BIRLA INSTITUTE OF TECHNOLOGY
MESRA, RANCHI – 835 215
DEPARTMENT OF PHARMACEUTICAL SCIENCES
B. PHARM. – COURSE STRUCTURE (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 Computer	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 Computer Lab	0	0	3	2
GA1002/1004/1006/1008	Games/ NCC/ NSS/ 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 COMPUTER

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 COMPUTER 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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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
GA1002/1004/1006/1008	Games/ NCC/ NSS/ 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
CHEM 1005	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 Pharmaceutics Lab	0	0	3	2
GA1002/1004/1006/1008	Games/ NCC/ NSS/ 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

CHEM 1005 : 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.

PS 4405: 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
GA1002/1004/1006/ 1008	Games/ NCC/ NSS/ 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

PSB501: 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 4407: 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,

PS4409: 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.

PS4411: 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