B. PHARM. SYLLABUS 2011

DEPARTMENT OF PHARMACEUTICAL SCIENCE & TECHNOLOGY

BIRLA INSTITUTE OF TECHNOLOGY

MESRA, RANCHI – 835 215

BIRLA INSTITUTE OF TECHNOLOGY
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DEPARTMENT OF PHARMACEUTICAL SCIENCE & TECHNOLOGY
B. PHARM. – SYLLABUS (w.e.f. 2011-2012)

Semester – I

Subject Code	Name of Subject	L (h)	T (h)	P (h)	C
HU1101	Technical English	3	0	0	3
CS1151	Fundamental of Computers	3	0	0	3
MA1102/PS1407	Remedial Mathematics/ Biology	3	0	0	3
PS1401	Pharmaceutical Analysis – I	3	1	0	4
PS1403	Pharmaceutical Chemistry – I	3	1	0	4
PS1405	Pharmaceutical Microbiology	3	0	0	3
PS1402	Pharmaceutical Analysis Lab – I	0	0	3	2
PS1404	Pharmaceutical Chemistry Lab	0	0	3	2
PS1406	Pharmaceutical Microbiology Lab	0	0	3	2
ITP1002	Fundamental of Computers Lab	0	0	3	2
GA1002/1004/1006/1008	NCC/ NSS/ PT & Games/ CA	0	0	3	1
	TOTAL	**18**	**2**	**15**	**29**
	Total Hours	**35**			

CS: Computer Sciences; HU: Humanities; MA: Applied Mathematics
PS: Pharmaceutical Sciences; GA: Games/ NCC/ NSS/ CA
L: Lecture T: Tutorial P: Practical C: Credits h: Hours

HU1101: 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,

CS1151: FUNDAMENTALS OF COMPUTERS

Computer fundamentals:
***History*:** Introduction to Computer, Computer classifications (According to generation, size and use).
***Hardware*:** Introduction to hardware, CPU, Mother Board, Input devices, Output devices, Storage Devices and Memory. Various ports and slots available with mother board – ISA, PCI Serial, Parallel, PS/2 and USB and their uses.
***Software*:** Introduction to software, Simple example and use of Machine language, Assembly language and Higher level languages. Operating systems and classifications of application software according to their use.
***Networking*:** Introduction to networking, Classification of networking like LAN, WAN, Wi-Fi, Hardware for networking – Modem, Hub, Cables.

Data Representation:
Binary, Octal, Hexadecimal and their uses in computer. Binary addition, Binary substraction, signed numbers, Floating-point representation of numbers.

Logic Circuits:
Introduction, Switching circuits, AND, OR, NOT, NOR, NAND operation, Boolean Functions

Operating systems:
Introduction to different types of file manipulation and storage maintenance functions by using DOS, WINDOWS & LINUX
***File manipulations*:** Directories / folder / files searching, creating, copying, moving, deleting, renaming.
***Maintenance*:** Checking, Scanning and formatting a pen drives, CD Writing.

Internet:
History of internet, Introduction to Internet Browsers, URL. Introduction to email. How to check and compose an email. Important websites related to pharmaceutical information – like sites for information regarding drugs, medical literature, plants, adverse effects, clinical data, patent sites, FDA, WHO, etc.

Application of computers in Pharmacy:
Introduction to various uses of computer in pharmaceutical research and development, industries, authorities, education and hospitals

Programming language (Programming in C):
***Introduction to programming*:** Problem analysis, algorithm, flow chart, coding, execution, debugging and testing, program documentation.
Constants, types of variables, array variables, arithmetic operations, precedence rule, parentheses rule, logical operations, few important library functions.
***Design of programs*:** Initialization, input, validation, processing, print, closing a procedure.
Conditionals: *if statement*
Looping and Iteration: *for statement, while statement, do-while statement*

Books Recommended:

1. Fundamentals of Computer – V. Rajaraman, PHI Publication, 5th Edition
2. Computer and common sense, 4th edn., Hunt & Shelly, Prentice-Hall India.
3. DOS 6 & 6.22: An Introduction with computer fundamentals. Pradeep Nair, Payal Lotia, BPB Publications.
4. DOS 6 & 6.22 Instant Reference, 2nd Edn. Robert M. Thomas, BPB Publications.
5. Windows Instant Reference, Peter Dyson, BPB Publications.
6. ABCs of Windows, Sharon Crawford & Neil J. Salkin, BPB Publications.
7. Programming in C
8. Complete Reference MS- Office
9. Complete Reference Windows.
10. Complete Reference Internet
11. Linux OS

MA1102: 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. Demoivre'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

PS1407: REMEDIAL BIOLOGY

1. **Plant Cytology:** (4L)

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

2. **Plant Genetics:** (4L)

- Mendalism.
- Chromosomal aberration.
- Polyploidy.

3. **Morphology & Histology of different parts of the plants:** (5L)

- Root, stem, bark, leaf, flower, fruit and seed.

4. **Classification of plants (In brief).** (4L)
5. **General overview of physiology and various terminologies used in physiology.** (3L)
6. **Cell & Tissue:** (5L)

- Structure of cell, its components and their functions.
- Mechanism of transport through the cell membrane.

7. **Osseous System:** (5L)

- Structure, composition and functions of skeleton.
- Classification of joints, types of movements of joints, disorders of joints.

8. **Muscular System:** (5L)

- Gross anatomy & physiology of muscle contraction.
- Properties of skeletal muscles and their disorders.

Books Recommended:

1. Dutta: "Text Book of Botany"
2. Maheshwari: "Text Book of Botany"
3. Gupta: "Genetics"
4. Hess: "Plant Physiology"
5. Truemans: "Elementary Biology"
6. Vidyarathi: "Text book of Biology"
7. Guyton & Hall: Textbook of Medical Physiology" WB Saunders Company.
8. Chatterjee: Human Physiology" Vol I & II, Medical Allied Agency, Calcutta.
9.Chauraisia: "Human Anatomy – Regional & Applied" Part I, II, III, CBS Publishers & Distributors.

PS1401: PHARMACEUTICAL ANALYSIS – I

1. **Introduction to Pharmaceutical Analysis:** Significance of qualitative analysis in quality control, Different techniques of analysis, Preliminaries and definitions, Significance of figures. Rules for retaining significant digits. Types of errors, Minimization of error, selection of sample, precision and accuracy. Analytical balance and its reliability of measurements. Fundamentals of volumetric analysis, methods of expressing concentration, primary and secondary standards. [6 h]
2. **Acid Base Titration:** Acid base concepts role of solvers, Relative strength of acids and bases, ionization, Law of mass actions, Common ion effect, ionic product of water, pH, Hydrolysis of salts, Henderson-Hesselbalch equation, Buffers solutions, Neutralization curves, Acid-base indicators, Theory of indicators, Choice of indicators, Mixed indicators [5 h]
3. **Redox Titrations:** Concepts of oxidation and reduction, Redox reactions, strengths and equivalent weights of oxidizing and reducing agents, Theory of redox titrations, Redox indicators, cell representations, Measurement of electrode potential, Oxidation-reduction curves, Iodimetry and Iodometry, Titrations involving potassium permanganate, potassium dichromate, ceric ammonium sulphate [5 h]
4. **Complexometric Titration:** Stability constant, Metal-ion indicators, Types of EDTA - titrations with applications in Pharmaceuticals. [5 h]
5. **Precipitation Titrations:** Precipitation reactions, solubility products, Effect of acids, temperature and solvent upon the solubility of a precipitate, Argentometric titration and titrations involving ammonium or potassium thiocyanate, Adsorption indicators, Gay-Lussac method; Mohr's method, Volhard's method and Fajan's method. [5 h]
6. **Non-aqueous Titrations:** Basic Principles, Solvents involved & indicators. Acidimetry and Alkalimetry in non-aqueous solvents with special reference to Pharmacopoeial compounds. [5 h]
7. **Gravimetric Analysis:** Precipitation techniques, solubility products. Co-precipitation, post precipitation, Digestion, washing of the precipitate, Filtration, Filter papers, and crucibles, Ignition. Thermo gravimetric curves, specific examples like barium sulphate, aluminum as aluminum oxide, calcium as calcium oxalate and magnesium as magnesium pyrophosphate, organic precipitants. [5 h]

Books Recommended:

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

PS1403: PHARMACEUTICAL CHEMISTRY-I

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

1. Structure, Properties & Stereochemistry: [3 Hrs.]

- Atomic and Molecular orbitals, Molecular Orbital theory, Wave equation, Bonding and Antibonding orbitals
- Hybrid Orbitals - sp^3, sp^2, sp hybridizations
- Configuration- Enantiomers, Specification of Configuration by Sequence Rules
- Diastereoisomerism, Meso-structure & Conformational isomers.

2. Alkanes, Alkenes, Dienes & Alkynes:: [05 Hrs.]

- Transition states & Free-radical substitution.
- 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.
- Alicyclic compounds and Baeyer's theory

3. Aromatic Hydrocarbons:

3A. Benzene: [05 Hrs.]

- Structure and Propertis
- Electrophilic Aromatic substitution

3B. Phenols:

- Structure, nomenclature, physical properties
- Industrial sources and methods of preparation and Reactivity of phenols (acidity of phenols, ester formation, sulfonation, halogenation, Friedel-Crafts alkylation, Friedel-Craft acylation, Fries rearrangement, Reimer-Tiemann reaction).

4. A. Alkyl Halides: [05 Hrs.]

- Structure and properties
- Preparation and Substitution (SN1 and SN2) and Elimination Reactions.

B. Aryl Halides:

- Structure, Nomenclature, physical properties
- Electrophilic substitution and nucleophilic substitution
- Elimination addition mechanism in aromatic halides involving BENZYNE transition intermediate.

5. A. Alcohol, Ethers & Epoxides: [05 Hrs.]

- Preparation and Properties

B. Aldehyde and Ketones:

- Preparation and Properties
- Nucleophilic-addition reactions

- Cannizzaro's reaction, Carbanions, Aldol condensation, Wittig's- and Reformatsky- reactions.

6. A. Carboxylic Acids and their Derivative: [07 Hrs.]

- Nomenclature, structure and physical properties
- Acid chlorides, amides, esters & anhydrides
- Nucleophilic substitution - alkyl vs. acyl
- Kinetics of hydrolysis of esters by alkali and acids.
- Transesterification reactions

B. Alpha- and Beta- Unsaturated Carbonyl containing Compounds, Malonic Esters and Acetoacetic Esters:

a. Structure, Properties
b. Preparation
c. Applications in organic synthesis.

7. Amines: [06 Hrs.]

General- Nomenclature, classification, industrial sources, Physical properties, preparation, reductive amination, Hoffmann's Bromamide reaction.

i. Basicity of aliphatic and aromatic amines - effect of substituents on basicity of amines, conversion to amides. Hoffmann's elimination and its usefulness.

ii. Diazonium salts - Preparation, Sandmeyer's reaction, azo compounds. Benzedine rearrangement reaction.

Books Recommended :

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

PS1405: PHARMACEUTICAL MICROBIOLOGY

3 Hrs./Week **35 Hrs/Semester**

1. **Introduction to Microbiology & Microscopy: (04)**
   a) History, Scope and Applications
   b) Classification and Types of Microscope
   c) Principle and Applications of Compound, Dark Field, Phase Contrast and Fluorescence Microscope
   d) Different Parts of Compound Microscope, Resolving Power, Magnification Power, Numerical Aperture and Working Distance
   e) Electron Microscopy- SEM & TEM

2. **Biology of Microorganisms & Taxonomy: (06)**
   a) Size, Shape, Internal and External Features of microorganisms like Bacteria, Fungi, Yeasts, Actinomycetes and Viruses
   b) Taxonomy of Bacteria, Actinomycetes, Rickettsia, Spirochetes and Viruses

3. **Growth and Nutrition of Bacteria: (03)**
   a) Growth Curve, Generation Time
   b) Bacterial Nutrition
   c) Types of Culture media and their common ingredients
   d) Physical Factors affecting growth of bacteria

4. **Identification and Maintenance of Microbial Cultures: (06)**
   a) Staining Techniques- Simple and Differential Staining
   b) Identification of Bacteria- Biochemical and Screening Strategies
   c) Isolation of Pure Culture
   d) Permanent and Working Stock Preparations

5. **Bacterial Reproduction and Microbial genetics: (06)**
   a) Binary Fission, Conjugation, Transformation and Transduction
   b) Morphology and Classification of Spores
   c) Process of Replication, Transcription and Translation
   d) Mutation: Principles and Classifications

6. **Control of Microbes by Physical and Chemical Methods (05)**
   a) Sterilization: Different methods (Physical, Chemical, Mechanical), Sterilization monitors, Validation of Sterilization methods and equipments, D Value, Z Value
   b) Disinfection: Disinfectants, Factors Influencing activity of disinfectants, Dynamics of disinfection
   c) Antiseptics & their Evaluations: Chick Martin Test, Rideal Walker Test

7. **Sterility Testing of Pharmaceuticals as per I.P (02)**

8. **Microbial Assays: (03)**
   Importance and procedure for assay of Antibiotics, Vitamins and Amino Acids.

Books Recommended:

1. Pelczar et al.: "Microbiology," 5th ed., Tata McGraw Hill, 1993.
2. Hugo & Russel: "Pharmaceutical Microbiology," 1st ed., Blackwell Scientific Publication, 1977.
3. Controller of Publications: "Pharmacopoeia of India," 4th ed., Vol. I & II, 1996.
4. Purohit: "Microbiology," 6th ed., Agrobios, 2002.
5. Aulton ,Ed.: "Pharmaceutics-The Science of Dosage Form Design," ELBS, 1990.
6. Collett & Aulton, Eds.: "Pharmaceutical Practice," 1st 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,Salle: "Fundamentals and Principles of Bacteriology,"

PS1402: PHARMACEUTICAL ANALYSIS LAB. – I

Experiments involving-

- Acidimetry,
- Alkalimetry
- Redox titrations,
- Precipitaion titrations, and
- Gravimetric Analysis

with special reference to Pharmacopoeial products.

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.
11. Preparation and Standardization of 0.1 N Potassium Permanganate Solution.
12. Assay of Ferrous Sulphate I.P.
13. Preparation and Standardization of 0.1 N Sodium Thiosulphate Solution.
14. Assay of Copper Sulphate I.P.
15. Preparation and Standardization of 0.1 N Iodine Solution.
16. Preparation and Standardization of 0.1 N Silver Nitrate Solution.
17. Assay of Sodium Chloride I.P.
18. Preparation and Standardization of 0.1 N Ammonium Thiocyanate Solution.
19. Assay of Sodium Sulphate I.P.
20. Assay of Potassium Permanganate I.P./B.P.

Books Recommended:

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

PS1404: PHARMACEUTICAL CHEMISTRY LAB

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_2 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," 4th ed. (New Impression with Revision -1st Indian ed.), Orient Longman, 1986.
2. Vogel: "A Text Book of Practical Organic Chemistry (including Qualitative Organic Analysis)," 3rd ed., ELBS, 1975.
3. Furniss et al.: "Vogel's Text Book of Practical Organic Chemistry," 5th ed., (Reprint), ELBS, 1996.

PS1406: PHARMACEUTICAL MICROBIOLOGY LAB

1. **Introduction to the Scope of Microbiology.**
2. **Structure of Bacterial Cell.**
3. **Classification of Microbes and their Taxonomy-**
   Actinomycetes, bacteria, rickettsia, spirochetes and virus.
4. **Growth and Nutrition of Bacteria:**

- Growth curve, generation time
- Bacterial nutrition, culture media and their common ingredients
- Physicals factors affecting growth of bacteria.

5. **Identification of Microbes:**

- Staining Techniques-simple and differential techniques
- Bacterial reproduction and spores.
- Identification of Bacteria (Biochemical test and screening strategies)

6. **Maintenance of Laboratory Organisms :**

- Isolation of pure culture
- Permanent and working stock preparations.

7. **Microbial Genetics and Variations**.
8. **Control of Microbes by Physical and Chemical Methods :**
   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**.
10. **Microbial Assays :**
    Antibiotics, Vitamins and Amino acids.

Books Recommended:

1. Pelczar et al.: "Microbiology," 5th ed., Tata McGraw Hill, 1993.
2. Hugo & Russel: "Pharmaceutical Microbiology," 1st ed., Blackwell Scientific Publication, 1977.
3. Controller of Publications: "Pharmacopoeia of India," 4th ed., Vol. I & II, 1996.
4. Purohit: "Microbiology," 6th ed., Agrobios, 2002.
5. Aulton ,Ed.: "Pharmaceutics-The Science of Dosage Form Design," ELBS, 1990.
6. Collett & Aulton, Eds.: "Pharmaceutical Practice," 1st 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"

ITP1002: FUNDAMENTALS OF COMPUTERs LAB

1. Demonstration of hardware.
2. Operating system: DOS, WINDOWS & LINUX
    a. Searching directories or folders
    b. Creating and deleting files and folders
    c. Copying and Moving files and folders / directories
    d. Saving in pen drives and CD / DVD Writing
    e. Formatting and checking by pen drives and Bootable CD.
3. Create and save a document in a word processor program like MS WORD. Type few paragraphs, format them, and paste an image.
4. Create and save presentations in POWERPOINT presentations
5. Create and save a work sheet using MS EXCEL. Input data in cells, copy and move the data, make calculations, plot a graph from X and Y sets of data.
6. Internet (Search Engine, email, groups)
7. Simple programming in C: Few programs including if statement, for statement, while statement, do-while statement

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B. PHARM. – COURSE STRUCTURE (w.e.f. 2011-2012)

Semester – II

Subject Code	Name of Subject	L (h)	T (h)	P (h)	C
CH2203	Environmental Science	3	0	0	3
MA2102	Mathematics – I	3	1	0	4
PS2401	Pharmaceutical Analysis – II	3	0	0	3
PS2403	Pharmaceutical Inorganic Chemistry	3	0	0	3
PS2405	Pharmaceutics	3	0	0	3
PS2407	Human Anatomy and Physiology	3	1	0	4
PS2402	Pharmaceutical Analysis Lab – II	0	0	3	2
PS2404	Pharmaceutical Inorganic Chemistry Lab	0	0	3	2
PS2406	Pharmaceutics Lab	0	0	3	2
PS2408	Human Anatomy and Physiology Lab	0	0	3	2
GA2002/2004/2006/2008	NCC/ NSS/ PT & Games/ CA	0	0	3	1
	TOTAL	**18**	**2**	**15**	**29**
	Total Hours	**35**			

CH: Applied Chemistry; MA: Applied Mathematics
PS: Pharmaceutical Sciences; GA: Games/ NCC/ NSS/ CA
L: Lecture T: Tutorial P: Practical C: Credits h: Hours

CH2203: 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, west 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 reveres 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.

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

MA2102: 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
3. Sueddon : "The Use of Integral Transforms," Tata McGraw Hill
4. Grewal : "Higher Engineering Mathematics," Khanna Publishers.

PS2401: PHARMACEUTICAL ANALYSIS – II

1. **Quantitative Analysis:** [7 h]
   Elements: Nitrogen, Halogens, Sulphur, Oxygen and Phosphorus.
   Functional Groups: Alcoholic & phenolic hydroxyl, Amino, Carboxylic, Aldehydes and Ketone groups.

2. **Moisture Analysis:** Different methods of moisture analysis, Karl-Fischer's Reagent: Preparation, Standardization and application. [5 h]

3. **Oils and Fats Analysis:** Acid value, acetyl value, saponification value, ester value and iodine value, Determination of unsaponifiable matter. [5 h]

4. **Separation Techniques:** Fundamental principles of chromatography. Types of Chromatography. Paper Chromatography, Thin Layer Chromatography, Column chromatography and Electrophoresis. Separation of drugs from excipient. Separation of phytoconstituents from plant drugs. [7 h]

5. **Potentiometry and Conductometry:** Introduction, Electrochemical cells, half-cells, electrodes, measurement of potential, Potentiometric titrations and application in pharmaceutical analysis.
   Basic concepts, different types of conductometric titrations, apparatus used, Conductometric titrations and applications in Pharmaceutical Analysis. [6 h]

6. **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. [6 h]

Books Recommended:

6. Ayers: "Quantitative Chemical Analysis," 2nd ed., (Harper International ed.), Harper & Row, 1969.
7. Beckett & Stenlake: "Practical Pharmaceutical Chemistry," Part – I & II, 4th ed., (1st Indian ed.-Reprint), CBS Publishers & Distributors, 1999.
8. Vogel: "A Text-Book of Quantitative Inorganic Analysis (including Elementary Instrumental Analysis)," 3rd ed., ELBS-Longman, 1973.
1. Vogel: "A Text-Book of Quantitative Inorganic Analysis (including Elementary Instrumental Analysis)," 3rd ed., ELBS-Longman, 1973.
2. Jeffery et al.: "Vogel's Text Book of Quantitative Chemical Analysis," 5th ed.(Reprint),ELBS, 1996.
3. Furniss et al.: "Vogel's Text Book of Practical Organic Chemistry," 5th ed. (Reprint), ELBS, 1996.
4. Instrumental methods of analysis by Gurdeep Chatwal.

PS2403: PHARMACEUTICAL INORGANIC CHEMISTRY

1. Impurities in pharmaceutical, Limit tests of Cationic and anionic impurities of pharmacopoeal substance. [05 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. 6.

   Group VI B: Compounds of Oxygen, Sulphur and Selnium that are official in IP/BP. [05 Hrs.]
6. Group VII B: Compounds of Chbrine and Iodine that are official in IP/BP. [05 Hrs.]
7. Radiopharmaceuticals: Introduction and unit of radio-activity. Handling, Hazards and Precutions of radiopharmaceuticals. Applications of radioisotopes as diagnostic and therapeutic agents. [05 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.

PS2405: 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," 2nd 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, 3rd ed., WHO, 2003.
7. "European Pharmacopoea,"
8. Lund, Ed.: "The Pharmaceutical Codex – Principles & Practice of Pharmaceutics," 12th ed., The Pharmaceutical Press, 1994.
9. Gennaro et al., Eds. : "Remington's The Science & Practice of Pharmacy," 20th ed., Lippincott Williams & Wilkins, 2000.
10. Rawlins, Ed. : "Bentley's Textbook of Pharmaceutics," 8th ed. (Reprint), Bailliere Tyndall, 2002.
11. Carter, Ed.: "Cooper & Gunn's Tutorial Pharmacy," 6th ed., CBS Publishers, 1972.
12. Carter, Ed.: "Cooper & Gunn's Dispensing for Pharmaceutical Students," 12th ed., CBS Publishers, 1987.
13. Martin, Ed.: "Dispensing of Medication," Mack Publishing Company, 1972.
14. Stoklosa & Ansel: "Pharmaceutical Calculations," 10th ed., Waverly, 1996.
15. Zatz : "Pharmaceutical Calculations," 2nd ed., John Wiley, 1981.
16. Ansel : "Introduction to Pharmaceutical Dosage Forms," 3rd ed., Lea & Febiger, 1981.
17. Ansel et al. : "Pharmaceutical Dosage Forms & Drug Delivery Systems," 7th 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., Kislay Book House, 1990.

PS2407: HUMAN ANATOMY AND PHYSIOLOGY

1. 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.

2. 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.

3. Lymph and Lymphatic System: (4L)

- Composition, formation and circulation of Lymph, disorders of Lymph and Lymphatic system,
- Basic physiology and functions of spleen.

4. 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.

5. 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.

6. Urinary System (6L)

- Structure and functions of kidney and urinary tract
- Physiology of urine formation and acid-base balance
- Diseases of urinary tract

7. Reproductive system (5L)

- Male and Female Reproductive organs and their hormones
- Physilogy of menstruation, coitus and fertilization
- Sex differentiation, spermatogenesis and oogenesis
- Pregnancy and its maintainance and parturition

8. Endocrine system (4L)

- Basic anatomy and physiology of pitutary, thyroid, parathyroid, sdrenals, pancreas, testis and ovary, their hormones and functions

Books Recommended:

1.Best & Tayler: "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.

PS2402: PHARMACEUTICAL ANALYSIS LAB – II

- **Complexometric Titrations:**
  - Preparation and standardization of EDTA solution,
  - Some related experiments.
- **Non-aqueous Titrations**:
  - Preparation and standardization of Perchloric acid and Sodium/Potassium/ Lithium methoxide solutions,
  - Some related experiments.
- **Analysis of Oils & Fats**:
  - Determination of Acid value,
  - Determination of Saponification value.
- **Functional Group Analysis**:
  Estimation of groups in organic compounds-
  - Alcoholic,
  - Phenolic,
  - Amino.
- **Chromatography:**
  Simple experiments.

List of Experiments:

1. Preparation and Standardization of 0.05N Disodum 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, 4th ed., (1st Indian ed.-Reprint), CBS Publishers & Distributors, 1999.
2. Vogel: "A Text-Book of Quantitative Inorganic Analysis (including Elementary Instrumental Analysis)," 3rd ed., ELBS-Longman, 1973.
3. Jeffery et al.: "Vogel's Text Book of Quantitative Chemical Analysis," 5th ed. (Reprint),ELBS, 1996.
4. Furniss et al.: "Vogel's Text Book of Practical Organic Chemistry," 5th ed. (Reprint), ELBS, 1996.

PS2404: PHARMACEUTICAL INORGANIC CHEMISTRY LAB.

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 Boric acid.
6. Preparation of Ferric ammonium citrate.
7. Preparation of Ammonium Chloride.
8. Preparation of precipitated Sulphar.
9. Preparation of Sod. Benzoate from Benzoic Acid.
10. Limit test for Chloride in Sod. Citrate.
11. Limit test for Sulphate in Boric Acid.
12. Limit test for Sulphate in Sod. Phosphate.
13. Limit test for Iron in Amm. Chloride.
14. Limit test for Iron in Calcium Carbonate.

PS2406: PHARMACEUTICS LAB

Preparation of Pharmacopoeial Products representing different dosage forms:

I. Aromatic Waters ***(Atleast one product to illustrate each method of preparation) :***

Chloroform water IP'66 (Solution method)
Camphor water IP'66 (Alternative Solution method using Alcohol)
Peppermint water BP (Alternative Solution method using Talc)
Concentrated Dill water IP'66 (using Co-solvent)
Dill water IP'66 (Dilution method)

II. Spirits (Flavoured & Medicated) :

Chloroform Spirit IP'66
Aromatic Spirit of Ammonia NF

III. Solutions:

Aqueous Iodine Solution IP'66
Weak Iodine Solution IP'66
Strong Iodine Solution IP'66
Cresol with soap Solution IP'66

IV. Mucilages :

Acacia mucilage IP'66
Tragacanth mucilage IP'66

V. Syrups (Simple, Flavoured & Medicated):

Simple Syrup IP'66
Orange / Lemon Syrup IP'66
Codeine Phosphate Syrup BP'88

VI. Elixirs: Paediatric Chloral Elixir BP'88

VII. Linctus: Simple Linctus BP'88
Codeine Phosphate Linctus (Paediatric) BPC

VIII. Magmas: Milk of Magnesia BPC.
Bentonite Magma NF.

IX. Glycerites:

Borax Glycerin IP'66
Phenol Glycerin IP'66

X. Others:

Calamine Lotion IP'66
Non-staining Iodine ointment with Methyl salicylate BPC
Liniment of Turpentine IP'66
Orange Tincture / Lemon Tincture IP'66

Books Recommended:

1. Dixit et.al.: "Practical Pharmaceutics," Part II, Pragati Prakashan, 1986.
2. Ansel : "Introduction to Pharmaceutical Dosage Forms," 3rd ed., Lea & Febiger, 1981.
3. Controller of Publications: "Indian Pharmacopoeia," 1966.
4. Her Majesty's Stationery Office: "British Pharmacopoeia," University Press, Cambridge, 1988.
5. "United States Pharmacopoeia," XXI (1985), XXIII NFXVIII (1995).
6. "The Pharmaceutical Codex – Principles & Practice of Pharmaceutics," 12th ed., The Pharmaceutical Press, 1994.

PS2408: HUMAN ANATOMY AND PHYSIOLOGY 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.

Books Recommended :

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

BIRLA INSTITUTE OF TECHNOLOGY
MESRA, RANCHI – 835 215
DEPARTMENT OF PHARMACEUTICAL SCIENCES
B. PHARM. – COURSE STRUCTURE (w.e.f. 2011-2012)

Semester – III

Subject Code	Name of Subject	L (h)	T (h)	P (h)	C
CH1005	Applied Physical Chemistry	3	0	0	3
MA3102	Mathematics – II	3	1	0	4
PS3401	Pharmacy Practice - I	3	0	0	3
PS3403	Pharmaceutical Chemistry – II	3	0	0	3
PS3405	Pharmacognosy – I	3	0	0	3
PS3407	Physiological Chemistry	3	1	0	4
PS3402	Pharmacy Practice Lab – I	0	0	3	2
PS3404	Pharmaceutical Chemistry Lab – II	0	0	3	2
PS3406	Physical PharmaceuticsLab	0	0	3	2
GA3002/3004/3006/3008	NCC/ NSS/ PT & Games/ CA	0	0	3	1
	TOTAL	**18**	**2**	**12**	**27**
	Total Hours	**32**			

CH: Applied Chemistry; MA: Applied Mathematics
PS: Pharmaceutical Sciences; GA: Games/ NCC/ NSS/ CA
L: Lecture T: Tutorial P: Practical C: Credits h: Hours

CH1005: APPLIED PHYSICAL CHEMISTRY

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 Choloride - 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," 6th ed., ELBS, 1971.
3. Atkins & de Poule:: "Atkins Physical Chemistry," 7th ed., Oxford University Press, 2002.
4. Rackshit : "Physical Chemistry," 6th 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," 20th ed., Lippincott Williams & Wilkins, 2000.
9. Martin: "Physical Pharmacy," 4th ed., Waverly, 1993.
10. Florence & Attwood: "Physicochemical Principles of Pharmacy," 3rd ed., MacMillan Press, 1998.
11. Banker & Rhodes, Eds. : "Modern Pharmaceutics," 3rd ed. (Revised & Expanded), Marcel Dekker (DPS Vol. 72), 1996.
12. Aulton, Ed.: "Pharmaceutics – The Science of Dosage Form Design," 2nd ed., Chirchill Livingstone, 2002.

MA3102: MATHEMATICS - II

1. Biometrics : (20L)

- Definition of data. Data organization, diagramatic 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-Baye'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 $1/3^{rd}$ rule
- Solution of system of simultaneous linear equations by Gauss-Seidal Method

Books Suggested :

1. Bolton: "Pharmaceutical Statistics – Practical and Clinical Applications," 3^{rd} 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.

PS3401: PHARMACY PRACTICE – I

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: (3hrs)

Principles involved & Procedures adopted in Compounding of the following classes of extemporaneous pharmaceutical Preparations:

Solid Dosage Forms -

- Powders
- Hard Gelatin Capsules
- Tablet Triturates.

III. DISPENSING: (3hrs)

Principles involved & Procedures adopted in Compounding of the following classes of extemporaneous pharmaceutical Preparations:

Liquid Dosage Forms-

- Mixtures
- Emulsions (no details of emulsifiers & stability)
- Lotions
- Liniments
- Applications
- Throat Paints
- Eye Drops & Lotions
- Ear Drops
- Gargles & Mouthwashes.

IV. DISPENSING: (4hrs)

Principles involved & Procedures adopted in Compounding of the following classes of extemporaneous pharmaceutical Preparations:

Semi- Solid Dosage Forms-

i. Ointments & Creams--

- Ointment Bases, their Ingredients & Compositions
- Methods of Preparation & Evaluation
- Compendial Examples.

ii. Pastes & Jellies.

iii. Suppositories & Pessaries.

V. INCOMPATIBILITIES: (7hrs)

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.

VI COMMUNITY PHARMACY: (9hrs)

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.

VII. REVIEWS: (5hrs)

- 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," 12th ed., CBS Publishers, 1987.
2. Collet & Aulton, Eds.: "Pharmaceutical Practice," ELBS, 1991.
3. Sprowls, Ed.: "Prescription Pharmacy-Dosage Formulation & Pharmaceutical Adjuncts," 2nd 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," 1st ed., Kislay 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," 7th ed., Lippincott Williams & Wilkins, 2000.
9. Lund, Ed.: "The Pharmaceutical Codex – Principles & Practice of Pharmaceutics," 12th ed., The Pharmaceutical Press, 1994.
10. British National Formulary,
11. Hoover, Ed. : "Dispensing of Medication," Mac Publishing Co., 1976.

PS3403: PHARMACEUTICAL CHEMISTRY- II

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

1. Polynuclear Hydrocarbons: [05 Hrs.]
Napthalene, Anthracene and Phenanthrene

2. Heterocyclic compounds with five membered ring (I): [07 Hrs.]

- Five membered rings with one heteroatom (Pyrrole, Furan, Thiophene) and fused rings systems (Indole, Isoindole, Benzofuran,
- Five membered rings with two heteroatoms (Imidazole, Pyrazole, Thiazole, Oxazole) and fused ring systems (Benzimidazole, Benzpyrazole, Benzothiazole, Benzoxazole).

3. Heterocyclic compounds with six membered ring : [04 Hrs.]

- Six membered rings with one heteroatom (Pyridine and Pyrans) and fused ring systems (Quinoline, Isoquinoline, Benzopyran)

4. Heterocyclic compounds with six membered ring : [04 Hrs.]

- Six membered rings with two heteroatoms (Pyridazine, Pyrimidine) and fused ring systems (Quinazolines)
- Six membered ring with three hetero atoms: Triazine.

5. Carbohydrates: [08 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

ii. Disaccharides –
General method of structure elucidation with specific examples (Lactose and Sucrose)

iii. Polysaccharides –
Starch and Glycogen

6. Glycosides: [04 Hrs.]

- Introduction
- Structure elucidation of Ruberythric acid, Amygdalin and Salicin

7. Lipids: [04 Hrs.]

- Oils and Fats
- Synthesis of glycerides
- Classification of lipids and their uses

Books Recommended:

1. Acheson: "An Introduction to the Chemsitry of Heterocyclic Compound," Interscience Publisher.
2. I.L. Finar: "Organic Chemsitry," Vol. 2 ELBS Longman Publication.

PS3405: 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.

PS3407: PHYSIOLOGICAL CHEMISTRY

1. **Bioenergetics:** Concept of free energy, Redox potentiall, Electron transport system, High energy phosphates, Oxidative phosphorylation. (4L)
2. **Enzymes:** Classification, Kinetics, Michaelis-Menton equation and determination of Km value, Mechanism of enzymes action, Inhibitors & Activators, Co-enzymes (Vitamins and Metals as co-enzymes) (6L)
3. **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)
4. **Lipid Metabolism:** Oxidation of fattyacids, β-oxidation & energetic, α-oxidation, ω-oxidation, Biosynthesis of ketone bodies and their utilization, Biosynthesis of saturated and unsaturated fatty acids, Essential fatty acids & eicosanoids (prostaglandins, thromboxanes and leukotrienes), phospholipids and sphingolipids. (6L)
5. **Protein Metabolism:** Biosynthesis of Aminoacids, Protein synthesis, Urea cycle, Creatine and creatinine, Nitrogen balance, Diseases related with proteins and urea metabolism. (6L)
6. **Nucleic Acid Metabolism:** Purines and Pyrimidines biosynthesis & degradation, Diseases related with purines and pyrimidines metabolism. (6L)
7. Principles of nutrition and dietetics; Diet and its significance, Minerals (Ca, P, Mg, Fe, Na^+, K^+, Cl^-) Metabolism. Deficiency disorders. (6L)

BOOKS RECOMMENDED:

1. Stryer: "Biochemistry", 4th edition., W.H. Freeman & Company.
2. Mussay et al.: "Harpers Biochemistry", Prentice Hall International.
3. Marlin et al.: "Harpers Biochemistry", 24th edition., Lange Medical Publications.
4. Lehninger: "Biochemistry", 3rd edition., Worth, CBS Publishers & Distributors.
5. Conn & Stumpf: "Outline of Biochemistry", 5th edition., 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. Sathyanarayana: "Biochemistry",Book & Allied (P) Ltd., Reprint.
10. Singh: "Practical Manual of Biochemistry", 4th edition., CBS Publishers & Distributors.

PS3402: PHARMACY PRACTICE LAB – I

(Prescription Pharmacy lab)

Dispensing of prescriptions belonging to the following Dosage Forms:

	Dosage Forms	Number of Prescription
1.	Mixtures	10
2.	Emulsions	05
3.	Powders	05
4.	Incompatibility Illustration	05

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.

PS3404: 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 Benzylidine 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," 4th ed. (New Impression with Revision,1st Indian Reprint), Orient Longman, 1986.
2. Vogel: "A Text Book of Practical Organic Chemistry (including Qualitative Organic Analysis)," 3rd ed., ELBS, 1975.
3. Furniss et al.: "Vogel's Text Book of Practical Organic Chemistry," 5th ed., (Reprint), ELBS, 1996

PS3406: 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 / verity 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 (dvn), Volume surface diameter (dvs), particle number (N) and specific surface (Sv) 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).

BIRLA INSTITUTE OF TECHNOLOGY
MESRA, RANCHI – 835 215
DEPARTMENT OF PHARMACEUTICAL SCIENCES
B. PHARM. – COURSE STRUCTURE (w.e.f. 2011-2012)

Semester – IV

Subject Code	Name of Subject	L (h)	T (h)	P (h)	C
PSB4401	Organizational Behaviour (Hospital Pharmacy)	3	0	0	3
PS4401	Pharmaceutical Systems – I	3	0	0	3
PS4403	Natural Medicinals	3	0	0	3
PS4405	Pharmacology – I (General Pharmacology, Toxicology and Bioassay)	3	0	0	3
PS4407	Pharmacognosy – II	3	0	0	3
PS4409	Pharmaceutical Engineering – I	3	0	0	3
PS4402	Pharmacy Practice Lab – II	0	0	3	2
PS4404	Pharmacognosy Lab – I	0	0	3	2
PS4406	Physiological Chemistry Lab	0	0	3	2
ME1102	Pharmaceutical Engineering Drawing	0	0	3	2
GA4002/4004/4006/4008	NCC/ NSS/ PT & Games/ CA	0	0	3	1
	TOTAL	**18**	**0**	**15**	**27**
	Total Hours	**33**			

PS: Pharmaceutical Sciences; GA: Games/ NCC/ NSS/ CA
L: Lecture T: Tutorial P: Practical C: Credits h: Hours

PSB4401: ORGANIZATIONAL BEHAVIOUR
(Hospital Pharmacy)

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," 4th ed., Lea & Febiger, (3rd ed., 1974).
2. Gennaro et al., Ed. : "Remington: The Science & Practice of Pharmacy," 20th 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," 1st 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," 7th 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.

PS4401: PHARMACEUTICAL SYSTEMS – I

1. **Solubility of Drugs:** **6h**

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:** **6h**

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:** **7h**

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:** **8h**

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:** **8h**

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.

PS4403: NATURAL MEDICINALS

1. **Amino acids & Proteins** [03 Hrs.]
   Amino acid synthesis & properties, Structure and synthesis of peptides, End group analysis of proteins.
2. **Terpenes** [04 Hrs.]
   Introduction, Classification, Isolation, general methods of determining structure, Chemistry of monoterpenoids (Citral), Monocylic monoterpenoids (alpha-terpineol Menthol) Bicylic monoterpenoids (alpha-pinene, Camphor) Wagner – Mearwin rearrangement, Sesquiterpenoids (Farnesol) Diterpenoids (Phytol)
3. **Alkaloids & Purines** [10 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, Stercochemistry of tropines, 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.
   Uric acid, Caffeine, Theophylline & theobromine.
4. **Steroids & Steroidal Glycosides** [05 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. Chemistry of digitoxin, diosgenin and sarsasapogenin.
5. **Steroidal Hormones** [06 Hrs.]
   Source, extraction, structure elucidation, synthesis and medicinal uses corticosteroids: hydrocortisone and hydrocortisol.
   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 testosterones.
6. **Non-steroidal Hormones:** [02 Hrs.]
   Source, extraction, structure elucidation, synthesis and medicinal uses of the following
   iv. Adrenaline and Noradrenaline,.
   v. Thyroxine.
   An elementary treatment of oxytocin and Insuline.
7. **Vitamins:** [06 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_1, B_2, B_6, and C.

BOOKS RECOMMENDED:

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

PS 4405: PHARMACOLOGY – I
(GENERAL PHARMACOLOGY, TOXICOLOGY AND BIOASSAY)

1. General Pharmacology:

Module I (10L)

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

Module II (6L)

(i) Absorption, Distribution, Metabolism and Excretion of Drugs,
(ii) Principles of Basic and Clinical Pharmacokinetics,
(iii) Adverse Drug Reactions.

Module III (6L)

2. Bioassay:

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

Module IV (4L)

3. Principles of Toxicology:

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

Module V (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 VI

Autacoids: (8L)

i. Histamine and Serotonine,
ii. Prostaglandins, thromboxanes and leukotriens,
iii. Pentagastrin, Cholecystokinin, Angiotensin, Bradykinin and Substance P.

Module VII (3L)

4. Local Anaesthetics:

i. Classification on the basis of site of action and chemical nature,
ii. Mechanism of action.

Books Recommended:

1. Bhattacharya et al. : "Pharmacology," 2nd 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,

PS4407: 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.

7. 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
15. Publishing House, N.Delhi.
16. Pharmacopoeia of India, 1985,1996, Govt. of India, Ministry of Health and Family Welfare.
17. Pulok Mukherjee, Quality control of Herbal drugs, Business Horizons Pharmaceutical Publishers.
18. Raphael Ikan, Natural products a laboratory Guide, Academic Press.
19. Robinson, T., The biochemistry of alkaloids, Springer- Verlag, New York
20. Stahl, E., Thin Layer Chromatography- A Laboratory handbook, Springer-Verlag,Berlin.
21. Trease, G.E. and Evans, W.C. Pharmacognosy, 12th Edition, Bailliere Tindall,
22. Eastbourne, U.K.
23. Tyler, V.E., Brady, R., Pharmacognosy, Lea & Febiger.
24. V.D.Rangari, Pharmacognosy and Phytochemistry Volume I & II.
25. Wagner, S.B., Zgainsky, Plant drug Analysis.
26. Wallis, T.E. Textbook Of Pharmacognosy, J.A. Churchill Limited, London.

PS4409: PHARMACEUTICAL ENGINEERING – I

1. **Introduction of Unit Operations :** **7h**
   - 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 :** **4h**
   - 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:** **4h**
   - 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 & Fluid Handling Systems:** **6h**
   - 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.
   - Liquid Handling - Different types of pumps.
   - Gas Handling - Various types of fans, blowers and compressors.
5. **Materials of Construction:** **3h**
   - 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.
6. **Absorption and Extraction**: **3h**

   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.

7. **Distillation**: **3h**
   - 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,
   - Azeotopic and extractive distillation,
   - Mathematical problems on distillation.

Books Recommended :

1. MaCabe & Smith: "Unit Operations of Chemical Engineering," McGraw Hill, 1993.
2. Badger & Banchero: "Introduction to Chemical Engineering," 5th 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," 6th ed., CBS Publishers,1972.
6. Brown: "Unit Operations," Indian edition, Asian Publishing House, Hallman, Heat Transfer,8th Ed.

PS4402: 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, Liniments & Applications	07
b.	Enemas	03
c.	Ointments & Creams	07
d.	Pastes	03
e.	Ophthalmic preparations	02
f.	Prescriptions requiring isotonicity requirement	03
g.	Jelly	02
h.	Suppositories	03

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.

PS4404: 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 oilsl.
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.

PS4406: 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 α-amylase.
6. Estimation of SGOT, SGPT, Alkaline Protease and Bilirubin.

Books Recommended :

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

ME1102: 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, sgitators, crushers, flow sheet symbols.

Books Recommended:

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

BIRLA INSTITUTE OF TECHNOLOGY
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DEPARTMENT OF PHARMACEUTICAL SCIENCES
B. PHARM. – COURSE STRUCTURE (w.e.f. 2011-2012)

Semester – V

Subject Code	Name of Subject	L (h)	T (h)	P (h)	C
PS5401	Pharmaceutical System – II	3	0	0	3
PS5403	Pharmacology – II (Neuropharmacology)	3	0	0	3
PS5405	Chemotherapeutic Agents	3	0	0	3
PS5407	Instrumental Drug Analysis	3	0	0	3
PS5409	Pharmacognosy – III	3	0	0	3
PS5411	Pharmaceutical Engineering – II	3	0	0	3
PS5402	Product Development Lab – I	0	0	3	2
PS5404	Pharmacology Lab – I	0	0	3	2
PS5406	Natural Medicinals Lab	0	0	3	2
PS5408	Pharmaceutical Engineering Lab	0	0	3	2
	TOTAL	**18**	**0**	**12**	**26**
	Total Hours	**30**			

PS: Pharmaceutical Sciences
L: Lecture T: Tutorial P: Practical C: Credits h: Hours

PS5401: PHARMACEUTICAL SYSTEMS – II

1. Surface – active agents: 7h

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. Miceller solubilization: Mechanism of solubilization, Factors influencing the choice of solubilizing agents, Ternary phasediagram in the formulation of solubilized systems.

2. Colloidal dispersions: 7h

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: 7h

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: 6h**

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: 8h**

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.

PS5403: PHARMACOLOGY – II

(Neuropharmacology)

Autonomic Nervous System:

Module I (6L)

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.

Module IV (4L)

Drugs acting on Urinary System:

i. Fluid & electrolyte balance,

ii. Diuretics.

Central Nervous System:

Module V

(7L)

i. Neurotransmitter Systems,

ii. General Anesthetics,

iii. Alcohol and Antabuse,

Module VI (8L)

iv. Sedatives, Hypnotics and Tranquillizers,

v.Antipsychotic Agents.

vi. Antidepressant Agents.(classification, mechanism of action)

vii. Convulsants and Anticonvulsants(classification, mechanism of action)

Module VII (7L)

1. Analgesics, Antipyretics, Anti-inflammatory and
2. Antirheumatic and Antigout drugs, (classification, mechanism of action)

Books Recommended :

1. Bhattacharya et al.: "Pharmacology," 2nd 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.

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PS5405: CHEMOTHERAPEUTIC AGENTS

Classification, Structure, nomenclature, mode of action, uses and SAR of following catagonies 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*, sulfamethoxaole*, silver sulfadiazine*, sulfasalazine, dapsone*, solapsone and related drugs.
B: Nitrofuran derivatives: Nitrofurazone, nitrofurantoin* and furazolidone*.
C: Fluroquinalones: 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, Econoazole nitrate, Butoconazole, Oxyconazole nitrate, Tioconozole, 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.]
Melphalan, Chlorambucil, Busulfan, Thiotepa, Mercaptopurine*, Floxuridine, Methotrexate*, Dactinomycin, Doxorubicin hydrochloride, Idarubicin hydrochloride,
Etoposide, Vinblastin sulphate, Vincristin sulphate and related drugs.

7. Immunosuppresants 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.

PS5407: INSTRUMENTAL DRUG ANALYSIS

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

1. **Molecular Absorption Spectroscopy:** [09 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:** [04 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:** [04 Hrs.]
   Principle, instrumentation, interferences and applications in Pharmacy.

4. **Chromatography:** [07 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.

5. **NMR and ESR:** [04 Hrs.]
   Theoretical aspects, basic instrumentation, elements of interpretation of spectra and applications in pharmacy.

6. **Mass Spectroscopy:** [04 Hrs.]
   Theoretical aspects, basic instrumentation, elements of interpretation of spectra and applications in pharmacy.

7. Validation, quality of equipment, validation of equipment, validation of analytical procedures. [04 Hrs.]

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.
10. WHO Manual on Validation

PS5409: 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) Belladona, 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.

PS5411: PHARMACEUTICAL ENGINEERING – II

1. **Size Reduction & Size Separation**: 9h
   - 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.
   - 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.

2. **Filtration**: 3h
   - Theory of filtration, filter aid, filter media,
   - Theory of filtration.
   - Types of industrial filters and their operation
   - Mathematical problems.

3. **Drying:** 5h
   - 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.

4. Crystallization: 4h
   - 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.

5 Mixing & Solid Handling: 4h
   - Theory of mixing,
   - Solid-solid, solid-liquid and liquid-liquid mixing equipments.
   - Handling of solids in pharmaceutical plants,
   - Storage and weighing of solids,
   - Types of conveyors, their operation, and uses.

6. Basic Reaction Engineering & Brief description on Bioreactors: 3h

- 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).
- Fundamentals of bioreactor design for pharmaceutical operation.

7. Automated Process - Control System: 2h

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

PS5402: PRODUCT DEVELOPMENT LAB- I

Diverse Experiments covering theoretical principles based on PS 4401 and PS 5401, relevant to the formulation of Pharmaceutical Dosage Forms.

PS5404: 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 determine the writhing effect in mice.
11. To study the behavioural effects of CNS-depressant and CNS-stimulant drugs in mice.
12. To record a Concentration Response Curve (CRC) or Dose Response Curve (DRC) of Acetylcholine using rectus abdominis muscle preparation of frog.
13. To record the effect of Physostigmine (Eserine) on the CRC of Acetylcholine using rectus abdominis muscle preparation of frog.
14. To record the effect of d – tubocurarine on the CRC of acetylcholine using rectus abdominis muscle preparation of frog.
15. To study the CRC of Acetylcholine using rabbit intestine.
16. To study the antagonistic and synergistic action of Atropine and Eserine in rabbit intestine.
17. To study the CRC of Acetylcholine using guinea pig ileum.
18. To study the antagonistic and synergistic actions of Atropine and Eserine in 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,

PS5406: NATURAL MEDICINALS 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. Raphel Ikan, Practical Guide Natural Products.
2. J.B. Harborne, Phytochemical Methods.

PS5408: PHARMACEUTICAL ENGINEERING LAB

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

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DEPARTMENT OF PHARMACEUTICAL SCIENCES
B. PHARM. – COURSE STRUCTURE (w.e.f. 2011-2012)

Semester – VI

Subject Code	Name of Subject	L (h)	T (h)	P (h)	C
MSH1131	Principles of Management	3	0	0	3
PSB601	Professional Ethics (Pharmaceutical Jurisprudence)	3	0	0	3
PS6401	Industrial Pharmacy – I	3	0	0	3
PS6403	Pharmacology – III (Systemic Pharmacology)	3	0	0	3
PS6405	Pharmacognosy – IV	3	0	0	3
PS6407	Synthetic Medicinals – I	3	0	0	3
PS6402	Product Development Lab – II	0	0	3	2
PS6404	Pharmacology Lab – II	0	0	3	2
PS6406	Pharmacognosy Lab – II	0	0	3	2
PS6408	Instrumental Drug Analysis Lab	0	0	3	2
	TOTAL	**18**	**0**	**12**	**26**
	Total Hours	**30**			

PS: Pharmaceutical Sciences
L: Lecture T: Tutorial P: Practical C: Credits h: Hours

MSH1131: PRINCIPLES OF MANAGEMENT

PSB601: PROFESSIONAL ETHICS

(Pharmaceutical Jurisprudence)

I. INTRODUCTION: (2)

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

II. DETAILED STUDY OF THE FOLLOWING ACTS & RULES (23)

(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)

1. AICTE Act
2. Factories Act
3. States Shops & Establishment Act & Rules
4. Poison Act
5. Insecticide Act
6. Prevention of Cruelty to Animals Act
7. Patent Act
8. GATT Agreement
9. 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,".

PS6401: INDUSTRIAL PHARMACY-I

1. **Preformulation:** **(7)**
   Dosage form Design, Methodology, Physico-chemical considerations of a new medicinal agent involved in formulation of dosage form.
2. **Tablets:** **(10)**
   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, multiplayer 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:** **(3)**

   A. Sugar, Film, Enteric, Fluid bed coating, Coating Materials, solvents, processing problems.
   B. Evaluation of coated tablets (including official procedures).
   C. A critcal study of selected Pharmacopoeial (IP/BP) monographs based on (i) coating types, and (ii) Deviations from normal official limits.
4. **Capsules:** **(4)**
   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:** **(5)**
   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. **Medicated Applications:** **(6)**
   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 & Expended).
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.

PS6403: PHARMACOLOGY – III

(Systemic Pharmacology)

Module I (6L)

Drugs acting on GIT:

i. Antacid, Antisecretory and Anti-ulcer drugs,
ii. Emetics and Antiemetics,
iii. Laxatives and Antidiarrhoreal drugs.

Module II (6L)

Drugs acting on Hemopoietic System :

iii. Coagulants and Anticoagulants,
iv. Fibrinolytic and Anti-platelet drugs,
v. Hematinics,
vi. Blood and Plasma volume expanders.

Module III

Drugs acting on Respiratory System : (4L)

i. Anti-asthmatic drugs including bronchodialators,
ii. Anti-tussive and expectorants, drugs used in common cold
iii. Respiratory stimulants.

Module IV (7L)

Drugs acting on Cardiovascular System:

i. Digitalis and Cardiac Glycosides,
ii. Antihypertensive agents,
iii. Antihyperlipedemic drugs,

Module V (6L)

iv. Antianginal and Vasodilator agents,
v. Antiarrythmic agents,
vi. Drugs used in the therapy of shock.

Module VI (6L)

Pharmacology of Endocrine System:

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 (6L)

i. Androgenic & Anabolic steroids,
ii. Estrogen, Progesterone and Oral Contraceptives,
iii. Drugs acting on the Uterus.

Books Recommended

1. Bhattacharya et al.: "Pharmacology," 2nd 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

PS6405: PHARMACOGNOSY – IV

1. Metabolites: (3L)
i.General techniques of biosynthetic studies and basic metabolic pathways.
ii.Brief introduction to biogenesis of secondary metabolites of pharmaceutical importance.

2. Chemistry, biogenesis and pharmacological activity of medicinally important (4L)
A)**Terpenes &Terpenoids:** monoterpenes, sesquiterpenes, diterpenes and triterpenoids.
B) **Carotenoids:** _-carotenoids, _-carotenes, vitamin A, xanthophylls of medicinal importance.

3. Chemistry, biogenesis and pharmacological activity of medicinally important (8L)
A)**Glycosides:** Chemistry and biosynthesis of –digitoxin, digoxin, hecogenin, sennosides, diosgenin and sarasapogenin.
B)**Alkaloids:** Atropine and related compounds, quinine, reserpine, morphine, papavarine, ephedrine, ergot and vinca alkaloids.
C) **Lignans ,Quassanoids & Flavonoids** : Podophyllotoxin, Picropodophyllin,Quassin, Naringin, Quercitin, hesperidin.

4. Study of Neutraceuticals as health foods: Introduction, Types of spirulina,soya and garlic (2L)

5.Herbal Cosmetics (10L)
A)Brief study of Phytocosmetics of industrial significance and current status.
Herbs used for different cosmetic preprations Like Shampoos (soapnut), Conditioners, (Amla, Henna, Hibiscus, Tea), Hair darkeners (Amla, Henna), Skincare (Aloe,Turmeric)

6) 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 Mukherjiee, 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.

PS6407: 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.

1. **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.

2. **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.

3. **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.

4. **Local Anaesthetics:** Cocaine, Benzocaine*, Butamben, Procaine*, Lignocaine*, Dibucaine* and related drugs of clinical importance.

5. **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, Barbital*, Phenobarbital, Triclofos sodium* and related drugs.
   C. **Antipsychotics and antiemetics:** Chloropromazine hydrochloride*, Prochlorperazine maleate*, Trifluoperazine hydrochloride, Chlorprothixene, Thiothixene, Haloperidol and related drugs.

6. **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.
7. **Antifertility agents:** [03 Hrs.]

   Oral contraceptives with emphasis on combination regimen, Intrauterine Devices & Implants etc. Synthesis of Medroxyprogesterone.

BOOKS RECOMMENDED:

1. Wolf's, Burger – Textbook of Medicinal Chemistry Vol. I, II, III.
2. Wilson & Gisvold, A textbook of organic Pharmaceutical and Medicinal Chemistry.
3. William Foye – Elements of Medicinal Chemistry.

PS6402: PRODUCT DEVELOPMENT LAB- II

Diverse Experiments covering theoretical principles based on PS 6401, relevant to the formulation and evaluation of Pharmaceutical Solid Dosage Forms

PS6404: PHARMACOLOGY LAB. – II

19. To study the CRC of Histamine using rabbit intestine.
20. To study the antagonistic action of Diphenhydramine on CRC of Histamine in rabbit intestine.
21. To study the CRC of Histamine using guinea pig ileum.
22. To study the antagonistic action of Diphenhydramine on CRC of Histamine in guinea pig ileum.
23. To study the CRC of 5 – HT in guinea pig ileum.
24. To study the antagonistic action of Cyproheptadine in guinea pig ileum.
25. Cumulative dose response curve of Acetylcholine, Histamine and 5 HT in rabbit intestine.
26. To study the effect of Drugs on isolated uterus.
27. To find out the strength (concentration) of given sample of Acetylcholine by interpolation bioassay method using rectus abdominis muscle preparation of Frog.
28. To estimate the strength of the unknown sample of Acetylcholine by 3-point bioassay employing rectus abdominis muscle of Frog.
29. To estimate the strength of the unknown sample of Acetylcholine by 4-point bioassay employing rectus abdominis muscle of Frog.
30. To estimate the strength of the unknown sample of Acetylcholine by 3-point bioassay employing Rabbit jejunum.
31. To estimate the strength of the unknown sample of Acetylcholine by 4-point bioassay employing Rabbit jejunum.
32. To estimate the strength of the unknown sample of Histamine by 3-point and 4-point bioassay employing Rabbit jejunum.
33. To estimate the strength of the unknown sample of Acetylcholine by 3-point bioassay employing Guinea Pig ileum.
34. To estimate the strength of the unknown sample of Acetylcholine by 4-point bioassay employing Guinea Pig ileum.
35. To estimate the strength of the unknown sample of Histamine by 3-point bioassay employing Guinea Pig ileum.
36. To estimate the strength of the unknown sample of Histamine by 4-point bioassay employing Guinea Pig ileum.
37. To estimate the strength of the unknown sample of 5HT by 3-point and 4 point bioassay employing 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,

PS6406: 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,- 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. Chromatgraphic 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, Manipa.l
11. Kokate C. K, Practical Pharmacognosy , Nirali Prakashan.
12. Central council of Research in Ayurveda and Siddha (CCRAS) Guidelines.

PS6408: INSTRUMENTAL DRUG ANALYSIS LAB

List of Experiments

1. Determination of λmax. 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 Chloroqine 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 Na^+ and K^+ ion using Flame Photometer in the given sample.
10. Determination of α-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.

BIRLA INSTITUTE OF TECHNOLOGY
MESRA, RANCHI – 835 215
DEPARTMENT OF PHARMACEUTICAL SCIENCES
B. PHARM. – COURSE STRUCTURE (w.e.f. 2011-2012)

Semester – VII

Subject Code	Name of Subject	L (h)	T (h)	P (h)	C
PS7401	Industrial Pharmacy – II	3	0	0	3
PS7403	Biopharmaceutics & Pharmacokinetics	3	0	0	3
PS7405	Synthetic Medicinals – II	3	0	0	3
PS7407	Pharmacology – IV (Chemotherapeutic Pharmacology)	3	0	0	3
PS7409/ PS7411/ PS7413	ELECTIVE – I	3	0	0	3
PS7415/ PS7417	ELECTIVE – II	3	0	0	3
PS7402	Product Development Lab – III	0	0	3	2
PS7404	Biopharmaceutics Lab	0	0	3	2
PS7406	Project	0	0	10	2
	TOTAL	**18**	**0**	**16**	**24**
	Total Hours	**34**			

PS: Pharmaceutical Sciences
L: Lecture T: Tutorial P: Practical C: Credits h: Hours

ELECTIVE – I: (Any one)	**ELECTIVE – II: (Any one)**
1. PS7409 Cosmetic Technology 2. PS7411 Clinical Pharmacology 3. PS7413 Herbal Formulations & Standardization	1. PS7415 Pharmaceutical Biotechnology 2. PS7417 Fundamentals of Tissue Culture

PS7401: INDUSTRIAL PHARMACY – II

1. Liquid Orals: **5**

C. Formulation Considerations: Solubility, stability and Organoleptic properties.

D. Manufacturing Considerations: Raw materials, Equipments, Compounding & Packaging.

2. Emulsions: **7**

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: **5**

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: **10**

A. 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.

B. Large Volume Parenterals

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: **5**

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: 4

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 & Expended).
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.

PS7403: BIOPHARMACEUTICS & PHARMACOKINETICS

I. BIOPHARMACEUTICS: 2h

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 5h

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 (10 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: 18h

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 (ka)
      - Elimination Rate Constant (K) & Elimination Half - life ($t_{½}$).
      - AUC, Cmax, and tp.
   iii) Apparent Volume of Distribution (Vd) & Renal Clearance (Q)-
      - Pharmacokinetic expressions for the above Administration situations.

Books Recommended :

1. Gibaldi : "Biopharmaceutics & Clinical Pharmacokinetics," 3rd ed., Lea Febiger, 1984.
2. Swarbrick, Ed., : "Current Concepts in Pharmaceutical Sciences (Bio-pharmaceutics)," 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)," 3rd 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)," 4th ed. (Revised & Expanded), Marcel Dekker, 1987.
8. Shargel & Yu: "Applied Biopharmaceutics & Pharmacokinetics," 4th ed., Appleton & Lange, 1999.
9. Gibaldi & Perrier : "Pharmacokinetics," 2nd ed. (Revised & Expanded), Marcel Dekker (series in Text-Books & Monographs : Swarbrick, Ed., vol.15), 1982.
10. Welling & Tse, Eds. : "Pharmacokinetics," 2nd 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.

PS7405: 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*, Tetrahydrazoline 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*, Procylidine 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 hypoglyceimic 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 RECOMMENED:

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

PS7407: PHARMACOLOGY – IV

(Chemotherapeutic Pharmacology)

1. **Chemotherapeutic Pharmacology:**

Module I (4L)

i. General Principles of chemotherapy,
ii. Sulphonamides and Cotrimoxazole,

Module II (6L)

iii. Antibiotics - Penicillins, Cephalosporines, Chloramphenicol,
iv. Macrolides, Quinolones & miscellaneous antibiotics,

Module III (4L)

v. Chemotherapy of Tuberculosis and Leprosy,
vi. Fungal diseases,

Module IV (4L)

vii. Protozoal Parasites (Malaria, Amoebiasis, Anthelmintics),
viii. Viral infections,

Module V (4L)

ix. Urinary-tract infections,
x. Sexually-transmitted diseases,

Module VI

xi. Chemotherapy of Malignancy and Immunosuppressive agents. (3L)

Module VII (4L)

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," 2nd 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.

PS7409: COSMETIC TECHNOLOGY (ELECTIVE)

A. **Perfumes:**

Basic principles of perdumary and fragrane, perfumery raw materials (natural as well as synthetic), Fixatives (Animal secretions, Resinous fixatives, Essentials 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, Cleansings creams, Moisturizing creams, Face powder, Lipistick.
    ii. Hand Products: Protective creams, Hand creams and lotions, Liquid creams, Hand cleaners, Nail lacquers.
    iii. Body Cosmetics: Antiperpirants and Deodorants. Depilatories. Talcum and Dusting powders, Perfumes.
    iv. Preparations for Oral hygience: 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" Dlavarre.
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.

PS7411: CLINICAL PHARMACOLOGY (ELECTIVE)

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 failune, 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. 9th 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.

PS7413: HERBAL DRUG FORMULATION & STANDARDIZATION (ELECTIVE)

Prospects of Traditional medicine in primary health and economic growth. (4L)

A. Regulatory status of herbal medicines – WHO, India, Europe, US (4L)

B. Overview on the traditional formulations. (Asava, Arista, Gutika, Tinctures) (5L)

C. 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^{nd} Edn.) A Biosynthetic Approach - Paul M. Dewier.
3. Pharmacognosy, Phytochemistry Medicinal Plants (2^{nd} 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

PS7415: PHARMACEUTICAL BIOTECHNOLOGY (ELECTIVE)

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,"1st ed. (Reprint),CBS Publisher, 1996.
2. Old & Primrose: "Principles of Gene Manipulation," 5th ed. (Reprint), Blackwell Science Ltd., 1996.
3. Gupta: "Elements of Biotechnology,"1st 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.

PS7417: FUNDAMENTALS OF TISSUE CULTURE (ELECTIVE)

1. **Basics of plant and animal In Vitro culture:** Applications, benefits and limitations of plant and animal cell cultute techniques, culture procedures and principles of animal cell cultures, culture media components, role of plant growth regulators, sterilization techniques, aseptic manipulation techniques.

2. **Callus Culture and Cyto-Differentiation in plants:** Organogenesis and embryogenesis, clonal/micro propagation, somaclonal variation, production and use of haploids, suspension culture, artificial seeds. production of secondary metabolites and other plant-derived chemicals, bioreactors, bio-transformation

3. **Protoplast Culture:** Isolation, purification and plating; regeneration, protoplast fusion, somatic hybrids and cytoplasmic hybrids.

4. **Transgenic Plants:** Plant cell transformation: vectors and techniques used.genetically modified crops, resistance against biotic and abiotic stresses, molecular farming.

5. **Characteristics of animal cells in culture:** Contact inhibition, anchorage independence/dependence, cell-cell communication, cell senescence. methods of disaggregating primary cultures, development and maintenance, cloning of cell lines, cell synchronization viral sensitivity of cell lines, cell line preservation and characterization, stern cell lines.

6. **Methods of animal Cell and Organ Culture:** Micro carrier cultures, cell immobilization, animal cell bioreactor, large scale cell cultures for biotechnology, somatic cell fusion, flow cytometry, transfection. methods, behavior and utility of organ culture, whole embryo culture.

7. **Applications of Animal Cell Culture:** Use in gene therapy, cloning from short-term cultured cells, cloning from long-term cultured cells, cloning for production of transgenic animals, cloning for conservation.

Books Recommended:

1. Freshney, Animal cell culture — a practical approach
2. N. Jenkins, Animal Cell Biotechnology: methods and protocols.
3. Dixon and Gonzales, Plant cell culture — a practical approach.
4. Razdan, An introduction to plant tissue culture.

PS7402: PRODUCT DEVELOPMENT LAB- III

Diverse Experiments covering theoretical principles based on PS 7401, relevant to the formulation and evaluation of Pharmaceutical Liquid and Parenteral Dosage Forms.

PS 7404: BIOPHARMACEUTICS LAB

Diverse Experiments covering theoretical principles based on PS 6401, PS 7401 & and PS 8401, relevant to In-vitro Dissolution studies and Bioavailability studies.

PS 7406: PROJECT

BIRLA INSTITUTE OF TECHNOLOGY

MESRA, RANCHI – 835 215
DEPARTMENT OF PHARMACEUTICAL SCIENCES
B. PHARM. – COURSE STRUCTURE (w.e.f. 2011-2012)

Semester – VIII

Subject Code	Name of Subject	L (h)	T (h)	P (h)	C
PS8403	Drug Delivery System	3	0	0	3
PS8405/ PS8407/ PS8409/	ELECTIVE – III	3	0	0	3
PS8411/ PS8413/	ELECTIVE – IV	3	0	0	3
PS8402	Product Development Lab - IV	0	0	3	2
PS8404	Synthetic Medicinals Lab	0	0	3	2
PS8406	Project	0	0	10	2
	TOTAL	**9**	**0**	**16**	**15**
	Total Hours	**25**			

PS: Pharmaceutical Sciences
L: Lecture T: Tutorial P: Practical C: Credits h: Hours

ELECTIVE – III: (Any one)	**ELECTIVE – IV (Any one)**
1. PS8405 Drug Design 2. PS8407 Clinical Pharmacy & Drug Interactions 3. PS8409 Quality Assurance & Drug Regulatory Affairs	1. PS8411 Fermentation Technology and Biological Products 2. PS8413 Pharmaceutical & Biomedical Polymers

PS8403: DRUG DELIVERY SYSTEMS

1. **Sustained Release Dosage Forms:** **(10)**
   a. Introduction and Terminology.
   b. Release rate and dose considerations- Estimation of initial and maintenance dose.
   c. Physicochemical and Biological properties influencing Oral Sustained Release Dosage Form Design.
   d. Diffusional system.
   e. Dissolution- controlled system.
   f. Osmotic systems
   g. Ion Exchange Resins
   h. Formulation, In-vitro and In-vivo evaluation.

2. **Targeted Delivery System:** **(5)**
   a. Introduction
   b. Rationale of Targeted Drug Delivery
   c. Biological Processes and Events involved in Drug Targeting (in Brief)

3. **A brief discussion on following Drug Carrier Systems** **(10)**
   a. Liposomes
   b. Prodrugs
   c. Nanoparticles
   d. Resealed Erythrocytes

4. **Cosmeceuticals:** **(5)**
   a. Definition
   b. Drug Vs. Cosmetics: Cosmeceuticals
   c. Need of Hour
   d. The cosmetic perspective and International Scenario
   e. Products Potentially classified as cosmeceuticals.

BOOKS RECOMMENDED:

1. Lachman et al : Theory and Practice of Industrial Pharmacy
2. Remington Pharmaceutical Sciences.
3. Banker and Rhodes : Modern Pharmaceutics (Revised & Expended), Marcel Dekker, 1996
4. Robinson and Lee : Controlled Drug Delivery : Fundamental and Applications, Marcel Dekker
5. Ansel et. al.: Pharmaceutical Dosage Forms and Drug Delivery System., Lippincott Williams & Wilkins, 2011.
6. Jain Ed.: Advances in Controlled and Novel Drug Delivery, CBS Publishers & Distributors.
7. Elsher and Maibach, Eds.: Cosmeceutical: Drug Vs. Cosmetics, Marcel Dekker, 2000.

PS8405: DRUG DESIGN (ELECTIVE)

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, Stereoisoness, Optical and geometrical isomers, steric features of drugs, configurational and conformational isomers, examples from analgetics, adrenergic drugs, cholinergic drugs etc.
4. **Isosterism and Bioisoterism:** [04 Hrs.]
   Concepts of isosterism, applications of bioisoterism, 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 – besiding 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.

PS8407: CLINICAL PHARMACY & DRUG INTERACTIONS (ELECTIVE)

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.

PS8409: QUALITY ASSURANCE & REGULATORY AFFAIRS (ELECTIVE)

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, 5th edn., (1998).
2. Good Laboratory Practice by Sandy Weinberg, Mercel Dekker, New York, 2nd edn. Vol. 69 (1995).
3. New Drug Approval Process by Richard A Guarino, Mercel Dekker, New York, 2nd 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, 2nd edn., Vandana Publishing, New Delhi

PS 8411: FERMENTATION TECHNOLOGY & BIOLOGICAL PRODUCTS (ELECTIVE)

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

PS8413: PHARMACEUTICAL AND BIOMEDICAL POLYMERS (ELECTIVE)

I. **Introduction**: Biomaterials- Definition, Classification, Applications. Biological materials and Biomaterials. Implants and transplants. Advantages and disadvantages of biomaterials. Comparison with natural tissue replacement materials. (4)

II. **Structure Property Relationship**: Natural polymers like Proteins, Polysaccharides etc. and synthetic polymers like Polyolefins, Acrylics, Cellulose epoxy resins, Fluoro polymers, Vinyl polymers, Polyurethanes, Silicones, Hydrogels etc. Molecular weight averages, molecular weight determination from solution viscosity, conformation of dissolved linear macromolecules. Polymers as thickening agents. (6)

III. **Polymers in Solutions**: Solvent selection, preparing polymer solutions, thermodynamics of polymer solution. Phase separation, gel formation coacervation and microencapsulation. (3)

IV. **Biocompatibility and Blood Compatibility of Polymers**: In vitro and In vivo test. Modification to enhance biocompatibility- copolymerization, blending, surface treatments (coating, heparinization, grafting etc.), thromboresistant surface. (5)

V. Bioactive, Bioresorbable, Biodegradable, Superabsorbent, Biostable and porous tissue ingrowth implant materials. Sterilization of implants. Deterioration of polymer properties. (5)

VI. **Surgical, Medical and Paramedical Applications of Polymers**: Soft tissue replacement- Extra corporeal, intra corporeal, blood interfacing, sutures, surgical tapes, adhesives, percutaneous devices, heart assist device, artificial skin, maxillofacial organs, kidney, eye etc. Hard tissue replacement- various joints, fracture fixation devices, dental implants. Bone implants fixation problems and steps to mitigate them. (7)

VII. **Polymers in Drug Delivery Systems**: Classification, Pharmaceutical Applications of biomaterials, Hydrogel biomaterials, Liposome synthesis from biomatrials, Tissue engineering, Adhesive biomaterials, Nanoparticles. (5)

Books Recommended:

1. Biomaterials- An Introduction – J. B. Park, Plenum Press
2. Plastic Materials – J. S. Brydson, 3rd Edn. Burthreoortle 1975
3. Martin's Physical Pharmacy and Pharmaceutical Sciences –Patrick J. Sinko (5th edn.), Lippincott Williams & Wilkins.

PS8402: PRODUCT DEVELOPMENT LAB- IV

Diverse Experiments covering theoretical principles relevant to the formulation and evaluation of Pharmaceutical Topical/ External/Cosmetic Preparations.

PS8404: 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 benzaledehyde.*
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

PS8406: PROJECT