & Yu: “Applied Biopharmaceutics & Pharmacokinetics,” 4<sup>th</sup> ed., Appleton & Lange, 1999.
9. Gibaldi & Perrier : “Pharmacokinetics,” 2<sup>nd</sup> ed. (Revised & Expanded), Marcel Dekker (series in Text-Books & Monographs : Swarbrick, Ed., vol.15), 1982.
10. Welling & Tse, Eds. : “Pharmacokinetics,” 2<sup>nd</sup> ed., Marcel Dekker, 1995.
11. Wagner : “Fundamentals of Clinical Pharmacokinetics,” Drug Intelligence Publication
12. Wagner : “Pharmacokinetics for the Pharmaceutical Scientist,” Technomic Publishing
13. Pecile & Resigno : “Pharmacokinetics,” Plenum Press.
14. Ritschel : Hand Book of Basic Pharmacokinetics, Drug Intelligence Publication.
15. Winter : Basic Clinical Pharmacokinetics, Applied Therapeutics,
16. Brahmankar & Jaiswal : Biopharmaceutics & Pharmacokinetics (A Treatise), Vallabh Prakashan, 1995.
17. Venkateshwarlu : Fundamentals of Biopharmaceutics & Pharmacokinetics, Paras Publishing, 2000.

## PS 7305: SYNTHETIC MEDICINALS I

Classification, Structure, nomenclature, mode of action, Uses and SAR of following categories of drugs alongwith synthesis (\*) and assay (\*) of official (IP/BP) compound.

- Opioid Analgesics and anti-tussives:** [07 Hrs.]  
A. **Morphine and related drugs:** Meperidine hydrochloride\*, Fentanyl citrate\*, Methadone hydrochloride\*, and related drugs of clinical importance.  
B. **Anti-tussives:** Noscapine, Dextromethorphan hydrogen bromide and Benzonatate.
- Analgesic, anti-inflammatory (NSAID) and antipyretic drugs:** [04 Hrs.]  
Aspirin, Paracetamol\*, Indomethacin\*, Sulindac, Salsalate\*, Diclofenac sodium, Ibuprofen\*, Naproxen\*, Piroxicam\*, Phenylbutazone\* and related drugs of clinical importance.
- Antihistaminic agents:** [03 Hrs.]  
Introduction to H1, H2 and H3 receptors. Diphenhydramine hydrochloride\*, Dimenhydrinate, Bromo diphenhydramine hydrochloride\*, Doxylamine Succinate\*, Carbinoxamine maleate\*, Clemastine fumarate\*, Tripelenamine hydrochloride\*, Pyrilamine maleate\*, Cyclizine hydrochloride\*, Chlorcyclizine hydrochloride\*, Meclizine hydrochloride\*, Triprolidine hydrochloride\*, Phenidamine tartarate\*, Promethazine hydrochloride\*, Cyproheptadine hydrochloride\*, Cimetidine\*, Ranitidine, Omeprazole and related drugs of clinical importance.
- Local Anaesthetics:** Cocaine, Benzocaine\*, Butamben, Procaine\*, Lignocaine\*, Dibucaine\* and related drugs of clinical importance.
- Drugs acting on CNS-I:** [06 Hrs.]  
A. **General anaesthetics:** Halothane\*, Methoxyflurane, Methohexital sodium\*, Thiamylal sodium\*, Ketamine hydrochloride\* and related drugs.  
B. **Anxiolytics, Sedatives and Hypnotics:** Chlordiazepoxide\*, Diazepam\*, Alprazolam, Barbitol\*, Phenobarbital, Triclofos sodium\* and related drugs.  
C. **Antipsychotics and antiemetics:** Chlorpromazine hydrochloride\*, Prochlorperazine maleate\*, Trifluoperazine hydrochloride, Chlorprothixene, Thiothixene, Haloperidol and related drugs.
- Drugs acting on CNS-II:** [06 Hrs.]  
D. **Anticonvulsants or antiepileptics:** Phenytoin\*, Barbiturates, Trimethadione\*, Ethosuximide\*, Carbamazepine\*, Primidone\*, Valporic acid\* and Clonazepam\* and related drugs.  
**CNS stimulants and antidepressants:** Nikethamide\*, Doxapram hydrochloride\*, Dextroamphetamine sulphate\*, Amitriptyline hydrochloride\*, Imipramine hydrochloride\*, Doxepin hydrochloride\* and related drugs.
- Antifertility agents:** [03 Hrs.]  
Oral contraceptives with emphasis on combination regimen, Intrauterine Devices & Implants etc. Synthesis of Medroxyprogesterone.

### **BOOKS RECOMMENDED:**

- Wolf's, Burga – Textbook of Medicinal Chemistry Vol. I, II, III.
- Wilson & Gisenold, A textbook of organic Pharmaceutical and Medicinal Chemistry.
- William Foye – Elements of Medicinal Chemistry.

## PS7307: INSTRUMENTAL DRUG ANALYSIS

Working Principle, basic instrumentation, pharmaceutical application and general interpretation methodologies of the following analytical techniques

### 1. **Molecular Absorption Spectroscopy:** [08 Hrs.]

UV-Visible Spectroscopy including Nepheloturbidimetry: Brief review of electromagnetic spectrum and absorption of radiations. The chromophore concept, absorption law and limitations. Theory of electronic spectroscopy, absorption by organic molecules, choice of solvent and solvent effects, modern instrumentation – design and working principle. Applications of UV-Visible spectroscopy (qualitative and quantitative analysis), Woodward – Fischer rules for calculating absorption maximum, Photometric titrations and its applications.

IR/Raman Spectroscopy: Introduction, basic principles, vibrational frequency and factors influencing vibrational frequency, instrumentation and sampling techniques, applications in Pharmacy. FT-IR-theory and applications.

### 2. **Molecular Emission Spectroscopy:** [03 Hrs.]

Spectrofluorimetry: Theory, instrumentation, advantages, relationship of chemical structure to fluorescence spectra, solvent effect, effect of acids and bases on fluorescence spectra, concentration effects, factors affecting fluorescence intensity, comparison of fluorescence and UV-Visible absorption methods and applications in Pharmacy.

### 3. **Atomic absorption and Flame Emission Spectroscopy:** [03 Hrs.]

Principle, instrumentation, interferences and applications in Pharmacy.

### 4. **Electroanalytical techniques:** [08 Hrs.]

Potentiometry: Introduction, Electrochemical cells, half-cells, electrodes, measurement of potential, Potentiometric titrations and application in pharmaceutical analysis.

Conductometry: Basic concepts, different types of conductometric titrations, apparatus used, Conductometric titrations and applications in Pharmaceutical Analysis.

Polarography and Amperometry: Basic concept, theoretical considerations, Basic instrumentation, apparatus, principles, general polarography analysis and applications in pharmaceutical analysis. Amperometric titrations with one polarized electrode, general procedure, titration curves and applications.

Electrophoresis: Principle, instrumentation and application.

### 5. **Chromatography:** [08 Hrs.]

**High Performance Thin Layer Chromatography:** Theory and Principle, instrumentation, elution techniques and pharmaceutical applications.

**High Performance Liquid Chromatography :** Principle, instrumentation, solvents used, sample preparation, pre and post column derivatisation, elution techniques, classification of chromatographic methods based on mechanism of separation (Reverse Phase/Normal Phase chromatography), applications in Pharmacy.

**Gas Chromatography :** Theory and principle, instrumentation and applications in Pharmacy.



- 6. NMR and ESR:** [03 Hrs.]  
Theoretical aspects, basic instrumentation, elements of interpretation of spectra and applications in pharmacy.
- 7. Mass Spectroscopy:** [03 Hrs.]  
Theoretical aspects, basic instrumentation, elements of interpretation of spectra and applications in pharmacy.

**Books Recommended:**

1. Practical Pharmaceutical Analysis (Vol-II) by Beckett and Stenlake.
2. Instrumental methods of analysis by Gurdeep Chatwal.
3. Spectroscopy by William Kemp.
4. Textbook of Chemical Analysis A.J. Vogel.
5. Textbook of Pharmaceutical Analysis by K.A. Connors.
6. Indian Pharmacopoeia '96, Vol I and II.
7. Spectrometric identification of organic compounds by R.M. Silverstein, John Wiley and Sons Inc.
8. Quantitative analysis of Drugs in Pharmaceutical Formulations by P.D. Seth.
9. Application of Absorption Spectroscopy of Organic Compounds by John R. Dyer.

**PS7309: PHARMACOLOGY – IV**  
**(Chemotherapeutic & Endocrine Pharmacology)**

**1. Chemotherapeutic Pharmacology:**

Module I		(5L)
i.	General Principles of chemotherapy,	
ii.	Sulphonamides and Cotrimoxazole,	
Module II		(6L)
iii.	Antibiotics - Penicillins, Cephalosporines, Chloramphenicol, Macrolides, Quinolones & miscellaneous antibiotics,	
Module III		(8L)
iv.	Chemotherapy of Tuberculosis and Leprosy,	
v.	Fungal diseases,	
vi.	Protozoal Parasites (Malaria, Amoebiasis, Anthelmintics),	
Module IV		(6L)
vii.	Viral infections,	
viii.	Urinary-tract infections,	
ix.	Sexually-transmitted diseases,	
Module V		
x.	Chemotherapy of Malignancy and Immunosuppressive agents.	

**2. Pharmacology of Endocrine System:**

Module VI		(6L)
i.	Hypothalamic & Pituitary hormones, ACTH & Corticosteroids,	
ii.	Thyroid hormones & Antithyroid drugs- Parathormone, Calcitonin and Vit. D,	
iii.	Insulin, Oral Hypoglycemic agents and Glucagon,	
Module VII		(5L)
iv.	Androgenic & Anabolic steroids,	
v.	Estrogen, Progesterone and Oral Contraceptives,	
vi.	Drugs acting on the Uterus.	

**Books Recommended:**

1. Bhattacharya et al.: "Pharmacology," 2<sup>nd</sup> ed., Elsevier,
2. Seth: "Text Book of Pharmacology," Elsevier,
3. Goodman & Gilman: "The Pharmacological Basis of Therapeutics," Pergamon Press,
4. Crossland : "Lewis Pharmacology," Churchill Livingstone,
5. Katzung: "Basic and Clinical Pharmacology," Prentice Hall,
6. Tripathi: "Essentials of Medical Pharmacology," Jaypee Brothers,
7. Satoskar: "Pharmacology & Pharmacotherapeutics," Popular Prakashan,
8. Bennet & Brown : "Clinical Pharmacology," Churchill Livingstone,

## PS7311: PHARMACOGNOSY – IV

- 1. Metabolites:** (3L)
- General techniques of biosynthetic studies and basic metabolic pathways.
  - Brief introduction to biogenesis of secondary metabolites of pharmaceutical importance.
2. Chemistry, biogenesis and pharmacological activity of medicinally important (4L)
- Terpenes & Terpenoids:** monoterpenes, sesquiterpenes, diterpenes and triterpenoids.
  - Carotenoids:**  $\alpha$ -carotenoids,  $\beta$ -carotenes, vitamin A, xanthophylls of medicinal importance.
3. Chemistry, biogenesis and pharmacological activity of medicinally important (8L)
- Glycosides:** Chemistry and biosynthesis of –digitoxin, digoxin, hecogenin, sennosides, diosgenin and sarasapogenin.
  - Alkaloids:** Atropine and related compounds, quinine, reserpine, morphine, papavarine, ephedrine, ergot and vinca alkaloids.
  - Lignans ,Quassanoids & Flavonoids :** Podophyllotoxin, Picropodophyllin, Quassin, Naringin, Quercitin, hesperidin.
4. Study of Nutraceuticals as health foods: Introduction, Types of spirulina, soya and garlic (2L)
5. Herbal Cosmetics (10L)
- Brief study of Phytocosmetics of industrial significance and current status.  
Herbs used for different cosmetic preparations Like Shampoos (soapnut), Conditioners, (Amla, Henna, Hibiscus, Tea), Hair darkeners (Amla, Henna), Skincare (Aloe, Turmeric)
- 7) Herbal pesticides: Neem, Tobacco, Pyrethrum Vitex Acorus and turmeric. (5L)

### Books recommended:

- 1) Ayurvedic Pharmacopoeia of India, All Volumes.
- 2) Ayurvedic Formulary of India, Govt. of India, New Delhi
- 3) British Pharmacopoeia
- 4) Herbal Pharmacopoeia, IDMA, Mumbai
- 5) Herbal Product Volume I & II, NISCAIR, New Delhi
- 6) Horborne J. B. Phytochemical methods, Chapman and Hall, International Edition, London
- 7) Kokate C. K. Purohit A. P. and Gokhale S. B. , Pharmacognosy (degree ) Nirali Prakashan
- 8) Medicinal Plants of India, Indian Council of Medical Research, New Delhi
- 9) Peach K, And Tracey M. V., Modern Methods Of Plant Analysis, 1-4, Narosa Publishing House, N.Delhi
- 10) Pharmacopoeial Standards Of Ayurvedic Formulations
- 11) Pulok Mukherjee, Quality Control Of Herbal Drugs
- 12) Swain T., Comparative Phytochemistry, Academic Press London
- 13) Trease, G.E. And Evans, W.C. Pharmacognosy, 12th Edition, Bailliere Tindall, Eastbourne, U.K.
- 14) Tyler, V.E., Brady, R., Pharmacognosy
- 15) V.D.Rangari, Pharmacognosy And Phytochemistry Volume I & II
- 16) Wallis, T.E. Textbook Of Pharmacognosy, J.A. Churchill Limited, London
- 17) Robert Verpoorte & Pulok Mukherjee, GMP For Botanicals, Business Horizons, New Delhi.
- 18) Quality Control Of Crude Drug B ICAR, New Delhi.
- 19) Quality Control Of Crude Drug By WHO

- 20) Balsam M S Cosmetics: Science And Technology All Vol New York: John Wiley And Sons, 1972.
- 21) Paye Marc, Handbook Of Cosmetics And Technology. New York: Taylor And Francis, 2006
- 22) Rieger Martin M Harry's Cosmeticology. New York: Chemical Publishing Co. Inc., 2000.
- 23) Thomssen E G Modern Cosmetics. Bombay: Universal Publishing Corporation, 2006.
- 24) Poucher W A Perfumes, Cosmetics and Soap Vol - 2.London: Chapman Hall, 1993
- 25) Gibbs R Darnely, Chemotaxonomy of Flowering Plants 4 volumes, McGill, University Press
- 26) Swain T., Chemical Plant Taxonomy, Academic Press London
- 27) Ross, M.S.F. and Brain, K.R., An Introduction to Phytopharmacy, Pitman Medical Rent

## **PS 7302: Product Development Lab.-II**

### **List of Experiments**

1. To formulate & evaluate placebo tablets.
2. To formulate & evaluate Ascorbic Acid tablets/Soluble Aspirin Tablets.
3. To formulate & evaluate Aluminium Hydroxide Gel Tablets/DCP/Calcium Carbonate tablets.
4. To formulate Hard Gelatine Capsules I.P. of the drug that does not involve any equivalence.
5. To formulate Hard Gelatine Capsules I.P. of the drug, involving equivalence.
6. To formulate Antacid (Aluminium hydroxide gel) suspension.
7. To prepare sterile water for injection IP.
8. To develop Calcium gluconate injection IP.
9. To develop Ascorbic acid injection IP.
10. To formulate dextrose & sodium chloride injection (isotonic) IP.
11. To develop and prepare cough syrup.
12. To develop and prepare Systemic Alkalizer
13. To develop and prepare Systemic Alkalizer with Paracetamol.

## **PS7308: DRUG ANALYSIS LAB.**

### List of Experiments:

1. Assay of Aluminium Hydroxide Tablets I.P.
2. Assay of Sulphur Ointment. I.P.
3. Assay of Metronidazole Tablets. I.P.
4. Assay of Lignocaine Injection I.P.
5. Assay of Ibuprofen Tablets I.P.
6. Assay of Soluble Aspirin Tablets I.P.
7. Assay of Aspirin Tablets I.P.
8. Assay of Ascorbic Acid Tablets I.P.
9. Assay of Calcium Phosphate / Gluconate Tablets.
10. Assay of Ferrous Sulphate Tablets I.P.
11. Assay of Ampicillin / Amoxicillin Capsules.
12. Assay of Ethambutol Tablets I.P.
13. Assay of Aminophylline Tablets I.P.
14. Assay of Sodium Chloride, Potassium Chloride and Dextrose in the given sample.

### PS 7310: PHARMACOLOGY LAB – III

1. To find out the strength (concentration) of given sample of Acetylcholine by interpolation bioassay method using rectus abdominis muscle preparation of Frog.
2. To estimate the strength of the unknown sample of Acetylcholine by 3-point bioassay employing rectus abdominis muscle of Frog.
3. To estimate the strength of the unknown sample of Acetylcholine by 4-point bioassay employing rectus abdominis muscle of Frog.
4. To estimate the strength of the unknown sample of Acetylcholine by 3-point bioassay employing Rabbit jejunum.
5. To estimate the strength of the unknown sample of Acetylcholine by 4-point bioassay employing Rabbit jejunum.
6. To estimate the strength of the unknown sample of Histamine by 3-point and 4-point bioassay employing Rabbit jejunum.
7. To estimate the strength of the unknown sample of Acetylcholine by 3-point bioassay employing Guinea Pig ileum.
8. To estimate the strength of the unknown sample of Acetylcholine by 4-point bioassay employing Guinea Pig ileum.
9. To estimate the strength of the unknown sample of Histamine by 3-point bioassay employing Guinea Pig ileum.
10. To estimate the strength of the unknown sample of Histamine by 4-point bioassay employing Guinea Pig ileum.
11. To estimate the strength of the unknown sample of 5HT by 3-point and 4 point bioassay employing Guinea Pig ileum.
12. To estimate the strength of the unknown sample of Oxytocin by 3-point and 4-point bioassay using Rat uterus.
13. To estimate the strength of the unknown sample of 5HT by 3-point and 4-point bioassay employing Rat fundus strip preparation.
14. To record the concentration-dependent contractile response of Phenylephrine on the isolated Rat vas deferens preparation.
15. To study the local anaesthetic property of Procaine hydrochloride using foot withdrawal reflex of Frog.
16. Determination of  $PA_2$  Value.

#### **Books Recommended:**

16. Kulkarni: "Hand Book of Experimental Pharmacology," Vallabh Prakashan,
17. Pillai: " Experimental Pharmacology," CBS Publishers & Distributors,
18. Prakash: "Experimental & Clinical Physiology," MacMillan,

### PS 7312: PROJECT-I

## **B. PHARM. : 8<sup>TH</sup> SEMESTER**

### **PS 8301: PHARMACEUTICAL ENTERPRISE MANAGEMENT**

#### **1. Fundamental Concepts of Management:**

- Definition and different concepts of Management
- Evolution of management, Scope of management
- Administrative management and various functions of a manager including planning, staffing, controlling and directing
- Pharmaceutical Entrepreneurship development.

#### **2. Principles of Management:**

- Coordination, Communication, Motivation
- Decision making, Leadership, Innovation, Creativity
- Delegation of authority / responsibility, Record keeping
- Identification of key areas to give maximum thrust for development & perfection.

#### **3. Economics:**

- Principles of economics with special reference to laws of demand & supply
- Demand schedule, demand curve
- General principles of insurance.

#### **4. Business Organization:**

Forms of Business organization-Sole trading, Partnership, Joint Stock Company, Cooperatives.

#### **5. Marketing Management:**

- i. Functions- buying, selling, transportation, storage, finance.
- ii. Channels of Distribution- wholesale, retail, departmental store, multiple shop and mail order business.
- iii. Market Research- brief introduction to market research with respect to pharmaceutical industries.

#### **6. Human Resource Management:**

- Recruitment and selection of employees
- Motivation
- Compensation
- Training & Development of employees in a pharmaceutical industry
- Pharmacist-patient relationship and pharmacist – wholesaler relationship
- Labour welfare schemes.

#### **7. Materials' Management:**

- i. A brief exposure on the basic principles of management – major areas, scope, purchase.
- ii. Stores Management - Inventory Control (ABC & VED) and evaluation of material management with reference to drugs and pharmaceuticals.

#### **8. Accountancy:**

- Basic principles of accountancy
- Ledger posting and book entries, columns of a cashbook
- Bills of exchanges
- Preparation of trial balance, Profit & Loss account, Balance sheet.

**Books Recommended:**

1. Smith: "Principles and Methods of Pharmacy Management," 1<sup>st</sup> ed., Lea & Febiger, Philadelphia, 1975.
2. Koontz & O'Donnell: "Principles of Management," McGraw Hill,
3. Koontz & Weihrich: "Essentials of Management," 5<sup>th</sup> ed., McGraw Hill, 1974.
4. Drucker: "The Practice of Management," 1<sup>st</sup> ed., Allied Publishers, 1977.
5. Prasad : "Principles & Practice of Management," 6<sup>th</sup> ed., Sultan Chand & Sons, 2001.
6. Ali & Gupta : "Drug Store & Business Management," CBS Publisher, 1996.
7. Kotler & Armstrong: "Principles of Marketing," 8<sup>th</sup> ed., Prentice Hall India Pvt. Ltd., 2001.
8. Rao: "Pharmaceutical Marketing in India," Asian Institute of Pharmaceutical Marketing, Hyderabad,
9. Ramaswamy & Namakumari : "Marketing Management, Planning, Implementation & Control," 3<sup>rd</sup> ed., MacMillan India Ltd., 2003.
10. Kulshetra & Gupta : "Practical Problems in Management Accounting," 1<sup>st</sup> ed., Sahitya Bhawan, 1995.
11. Mamoria: "Personnel Management," 5<sup>th</sup> ed., Himalayan Publishing House, 1987.
12. Flippo: "Personnel Management," 6<sup>th</sup> ed., McGraw Hill, 1984.
13. Raman: "Accountancy & Commerce,"
14. Ganapathy : "Principles of Economics,"



## PS 8303: BIOLOGICAL & FERMENTATION PRODUCTS

1. **Surgical Products:** (5L)
  - a. Definition, primary wound dressing, absorbents, surgical cotton, surgical gauzes etc., bandages, adhesive tape, official dressings
  - b. Medical prosthetics and organ replacement materials.
2. **Ligatures and Sutures:** (2L)

Preparation, preservation & standardization of ligatures and sutures with special reference to catgut.
3. **Immunity and Immunological products:** (20L)
  - i. Introduction to antigen and antibody, . Different types of antigen- antibody reactions, Defensive mechanisms of our body, Interferon.
  - ii. Manufacturing, preservation and standardization of vaccines and sera  
(official in IP/BP ) with special reference to:
    - a. Cholera vaccine, Pertusis vaccine, TAB vaccine, BCG vaccine, Small Pox vaccine, Rabies vaccine, Yellow fever vaccine, Influenza vaccine, Polio vaccine, Thyphus vaccine
    - b. Diptheria toxoid, Tetanus toxoid, Staphylococcal toxoid
    - c. Diptheria antitoxin, Gas gangrene antitoxin, Botulinum antitoxin, Tetanus antitoxin
    - d. Rabies antisera, Normal immunoglobulin etc.
4. **Diagnostic Agents:** (3L)

Preparation and application of various diagnostic agents with special reference to detection of diseases like diptheria and tuberculosis.
5. **Blood and Blood - Related Products :** (5L)
  - a. Whole Human Blood, Concentrated RBC
  - b. Dried Human Plasma, Dried Human Serum
  - c. Human Fibrinogen, Human Thrombin, Human Fibrin Foam
  - d. Human Normal Immunoglobulin
  - e. Any other product with reference to compendial standards.
6. **General Processes in Microbial Production:** (5L)
  - a. Alcohol,
  - b. Acetic acid, and
  - c. Antibiotics like Penicillin, Tetracycline, Streptomycin.

### Books Recommended :

1. Pepler & Pepler: "Microbial Technology," Vol. I & II, Academic Press, 1979.
2. Hugo & Russel: "Pharmaceutical Microbiology," 1<sup>st</sup> ed., Blackwell Scientific Publication, 1977.
3. Prescott & Dunn: "Industrial Microbiology," Agrobios India., 2002
4. Controller of Publications: "Pharmacopoeia of India," 4<sup>th</sup> ed., 1996.
5. Her Majesty's Stationary Office: "British Pharmacopoeia," University Press, Cambridge,
6. Carter, Ed.: "Cooper & Gunn's Tutorial Pharmacy," 6<sup>th</sup> ed., CBS Publishers, 1972.
7. Rawlins, Ed.: "Bentley's Textbook of Pharmaceutics," 8<sup>th</sup> ed. (Reprint), ELBS, 2002.
8. Shetty: "Immunology-Introductory Textbook," New Age Int. Pvt. Ltd, 2001
9. Sykes: "Disinfection & Sterilization," 2<sup>nd</sup> ed.,

## PS 8305: PHARMACEUTICAL JURISPRUDENCE

### I. INTRODUCTION:

1. Pharmaceutical Legislations
2. Drugs & Pharmaceutical Industry
3. Pharmaceutical Education

### II. DETAILED STUDY OF THE FOLLOWING ACTS & RULES

(as amended up-to-date while citing relevant cases' Judgments of various High Courts):

1. Drugs & Cosmetics Act & Rules
2. Pharmacy Act
3. Pharmaceutical Ethics
4. Medicinal & Toilet Preparation (Excise Duties) Act & Rules
5. Drugs & Magic Remedies ( Objectionable Advertisement) Act
6. Narcotic Drugs & Psychotropic Substances Act & Rules
7. Drugs price Control order.

### III. BRIEF STUDY OF THE FOLLOWINGS WITH REFERENCE TO THE MAIN PROVISIONS: (10 hrs)

2. AICTE Act
3. Factories Act
4. States Shops & Establishment Act & Rules
5. Poison Act
6. Insecticide Act
7. Prevention of Cruelty to Animals Act
8. Patent Act
9. GATT Agreement
10. Trade & Merchandise Marks Act .

### Books Recommended :

1. The Bare Acts & Rules (With Latest Amendments), Government of India.
2. Mittal : "A Text Book of Forensic Pharmacy," X ed., National Book Depot.
3. Jain : "A Text Book of Forensic Pharmacy," Vallabh Prakashan,
4. Mallick : "Drug and Cosmetics Act & Rules together with Drug (Prices Control) Order," XI ed., Eastern Book Company, 1998.
5. Beotra : "The Law of Drugs," Medicine & Cosmetics, 1992.
6. Bharati : "Drugs & Pharmacy Laws in India," Sadhana Mandir.
7. Despande, S.W.: "Drugs & Cosmetics Acts Rules,".

## PS8307: SYNTHETIC MEDICINALS-II

Classification, Structure, nomenclature, mechanism of action, uses and SAR of following categories of drugs along with synthesis (\*) and assay (\*) of official (I.P. / B.P.) compounds.

1. **Drugs acting on ANS-I (Adrenergic drugs):** [07 Hrs.]
  - A. **Sympathomimetic agents:** Adrenergic receptor hypothesis, Epinephrine, Nor-epinephrine, Dopamine, Phenylephrine\*, Salbutamol\*, Ephedrine\*, Pseudoephedrine\*, Clonidine\*, Tetrahydrozoline and related drugs.
  - B. **Adrenergic Antagonists:** Tolazoline\*, Phentolamine\*, Phenoxybenzamine, Prazosin\*, Propranolol\*, Acebutolol\*, Atenolol\*, Metoprolol\*, Labetolol and related drugs.
2. **Drugs acting on ANS-II (Cholinergic drugs and ganglionic blockers):** [07 Hrs.]
  - C. **Cholinergic receptors drugs and related agents:** Cholinergic receptors, biochemical effects of muscarinic stimulation, cholinergic neuro chemistry and stereochemistry of cholinergics. Acetylcholine\*, Carbachol\*, Physostigmine, Neostigmine, Pyridostigmine\* and related drugs.
  - D. **Cholinergic Blocking agents:** Atropine sulphate, Hyoscyamine sulphate, Scopolamine hydrogen bromide, Homatropine hydrogen bromide\*, Ipratropium bromide\*, Tropicamide\*, Cyclopentolate hydrochloride\*, Dicyclomine hydrochloride\*, Procyclidine hydrochloride\* and related drugs.
  - E. **Drugs used in the treatment of neurodegenerative disorders:** Antiparkinsonism  
Anti-alzheimers agents.
  - F. **Ganglionic blocking agents and Neuromuscular blockers:** Nicotine, Mecamylamine hydrochloride\*, Tubocurarine chloride, Galamine triethiodide\*, Decamethonium bromide\* and others.
3. **Hormone and related Drugs :** [05 Hrs.]
  - A. Insulin & its preparations.
  - B. Synthetic hypoglycemic agents: Tolubutamide\*, Chlorpropamide\*, glibenclamide\*, metformin\*, phenformin\* and others.
  - C. Thyroid and Antithyroid agents: Thyroid preparations, Methimazole and others.
4. **Cardiovascular drugs-I:** [06 Hrs.]
  - A. **Anti-anginal Drugs:** Vasodilators and Cardiotonics: Amylnitrate, Nitroglycerin\*, Isosorbide dinitrate\*, Verapamil\*, Nifedipine\*, Amlodipine, Dipyridamole, Digoxin, Digitoxin and related drugs.
  - B. **Anti-arrythmic Drugs:** Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate\*, Lidocaine hydrochloride.
  - C. **Anti-hypertensive Agents:** Captopril\*, Lisinopril, Enalapril\*, Reserpine, Guanethidine monosulphate\*, Methyldopate hydrochloride\*, Sodium nitroprusside, Minoxidil and others.

5. **Cardiovascular drugs-II :** [03 Hrs.]

D. **Anti-hyperlipidemic agents:** Clofibrate, Dextrothyroxine sodium, Cholestyramine resin, Niacin, Probucol and others.

E. **Anti-coagulants and anti-thrombolytics:** Protamine sulphate, Dicoumarol, Warfarin\* sodium and others.

6. **Diuretics:** [05 Hrs.]

Acetazolamide\*, Chlorthiazide\*, Hydrochlorthiazide\*, Furosemide\*, Ethacrynic acid, Spironolactone, Triamterene\*, Amiloride\* and related drugs.

7. **Diagnostic agents:** [03 Hrs.]

Fluorocein, metyrapone and iodine compounds.

**BOOKS RECOMMENDED:**

1. Wolf's – Burgers' Textbook of Medicinal Chemistry.
2. Wilson & Gisevold – A textbook of organic Pharmaceutical and Medicinal Chemistry.
3. William Foye – Elements of Medicinal Chemistry.
4. Harkishen Singh & V.K. Kapoor – Organic Pharmaceutical Chemistry, Vallabh Prakashan, Delhi

### PS 8302:PRODUCT DEVELOPMENT LAB. III

1. To predict the shelf life of a given product by Accelerated Stability Testing (AST).
2. To carry out “weight variation test” on commercial uncoated oral tablets I.P. belonging to different weight categories.
3. To carry out “Disintegration Test” on commercial uncoated oral tablets I.P. each of normal DT and the deviation.
4. To evaluate commercial oral coated tablet I.P. with representative of each coating type.
5. To carryout dissolution test on commercial products.
6. To evaluate the quality of ampoules.
7. To determine the bioavailability of given drug.
8. To formulate semi-solid preparations.
9. To Study the effect of Phase Volume Ratio ( $\phi$ ) on the rheological properties of emulsion.

### PS8308: SYNTHETIC MEDICINALS LAB.

#### List of Experiments:

1. Purification of Chloroform.
2. Purification of Methanol.
3. Purification of Acetone.
4. Purification of Benzene.
5. Purification of Ethylacetate.
6. Synthesis of Iodobenzene from aniline.\*
7. Synthesis of p-aminobenzenesulfonamide.\*
8. Synthesis of Cinnamic acid from benzaldehyde.\*
9. Synthesis of Quinoline from aniline.\*
10. Synthesis of Paracetamol from Phenol.\*
11. Synthesis of benzimidazole from o-phenylene diamine.\*
12. Synthesis of benzyl alcohol and benzoic acid from benzaldehyde.\*

\*Characterization of all compounds by mp, IR and monitoring of reaction carried out by TLC.

#### Book Recommended:

1. A.I. Vogel – Textbook of Practical Organic Chemistry.
2. F.G. Mann & B.C. Saunders – Practical Organic Chemistry BLBS publication

## **PS8306: INSTRUMENT DRUG ANALYSIS LAB.**

### List of Experiments

1. Determination of  $\lambda_{\text{max}}$ . of given sample using UV – Spectrocolorimeter and validity of Lambert-Beer's Law.
2. Assay of Paracetamol Tablets using UV- Spectrophotometer.
3. Assay of Metronidazole Tablets using UV- Spectrophotometer.
4. Assay of Chloroquine Phosphate Tablets using UV- Spectrophotometer.
5. Assay of Quinine Sulphate using UV- Spectrophotometer.
6. Assay of Nimesulide Tablets using UV- Spectrophotometer.
7. Assay of Riboflavin Tablets using Fluorescence Spectrophotometer.
8. Assay of Quinine Sulphate Tablets using Fluorescence Spectrophotometer.
9. Determination of  $\text{Na}^+$  and  $\text{K}^+$  ion using Flame Photometer in the given sample.
10. Determination of  $\alpha$ -Amino Acid using pH Meter.
11. Determination of Paracetamol using HPTLC.
12. Determination of Paracetamol using HPLC.
13. Demonstration of I.R. Spectrophotometer.
14. To study the effect of solvent and pH on UV Spectrophotometer of a given compound.
15. Demonstration of HPTLC and interpretation of HPTLC chromatogram.
16. Demonstration of GC-MS and interpretation of spectrum.
17. To study IR-Spectra of given compound(s) and its analogues.
18. Determination of mixture of Acids using Conductivity Meter.

## **PS 8312: PROJECT-II**

## ELECTIVE:

### PS 8321: COSMETIC TECHNOLOGY

#### A. Perfumes:

Basic principles of primary and fragrance, perfumery raw materials (natural as well as synthetic), Fixatives (Animal secretions, Resinous fixatives, Essential oil fixatives, Synthetic fixatives), improvers. Formulations of perfumes.

#### B. Cosmetics:

1. Principal of formulation and manufacture of cosmetics.
2. Emulsification in cosmetic, Preparation, preservation and stability of cosmetic products creams.
3. Formulation of following classes of cosmetic preparations:
  - i. Face Products: Vanishing creams, Cold creams, Emollient creams, Cleansing creams, Moisturizing creams, Face powder, Lipstick.
  - ii. Hand Products: Protective creams, Hand creams and lotions, Liquid creams, Hand cleaners, Nail lacquers.
  - iii. Body Cosmetics: Antiperspirants and Deodorants. Depilatories. Talcum and Dusting powders, Perfumes.
  - iv. Preparations for Oral hygiene: Mouthwash, Dentifrices.
  - v. Hair Products: Shampoos, Hair grooming & conditioning products, Hair waving & setting products.
  - vi. Shaving Products: Preshave and Aftershave lotions, shaving preparations.
  - vii. Baby specialities: Lotions.

#### C. Colours

D. Preservatives and Antioxidants: Classification, effective concentration, incompatibility.

E. Packing & labelling of cosmetics.

### BOOKS RECOMMENDED:

1. "Cosmetic: Science & Technology" – Sagarin
2. "Formulation and Function of Cosmetics" – Jellinek
3. "The Chemistry and Manufacture of Cosmetic" D'Alvarre.
4. "Cosmetic & Skin" – Walls and Lubowe.
5. "Principle of Practice of Modern Cosmetics" Raphe Harry.
6. "Perfumes, Cosmetics and Soaps" – Poucher.
7. Drug and Cosmetics Acts
8. IDMA Bullentins.

## PS8323: DRUG DESIGN

1. **Drug Design:** [06 Hrs.)  
Introduction – Definition, historical development towards drug discovery and drug development, Factors affecting drug designing programme inclusive drug distribution, oral systemic route, Protein binding
2. **Physical Properties and Biological Activity:** [06 Hrs.]  
Solubility, Ionization, Hydrogen bonding, Chelation, Surface active agents, Redox potential
3. **Stereochemistry and Biological Activity:** [04 Hrs.]  
Introduction, Stereoisomerism, Optical and geometrical isomers, steric features of drugs, configurational and conformational isomers, examples from analgetics, adrenergic drugs, cholinergic drugs etc.
4. **Isosterism and Bioisosterism:** [04 Hrs.]  
Concepts of isosterism, applications of bioisosterism, classical isosters, non classical bioisosters, application of bioisosterism in drug design.
5. **Metabolite antagonism:** [04 Hrs.]  
Historical development, essential metabolites, Wood fields theory of antimetabolites, competitive inhibition, examples from purine and pyrimidine, aminoacid antagonists, anti infamies.
6. **Receptors and theories of drug action : Introduction** [06 Hrs.]
  - A. Drug target – binding forces , electrostatics, hydrophobic, hydrogen bonding, vanderwaals force.
  - B. Drug receptor interaction – Type of receptors – molecular biology of receptors, Protein coupled receptors, Ion channel receptors, Nuclear receptors, GPCR (G protein coupled receptors). Histaminic Diuretic receptors.
  - C. Receptorial theories – occupancy theory, Rate theory, induced fit theory, macromolecular perturbation theory
7. **Approaches to drug design:** [06 Hrs.]  
QSAR – Hansch analysis, 3DQSAR approach COMFA  
CADD – Computer aided molecular modeling and docking studies – use of softwares sybl, Autodock guide.

### Book Recommended:

1. Manfred E Wolff & Burgers, Medicinal Chemistry and drug discovery – Vol. 1-VI, John Wiley & Sons.
2. E.J. Arins – Drug design series, Academic Press New York.
3. Progress in Medicinal Chemistry Series, Ellis & wert.
4. Receptor based drug design – P Leff, Marcel Dekker, New York – 1998.
5. Paul Charifron – Practical application of computer aided drug design – Marcel Dekker – 1997
6. Exploring QSAR – Fundamental and applications in chemistry and biology by Caronwasi Hansch & Alber Leo, ACS, Washington DC – 1995.



## PS8331: QUALITY ASSURANCE & REGULATORY AFFAIRS

1. Basic concept of Quality Control & Quality Assurance, Total Quality Management, Philosophy of GMP, GLP, ISO and introduction to ICH guidelines. [07 Hrs.]
2. Quality Control Laboratory: Responsibilities, routine controls, instruments, protocols, standard test procedure sampling plans etc. Quality control documentation and audits of QC facilities. [05 Hrs.]
3. Quality Control in Pharmaceutical Industries - Introduction to validation – Equipment, Method, Personnel and Process validations, Validation of water and air handling systems. [06 Hrs.]
4. In process quality control on various dosage forms. Standard Operating Procedures for operations like cleaning, filling, drying, compression, coating, sterilization etc. [06 Hrs.]
5. Concept and historical development of pharmaceutical product registration. Effect of GATT and WTO with regard to pharmaceuticals. Introduction to Intellectual Property Right. [04 Hrs.]
6. Regulations, requirements, procedures and application of new drug approval process: Preclinical studies, Brochure preparation for IND and ANDA. Clinical research protocols. [04 Hrs.]
7. Regulatory requirements – European community, United State, Japan, India and other territories. New Developments in regulatory affairs across the world with regard to WHO and ICH guidelines. [04 Hrs.]

### References Books:

1. Quality Control by Dale H. Bester field, Prentice Hall International Inc., New Jersey, 5<sup>th</sup> edn., (1998).
2. Good Laboratory Practice by Sandy Weinberg, Mercel Dekker, New York, 2<sup>nd</sup> edn. Vol. 69 (1995).
3. New Drug Approval Process by Richard A Guarino, Mercel Dekker, New York, 2<sup>nd</sup> edn., Vol. – 56 (1993).
4. Validation of Pharmaceutical Process by Carleton F.J. and Agalloco, Mercel Dekker, Inc. New York.
5. How to Practice GMP, by P P Sharma, 2<sup>nd</sup> edn., Vandana Publishing, New Delhi

**PS 8327: Pharmaceutical Marketing & Sales Management**

## PS 8329: HERBAL DRUG FORMULATION & STANDARDIZATION

- A. Prospects of Traditional medicine in primary health and economic growth. (4L)
- B. Regulatory status of herbal medicines – WHO, India, Europe, US (4L)
- C. Overview on the traditional formulations. (Asava, Arista, Gutika, Tinctures) (5L)
- D. Manufacture of Herbal Formulations: (6L)
  - i. Introduction to good manufacturing practice for (GMP) herbal formulation.
  - ii. Raw Material Testing.
  - iii. Development of suitable dosage forms.
- E. Quality assurance and stability testing of herbal drug formulations: (10L)
  - a. Chromatographic methods of analysis (PC, TLC, HPTLC, HPLC & GLC, GPC etc.)
  - b. Colorimetric and Fluorimetric methods.
  - c. Spectral methods (UV, Visible, IR, c-NMR, H-NMR, and Mass)
  - d. Testing for heavy metal and microbial contamination.
  - e. Lycopodium spore method.
- F. Preparation of pure phyto pharmaceuticals like Digoxin, Vincristine, Vinblastine, Atropine and Podophyllotoxin. (7L)

### Books & Journals Recommended

1. Text book of Pharmacognosy – Trease & Evans.
2. Medicinal Natural Products (2<sup>nd</sup> Edn.) A Biosynthetic Approach - Paul M. Dewier.
3. Pharmacognosy, Phytochemistry Medicinal Plants (2<sup>nd</sup> Edn.) – Jean Bructon.
4. Quality Control – Herbal Drugs – Pulok K. Mukherjee.
5. Pharmacognosy & Pharmabiotechnology – Ashutosh Kar.
6. Herbal Medicines – Manuchair Ebadi
7. Quality Control Methods for Medicinal Plants – WHO AITBS Publication
8. Chemistry of Natural Products – K.W. Bentley

## PS 8333: CLINICAL PHARMACY & DRUG INTERACTIONS

### MODULE I

1. Introduction to Clinical Pharmacy.

### MODULE II

2. Basic concepts of Pharmacotherapy
  - a. Clinical Pharmacokinetics and individualization of Drug therapy
  - b. Drug used in Infancy & Elderly (Paediatrics & Geriatrics)
  - c. Drug used during pregnancy.
  - d. Drug induced diseases.

### MODULE III

- e. Basics of Drug Interaction ADR & ADR monitoring
- f. Interpretation of Clinical Laboratory tests

### MODULE IV

3. Therapeutic Drug Monitoring
4. Concept of Essential Drugs & Rational Drug use

### MODULE V

Important disorders: their etiology, pathophysiology and disease management, dose regimen.

5. CNS disorders: Alzheimer's disease, Parkinsonism, schizophrenia
6. GI disorders: ulcerative colitis, hepatitis, cirrhosis

### MODULEVI

Important disorders: their etiology, pathophysiology and disease management, dose regimen.

7. Hemopoietic disorders: anaemia
8. endocrine disorders: diabetes mellitus and thyroid disorders.

### MODULEVII

Important disorders: their etiology, pathophysiology and disease management, dose regimen.

9. Joint and connective disorders: arthritis, gout, hyperuricaemia
10. neoplastic diseases: acute leukemias and Hodgkin's disease.

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## PS 8335:CLINICAL PHARMACOLOGY

Pathophysiology & applied therapeutics of diseases associated with following system / diseases.

1. Nervous System 6 L  
Pain and Analgesics  
Anaesthesia and Neuromuscular block  
Epilepsy, Parkinsonism.
2. Cardiovascular System 6 L  
Hypertension, Congestive cardiac failure, Ischaemic heart disease (Angina, Myocardial infarction), Arrhythmias, Hyperlipidaemias.
3. Respiratory System 4 L  
Asthma, Chronic obstructive airways diseases, Drug induced pulmonary diseases.
4. Renal System 6 L  
Diuretic therapy, Hyperkalaemia, Acute Renal failure, Chronic renal failure, Drug induced renal diseases.
5. Hemopoietic diseases 4 L  
Haemostasis, Anaemia, Drug induced haematological disorders.
6. Immunology 6 L  
Immune disease – pathogenesis, Glucocorticoids – anti-inflammatory, anti-allergic and immunosuppressive action in tissue & Immuno-modulators.
7. Endocrine System 6 L  
Adrenal corticoids, Diabetes Mellitus, Thyroid hormones, Hormone replacement therapy, Osteoporosis.

### References:

1. Clinical Pharmacology by P.N. Bennet & M. J. Brown eds. 9<sup>th</sup> edn., Churchill Livingstone.
2. Clinical Pharmacy and Therapeutics – Eric Herfindal, Williams and Wilkins Publication.
3. Pathologic basis of diseases – Robins SL, W.B. Sunders Publicaton.