INSTITUTE OF PHARMACY

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BUNDELKHAND UNIVERSITY, JHANSI

PROSPECTUS

B.PHARM. PART – I

EXAMINATION-2008

PUBLISHED BY

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B. Pharm Part - I

B.1.1 Testing Pattern :

1. Words meaning and usages.

2. Applied grammar : Part of Speech, punctuation, articles, tenses, phrases, verbs, concord' modifiers, conditionals, narration, prepositions & idioms.
3. Report writing:

Report writing in present day industrial set up.

4. Letter writing : application and communication Such as business correspondences, official, communications and acknowledgements.

5. Essay writing: all current issues & advancement in Science / Pharmacy.

References:

1. Close, R. A. A University Grammar of English Workbook, Longman, London, 1998.
2. Jones, Naneil, English Pronouncing Dictionary, ELBS, London, 1999.
3. Sharma, S. D. A, Textbook of Spoken & Written English, Vikas, 1994.
4. Bansal, R. K. l Spoken English of India, Orient Longman, 1993.

B.1.2 Mathematics

Algebra: Laws of indices, surds, pure and mixed surds, Rationalization of surds, equivalent fraction with a rational denominator of a surds. Square root, cube root and fourth root of a complex number Solution of quadratic equation, theory of quadratic equations. Solution of simultaneous equations and miscellaneous equations. Logarithm : properties of logarithms. Arithmetical, geometrical and hormonical progressions. Permutation and combination. Binomial theorem with positive index Matrices: types of matrices, addition, subtraction, multiplication and transpose of matrices. Adjoint and inverse of matrix, application of matrices in solving equations. Determinants and its properties applications determinants, applications of determinants in the solution of linear equations.

Co-ordinate Geometry : Distance formula, area of triangle and quadrilateral. Equations of straight line, angle between straight line, point of intersection of two straight lines, perpendicular distance of a point from the straight line. Second degree equation representing two lines. Equation of circle.

Trigonometry : Measurement of angles, relation between trigonometrically ratio of an angle of a right angle triangle, complementary and supplementary angles, multiple and submultiples angles. Product formulae, sum and difference formulae of trigonometric ratios. Identities of trigonometric ratios. Relation between sides and angles of any triangle: Area of triangle. Radius of circumscribed, inscribed circles.

Calculus : function, limit of function, limit of infinity, one sided limit. Differentiation of some function, product rule, quotient rule of differentiation, differentiation of function, inverse trigonometric function, differentiation or logarithmic form, parameter form, differentiation by substitution.

Integration as inverse of differentiation, simple integration formulae. Integration by substitution and by parts.

B.1.2 Biology

1. Nature and scope of Biology: Basis and origin of life. Living and Non-Living. Common features of Life process. Energy transformation and protein synthesis.
2. Cell as Unit of life : Micro and macro molecules of cell, enzymes, cell membranes, structural organization of cell, cellular respiration.
3. Kingdom of life, Biological classification, species and population, Biotic community, Biosphere.
4. Morphology and anatomy of Flowering plants, Absorption and Movement of water in plants, Mineral and Nitrogen, Nutrition in plants, photosynthesis, reproduction in flowering plants. Growth and development of flowering plants.
5. Human Nutrition: Organs of digestion and digestive processes. Food components and their assimilation. Nutritional deficiency diseases. Anatomical consideration of respiratory system: gaseous exchange and their transport in blood stream.

   Circulatory system: functions and circulation, blood vessels, heart-its anatomy and functioning.

   Excretion : Nitrogen excretion in animals, kidney it structure and function. Cutaneous and pulmonary excretion.

   Reproduction: male and female reproduction organs. Embryonic developments in mammals (up to three germinal layers).

6. Evolution of life: chemical and organic evaluation. Morphological evidence, homology, vestigial organs and embryological similarities, drawings major contributions, commercial origin of living organism and recombination as source of variability. Human evolution, evidences of human evolution and mans place among mammals.
7. Herediety and variation : Mandel's law of inheritance, genes, gene-expression, genetic code, hereditary material, cell division-mitosis and meiosis, molecular basis of differentiation.

B.I.3 Basic Electronics and Computer Application :

l. Basic Electronics: Semiconductors, p-n junction diode, LED, photodiode & its uses, Rectifiers (half Wave, full wave, with filters), transistors, configurations of transistors, Amplifiers Introduction to Integrated circuits, photocells & photo multipliers tubes.

2. Computers Application:

(i) History of Computers: to development & respective generation: Abacus, Napier's- bones, slide, Pascal computers. Need to use computers, application in pharmacy & in general. Computer classification: mainframe mini & microcomputer, comparison of analogue & digital computer Hardware & software, Calculator & computer.

(ii) Operating System: introduction to types of operating systems-UNIX, MS-DOS. RAM, ROM virtual memory etc.

(iii) Type of Language: Conventional language, their advantage, and limitations : C, Pascal FORTRAN, programming of these language constant & variables: Characters set, constant, variables naming the variables, getting data into memory, LET, INPUT, READ, DATA, print statement.

(iv) Introduction to computer Network & Data Structure: Architecture of seven layers communication. Data Structure: Like queues, list, trees, binary trees algorithms, flow charts, structured systems, analysis and development, ingress- SQL, Gateways etc., Statistics, methodology,

(v) Expressions: Arithmetic expression, Hierarchy of operations, rules of arithmetic, evaluation expressions, relational expression, logical operation, library function.

(vi) Printer control functions & Subroutines: user defines functions, subroutines, and subscript variables. Coma & semicolon control, the TAB function, PRINT, L-PRINT.

(vii) Computer Application in Pharmaceuticals & clinical studies.

Practicals:

Exercised based on the following are to be dealt:

I- Computer operating system like UNIX, MS- DOS etc.

2- Simple programmes in basic.

3- Study of soft ware package like WORD-STAR, LOTUS-123, etc.

B.1.4 Pharmaceutical Chemistry –I

(Inorganic Chemistry)

An out line of methods of preparation, uses, sources of impurities, test for purity and identity of the following classes of Inorganic Pharmaceuticals included in Indian Pharmacopoeia

I. Acids & Bases, Buffers and Water.

2 Topical Agents - Protective, astringents & anti-infectives.

3. Gastro-intestinal agent: acidifying agents, gastric antacids, protectives & adsorbents, cathartics.

4. Major intra & extra cellular electrolytes: physiological ions, physiological acid base balance electrolytic combination therapy.

5, Respiratory agents- expectorants and antitussives.

6. Pharmaceutical necessities-Antioxidants and preservatives.

7. Radio-Pharmaceuticals.

8. Essential trace elements- Iron and hematinics, Mineral supplement.

9. Complexation and chelation-Application in pharmacy.

10. Miscellaneous: filter aids, diluents, adsorbents, suspending agents, poison & antidotes, colorants. lubricants, demulcents, keratolytics and dermatologies, emetics, dental products (dentifrices & anti-caries agents).

Practicals :

1. Qualitative analysis of inorganic mixtures for three acidic and three basic radicals including interfering radicals.
2. Limit test for arsenic, lead, iron, chloride and sulphate.
3. Preparation, purification of simple inorganic compounds of pharmaceutical importance.

Book Recommended

I Remington's Pharmaceutical sciences.

2. Indian Pharmacopoeia.
3. J. H. Block, E. G. Roche, T. D. Soinc and C.O. Wilson inorganic Medicinal & Pharmaceutical chemistry, Lea and Febiger, Philadelphia.
4. C. A. Discher Modern Inorganic Pharmaceutical Chemistry, John Wiley & Sons, New York.
5. T. O. Soine, lea & Febiger, Philadelphia.

B.1.5 Pharmaceutical Analysis-I

1. The course shall cover- computation of analytical results. Significant figures, concept of error. precision and accuracy standard deviations, rejection of doubtful values with special reference to volumetric and gravimetric analysis, calibration of analytical equipments.

2. Fundamental of volumetric analysis, method of expressing concentrations, primary and secondary standards.
3. Physical chemical concepts required for analysis such as electrolytic

dissociations, modern concept of acid and bases, chemical equilibrium, pH & buffer actions, solubility products. common ion effect, hydrolysis of salts and amphoteric substances

4. Alkyl halides
5. Alcohols
6. Ethers
7. Carboxylic acids and theirs function a derivatives
8. Phenols
9. Aryl halides
10. Amines

Dicarboxylic acids, malonic acid esters and its importance, acetoacetic acid ester and its importance.

polynuclear aromatic hydrocarbons, naphthalene, phenanthrene

Hetero-cyclic compounds nomenclature, properties and reactions of pyridine, pyrrole, and furan.

Practicals

Practical to explain the students the importance of :

(i) Physical properties like solubility, M.P. & B.P.
(ii) Qualitative test for Nitrogen, sulphur and haogens
(iii) functional group analysis
(iv) Preparation of derivatives in ascertaining the identity of organic compounds.
(v) Preparation of simple organic compounds and their purification.

Book Recommended :

1. Morrison R.I. and Boyd. R.N. “Organic chemistry” prentice-hall and India Pvt. Ltd., New Delhi.
2. Bentley Driver’s “Text-book of pharmaceutical chemistry, by L.H. Acherden.

B.1.6 HUMAN ANATOMY AND PHYSIOLOGY

1. Introduction to anatomy and physiology : Definition, allied branches and basic terminology used in subjects. Introductory knowledge of organ and system.

2. The Cell: Structure of cell, its components, their functions and various transport mechanism across the cell membrane.

3. Elementary Tissues of human body: Classification, distribution and characteristic properties of epithelial, connective , muscular and nervous tissue , bone and cartilage.

4. Osseous system: Elementary knowledge of human Skeleton, joints, their classification, type of moments and disorder of joints.

5. Muscular system: General structure of skeletal muscle, physiology of muscle contraction, muscle fatigue and muscular disorder.

6. Haemopoietic system: Composition and function of blood and its elements, blood group and their significance, mechanism of coagulation.

7. Lymph and lymphatic system: Composition, formation, circulation, function and disorders of lymph and lymphatic system. Basic anatomy and function of spleen.

8. Cardiovascular system: Basic anatomy and physiology of heart. basic understanding of cardiac cycle, heart sounds , electrocardiogram (ECG). Systemic, pulmonary and coronary circulation. Blood pressure and its regulation.

9.Nervous system: Neurons, synapses, ganglion, plexus, membrane potential, and action potential, impulse generation and propagation. neuro transmission, reflex and electroencephalogram (EEG). Parts and functions of central nervous system and autonomic nervous system.

10. Digestive system: Anatomy of digestive organs, movements in gastro intestinal tract, Secretory function of elementary tract and role of enzymes in digestive processes.

11. Respiratory system: Anatomy of respiratory system, anatomy of kidney and physiology of urine formation and factors controlling it. Role of kidney in maintaining extracellular fluid volume and composition. acid – base balance.

13. Defense mechanism of body: Phagocytosis, macrophages, inflammation, complement system, immunity and allergy.

14 Special Sense: Basic anatomy and physiology of eye (vision), ear (hearing), taste (gestation), nose (olfaction) and skin (touch and pain).

15.Endocrine system: Basic anatomy and physiology of thyroid, pancreas , pituitary, adrenals and gonads.

16 Reproductive systems; Male and female reproductive systems, and their hormones, menstruation, coitus and fertilization. Pregnancy its maintenance and parturition, family planning methods and sexually transmitted diseases (STD).

Practicals; Based on theory.

B.1.7 Pharmaceutical Chemistry-II

The course shall comprise of the following topics covering structure, nomenclature, properties, methods of preparation & reaction.

1. Relation of structure with properties like density, melting point, boiling point, solubility, etc. (structure and properties).

2. Stereochemistry; Optical activity, isomerism, stereo isomerism, optical isomers, geometrical isomers, Racemic modification, specification of configuration & conformation.

3. Alkanes, alkenes, alkynes, cycloalkanes.

4. Arenes & dienes.

5. Benzene and alkyl benzenes.

6. Alkyl halides.

7. Alcohols.

8. Ethers.

9. Carboxylic acids and their functional derivatives.

10. Aldehydes and ketones.

11. Phenols.

12. Aryl halides.

13. Amines.

14. Dicarboxylic acids, malonic acid esters, acid esters and its importance, acetoacetic acid ester and its importance.

15. Polynuclear aromatic hydrocarbons, naphthalene, phenanthrene.

16. Hetero-cyclic compounds nomenclature, properties and reactions of pyridine, pyrrole and furan.

Practicals;

Practical to explain the students, the importance of;

(i) Physical properties like solubility M.P.& B.P.

(ii) Qualitative test for Nitrogen, Sulphur and Halogens.

(iii) Functional groups.

(iv) Preparation of derivatives in ascertaining the identity of organic compounds.

(v) Preparation of simple organic compounds and their purification.

Books Recommended ;

1. Morrison R.I. and Byod R.N. “Organic chemistry” Prentice – Hall and India Pvt. Ltd., New delhi.

2. Bentley Driver’s “text book of pharmaceutical chemistry, by L.H. Acherden.

B.1.8 INTRODUCTION TO DOSAGE FORMS

History of Pharmacy, pharmacopoeia and formularies

Dosage forms : Their definitions, classification, relative merits and demerits, and route of administration, principles involved and apparatus employed in the preparation of following dosage forms.

Waters, solutions, syrups, elixirs, infusions, decoctions, spirits, extracts, jellies, mucilages, glycerites, lotions, liniments, collodions, drouches, gargles, enemas, inhalations, sprays, creams, eye drops, ear drops, nasal drops and powders.

Type and uses of capsules, tablets and suppositories.

Pharmaceutical calculations, significant figures, different systems of weights and measures, calculation of dosages for children, reducing and enlarging of formulae, density, specific volume, percentage solution, allegation, proof spirits, thermometry, isotonic solutions, electrolyte solutions, displacement value.

Practicals

Preparation of waters, solution, syrups, elixirs, Infusions, decoctions, tinctures, spirits, jellies, mucilages, glycerites, lotions, liniments, drouches, gargles, enemas, inhalations sprays, creams, eye drops, ear drops, nasal drops and powders. Practice in pharmaceutical calculations.

Book Recommended :

1. Ansel : Introduction to pharmaceutical Dosages forms
2. Remington's Pharmaceutical Sciences.
3. Indian Pharmacopoeia
4. British Pharmacopoeia
5. Jain & Sharma : The Theory and practice of professional pharmacy
6. Jain Pharmaceutical arithmetic

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B.PHARM. PART – II

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B.2.1 Pharmacognosy and Phytochemistry - 1

Definition, historical background, present status and future scope of Pharmacognosy.

Classification of crude drugs alphabetical morphological, pharmacological / toxological, chemical and biological, chemical and physical methods of evaluation.

General principles of formation of primary and secondary plant metabolites, Biogenesis of carbohydrates, lipids, volatile oils and resins.

Plants and their environment factor influencing the variability in drug activity.

Systematic study of crude drugs including English, Indian names, their synonyms, official, biological, geographical sources, preparation, identification (by microscopic characteristic of drugs underlined), Chemical constituent, chemical and micro chemical tests, uses, adulterants and evaluation of the following drugs:

Drugs containing carbohydrates, starch, Honey, Agar, Alginates, Ispaghula, Bel, Pectin, Lactose, Acacia, Tragacanth, Sterculia, Katira and Guar gum.

Fixed Oils, fats and waxes castor oil, sesame oil, olive oil, Arachis oil, cotton seed oil, chaulmoogra oil, Neem oil, Fish liver oil and Theobroma oil, Lard, Lanolin, Beeswax and spermaceti.

Drugs containing volatile oils Mentha, Eucalyptus, Lemon grass, Orange - peel, Coriander, Caraway, Fennel. Dill, Black-pepper, Cardamom, Clove, Garlic, Pyrethrum, Turmeric, Cinnamon, Valerian, Chenopodium, Nutmeg and Terpentine oil.

Drug containing Resins Benzoin, Balsam of tolu, Colophony, Asafoetida, Jalap, Kaladana, Ginger, Colocynth, Capsicum and Podophyllum.

Study of the sources, physical and chemical tests of identity and salient microscopic features of the following:

a. Cellulose and Cellulose derivatives.
b. Fibers used as pharmaceuticals : Wool, Cotton, Glass wool, Jute, Silk, Nylon, Terylene and Polyster.
c. Inorganic pharmaceutical aids: Talc, Asbestos, Bentonite, Kaolin and Prepared chalk.

Practicals :

1. Morphological studies on drugs of different morphology.
2. Experiments on study of Microscopic & Diagnostic features of drugs belonging to various morphological parts with reference to trichomes, calcium oxalate crystals, starch grains, stomata, sclereides, palisade, vascular bundles & Secretary glands etc.
3. Histological examination and tissue system study of at least one representative drug of each category e.g. leaf, bark, root, rhizome, fruits etc.
4. Phytochemical study of un-organized drugs with reference to chemical tests for identification.
5. Exercises on extraction and isolation of carbohydrates, lipids, essential oils and resins from representative drugs deal in theory.
6. Evaluation of drugs by physical and chemical methods.
7. Chromatographic exercises on essentials oils.
8. Study of museum drugs.
9. Visit to medicinal plant garden.

Books Recommended :

1. Text Book of Pharmacognosy- Tyler, Brady and Robbins.
2. Text Book of Pharmacognosy- Trease and Evans
3. Pharmacognosy- Wallis
4. Pharmacognosy-Handa
5. Pharmacognosy - Kokate , Purohit and Gokhle
6. Plant physiology- Hess
7. Evaluation of phyto-pharmaceuticals- Turner.

B.2.2 Physical Pharmacy

Solubility and Distribution phenomenon General Principles, Solvent-Solute interactions, Solubility of gases in liquids, Solubility of liquids in liquids, Solubility of solids in liquids, distribution of solutes between immiscible solvents.

Micromeritics: particle size and size distribution, method for determining particle size, particle shape and surface area, methods for determining surface area, pore size, derived properties of powders.

Colloids: Introduction, Types of colloidal systems, Optical properties of colloids, kinetic properties of colloids, Electrical properties of colloids, solubilization.

Coarse Dispersions: Suspensions, interfacial properties of suspended particles, settling in suspensions, emulsions, theories of emulsification, Physical stability of emulsions, preservation of emulsions, rheologic properties of emulsions, phase equilibrium and emulsion formulation, special emulsion systems, Semisolids.

Complexation and protein Binding: metal complexes, organic molecular complexes, inclusion compounds, method of analysis, protein binding, Complexation and drug action, crystalline structure of complexes, thermodynamic treatment of stability constants.

Diffusion: steady slate diffusion, procedures and apparatus, Diffusion principles in biologic systems, Vapor sorption and transmission, thermodynamics or diffusion, diffusion of ecology.

Viscosity and Rheology: Newtonian systems, Law of flow, kinematic viscosity, effect of temperature, Non- Newtonian systems, Pseudoplastic, Dilatant, Plastic, thixotropy in formulation, determination of viscosity, capillary falling wall viscometer, rotational viscometers.

Surface and Interfacial Phenomenon: Liquid interface, surface and interfacial tensions, surface free energy, measurement surface and interfacial tensions, spreading coefficients adsorption at liquid interfaces, surface active agents, HLB classification, solubilization, detergency, adsorption at solid interfaces, solid gas and solid liquid interfaces, complex films, electric properties of interface.

Buffers: Buffer equation and Buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity.

Kinetics and Drug Stability : General considerations & concepts, half-life determination, influence of temperature, light, solvent, catalytic species, and

other factors, Accelerated stability study, expiration dating.

Polymer Science: pharmaceuticals application of polymers, polymers as thickening agents, preparing polymer solutions, phase separation, Gel formation, Mechanical properties of polymeric films, future trends in pharmaceutical and other biomedical uses of polymers.

Radio pharmaceuticals: Radioactivity and radionucleides, production of radio pharmaceuticals, radioactive decay, Units of energy, Measurement of radiation, Health physics, sterility and nonpyrogenicity, Regulation , Radio pharmaceutical dosage forms, choice of radionucleides, Generators, product type, Kits of official radio pharmaceuticals

Practicals :

Experiments on solubility, partition coefficient, Micromeritics, Colloids, Suspensions, Emulsions, Complexation and Drug protein Binding, Diffusion, Dissolution and Polymeric films.

Books Recommended:

1. Physical Pharmacy - Martin, Swarbrick and Cammarata.
2. Physical Pharmaceutics-Schotton. R
3. Remington's Pharmaceuticals Sciences

B.2.3 Pharmacology and Toxicology - I

General pharmacology: Introduction to pharmacology, Routes of drug administration, principles of drug action, factors modifying drug action, receptors, dynamics of absorption, distribution, metabolism and excretion of drugs, pharmacogenetics, tolerance and related phenomenon Application of Statistics in pharmacology. Basic principles of clinical pharmacology. Adverse reactions and drug interactions.

Pharmacology of peripheral Nervous System:

a. Neurohumoral Transmission (autonomic and somatic)
b. Parasympathomimetics, parasympatholytics, sympathomimetic adrenergic receptors and Neuron Blocking agents, Ganglionic stimulants and blocking agents. Basic pathophysiology of glaucoma, Myasthenia gravis.

   i. Neuromuscular blocking agents.

   ii. Local anesthetics

Pharmacology of Central nervous System:

a. Neurohumoral Transmission in CNS
b. General anesthetics
c. Alcohol and Alcohalism
d. Hypnotics and sedatives, Centrally acting muscle relaxants.
e. Psychopharmacological agents : Basic pathophysiology of psychoses, Depression and mania Antipsychotics, Anti-anxiety, Antidepressants, Antimanic and hallucinogenic drugs.

i. Pathophysiology of convulsive disorders and pharmacology of Antiepileptic drugs.

ii. Anti-parkinsonian drugs.

iii. Analgesics, antipyretics and Anti-inflammatory drugs. Basic pathophysiology of rheumatoid arthritis and gout.

iv. Narcotic Analgesics and Antagonists.

v. CNS stimulants.

vi. Drugs used in Migrain.

Drugs acting on Hemopoietic system:

a. Pathophysiology of various types of anemia's and coagulation disorders
b. Pharmacology of hematinics, Anticoagulants, Vitamin K, Fibrinolytic and Antiplatelet drugs; plasma expanders.

Drugs acting on Gastro-intestinal System: Pharmacology of antiulcer and antacid drugs; Purgatives, anti-diarrhoreal drugs, emetics and antiemetics; Appetizers, digestants, carminatives and Anti-spasmodics.

Drugs acting on Urinogenital Systems:

(a) Diuretics and antidiuretics,

(b) Oxytocics and uterine relaxants.

Respiratory System: Bronchodilators, Antitussives, Expectorants, Respiratory Stimulants.

Practicals :

1. Introduction to experimental pharmacology, Basic equipments used in pharmacology, preparation of physiological solutions, uses of various animals in pharmacological experiments, laboratory, anesthetics, smoking of drum fixing of tracing on smoked drums.
2. Study of Biological Responses as modified by different routes of administration.
3. Drug metabolism studies- enzyme induction and inhibition.
4. Drug receptor studies to demonstrate cholinergic, adrenergic and histaminergic receptors using isolated preparations.
5. Demonstration of simple experiments used for the evaluation of analgesics, antipyretics, anti-inflammatory and muscle relaxant drugs
6. Study of local anesthetics (surface, nerve block and infiltration).

Book Recommended:

1. Text book of Pharmacology- Barar
2. Pharmacology and Pharmacotherapeutics - Satoshkar & Bhandarkar.
3. The Pharmacological basis of Therapeutics - Goodman & Gillman.
4. Screening Methods in Pharmacology - Turner

B.2.4 Pharmaceutical Chemistry - III

Heterocyclic compounds: Nomenclature, structure and reaction of imidazoles, oxazoles, thiazoles, pyrazole, pyran, pyrimidines, indole, purine, quinoline, isoquinoline, carbazole, acridine and phenothiazine.

Carbohydrates: Classification, Monosaccharides: glucose, fructose and their reactions, configuration of aldoses. Cyclic structure or D- glucose, mutarotation and conformations, amino sugars, D-ribose, 2-deoxy D-ribose. Disaccharides: maltose, lactose, sucrose. Polysaccharides: starch, cellulose, dextrin, glycogen, inulin, dextrans.

Glycosides: Classification and methods of isolation, alpha and beta D-methyl-glycoside, structure of salicin, arbutin, amygdaline, sinigrin, anthraquinone glycosides, tannins, cardiac glycosides and saponins.

Protein and amino acids: Isolation and classification of proteins, hydrolysis of proteins, peptides, fibrous and glandular proteins. Classification, methods of synthesis and properties of amino acids. Nucleoproteins and nucleic acids, structure of nucleosides and nucleotides, structure of nucleic acids.

Lipids: Fats, oils and waxes, fatty acids, characterization and their physio-chemical properties. General knowledge of phospholipids, lecithins, cephalines, sphigomyeline, glycolipids.

Terpenes: Isolation, classification, general methods of determining structure with reference to citral, citronellal, terpeneols, carvone, limonene, menthol, thymol and camphor. An elementary treatment of rubber.

Alkaloids: general methods or determining structures of alkaloids, classification with an acquaintance with the structure of Alkaloids of Indian Pharmacopoeia.

Structure of uric acid, caffeine, theobromine, theophylline.

Practicals :

1. Separation of mixtures of two or three organic compounds and their identification.
2. Study the importance of different physicochemical properties to identity and establish the purity of natural products.

Book Recommended. :

1. Organic Chemistry, Vol. I & II – I. L. Finar
2. An Introduction to Heterocyclic Compounds- Acheson.
3. A Text Book or Biochemistry - West & Todd.
4. Text Book of Heterocyclic compounds – R. K. Bansal

B.2.5 Pharmaceutical Analysis - II

The course will include more advanced type of acidimetry, alkalimetry, redox, and complexometric titrations as applied to assay of drugs.

Redox titrations: principles and techniques using potassium permanganate, potassium dichromate, cerric sulphate, Iodine, iodide-iodate, bromide-bromate, titanous chloride solutions.

Precipitation titrations: General discussion, theory of indicators, argentimetry titrations, ammonium cyanate - silver salt titrations, Volhard's method.

Principle of diazotization: Titrations using sodium nitrite.

Complexometric methods: Complexometric titrations using EDTA principle, chelating agents, indicators, titrations with disodium edetate.

Group estimations: Determination of aldehyde, ketones, hydroxy, phenolic, carboxylic acid and methoxy groups.

Non-aqueous titrations: General discussion and principle of titrations in non aqueous media, aprotic, protophilic, protogenic and amphiprotic solvents, titrations with perchloric and potassium methoxide and tetrabutyl ammonium hydroxide.

Use of optical and electrical methods: Use of Polarimetry, Refractometry, Potentiometry and Conductometry in analysis of drugs.

Practicals:

Practicals involving:

1. Potassium permanganate, Iodine, Bromine, Cerric ammonium sulphate, and titanous chloride (Redox titrations).
2. Argentometric Titration (precipitation methods).
3. Use of EDTA.
4. Electrical and Optical methods.

Books recommended:

1. Vogel' s Text book of quantitative chemical analysis.

2. Practical Pharmaceutical chemistry - Becket and stanlake

3. A Text book of pharmaceutical analysis - Conor's

4. Pharmaceutical analysis - L.G. Challen

B.2.6 Pharmaceutical Engineering-I

This course is intended to introduce students the general theory of unit operations and manufacturing processes commonly used in pharmaceutical industries.

Elements of industrial stoichiometry material and energy balance.

Flow of fluids: Manometers, mechanism of fluid flow, Bernoulli's Theorem, friction losses, enlargement and contraction losses, measurement of flow of fluids, Transportation of fluids, pipe joints, pipe fittings, pumps, transportation of gases, ejectors, compressors, blowers.

Flow of Heat: Classification of heat flow processes, compound resistances in series, flow through cylinder, conduction through fluids. Overall coefficients, fluids in turbulent flow in clean pipes, forced and natural convection condensing vapors. Radiation: rate of radiation, heat transfer by radiation and convection. Tubular heaters: heat transfer by radiation and convection tubular heaters, heat interchangers, inductive heating

Evaporation: Types of evaporators, jacketed kettles, tube evaporators, forced circulation evaporation and evaporator accessories. Evaporator capacity, heat and material balances, multiple effect evaporation, capacity of multiple effect evaporators.

Distillation: Theory of distillation, distillation mixtures: (a) Binary mixtures of miscible liquids (b) Binary mixtures of immiscible liquids (c) Rectification; rectifying columns, fractionating column and simple calculations. McCabe theil method for calculation of theoretical plates, plate efficiency, Industrial equipment for vacuum, stream reflux and molecular distillation.

Drying: Classification of dryers, compartment, tunnel, rotary, cylindrical, vacuum, spray, fluidized bed dryers. Theory of drying, loss on drying and moisture content, equilibrium moisture content, principles of freeze drying, freeze dryers.

Humidity and air conditioning: Humidity charts, wet bulb temperature, wet bulb theory, humidification and dehumidification equipment, refrigeration.

Practical :

Introductory exercises on pharmaceutical engineering drawing experiments on flow of fluids and transportation of fluids, flow of heat, evaporation, distillation & drying.

Books Recommended:

1. An introduction to chemical engineering – Banchero
2. Chemical engineering - Richardson and coulson
3. Introduction to unit operation – McCabe and smith.
4. Theory and practice of industrial pharmacy- Lachman, lieberman and kanig
5. Bentley's text Book of pharmaceutics- Rowlin

B.2.7 Pharmaceutical Engineering –II

Size reduction: Mechanism of size reduction, factors influencing size reduction, pharmaceutical application, energy requirements, roller mill, and edge runner mill, comminuting mill, ball mill, Harding mill, hammer mill, fluid energy mill, colloid mill, closed circuit grinding.

Size separation: Standard screens, oscillating tray sitter grating sifters, cyclone separators, sedimentation, elutriation, handling of powders.

Filtration: Mechanism of filtration, factors affecting filter selection, Kozeny's equation, filter media, filter selection, filter aids, classification of filters – filter press, leaf filters, rotary continuous filters, metafilters, membrane filters.

Centrifugation: Theoretical consideration, laboratory equipment, large scale equipment, low temperature centrifuge for biological work.

Extraction: Extraction and leaching process, factors affecting the efficiency of leaching process, diffusion batteries, Dorr Agitator, Continuous extraction, Counter current extraction and calculation, Cragg's apparatus.

Crystallization: Classification, batch crystallizers, simple vacuum crystallizers, nucleation and crystal growth critical humidity prevention of caking, material and energy balances.

Mixing: Mechanism of mixing, equipment and selection, solid-solid, solid-liquid and liquid-liquid mixers used in pharmaceutical industry.

Conveying types or conveyers, belt conveyers, chain conveyer, screw conveyer, pneumatic conveyers, conveyance of manufactured materials.

Safety methods in pharmaceutical laboratories and works, appreciation of mechanical, chemical, electrical and fire hazards including inflammable gases and dusts.

Materials of construction, the nature, properties and uses of important materials employed in the construction of plants. Corrosion heat and corrosion resistant alloys and other materials, methods of reducing corrosion, protective coating.

Compaction and compression: Compression characteristics of powders and granules. Physics of tablet compression, measurement of punch forces, transmission of forces through powders, distribution of forces in powder mass, factors affecting strength of tablets.

Practicals:

Experiments based on theory.

Experiments of size reduction, size separation, filtration, extraction, crystallization, mixing, centrifugation, corrosion, compaction and compression.

Books Recommended:

1. Theory and practice of industrial pharmacy- Lachman, Lieberman and Kanig.
2. Tutorial pharmacy-Cooper and Gunn.
3. Bentley' s Text Book of Pharmaceutics- Rowlin

4. An introduction to chemical engineering- Badger and Banchero.

B.2.8 Mathematics and Statistics

Section A: Statistics no derivation of formulae (application part) condensation of data collected, various forms of frequency distribution, tabular presentation of data, structure of a table, simple table, complex table.

Bar diagram, graphical representation of frequency distribution, histogram, frequency polygon, cumulative frequency curve, some common types of frequency distribution.

Measure of central tendency: Calculation of arithmetic mean, geometric mean, median, quartiles and mode.

Measure of dispersion: Range, quartile deviation, mean deviation standard deviation, coefficient of variation, filling of curves using least square.

Principle of Interpolation: Graphical method curve fitting, Newton's Gregory Newton -Binomial method, Largranges method.

Probability: Simple and compound events, mutually exclusive events independent events. Additive and multiplicative law of probability use of binomial theorem.

Binomial distribution, characteristics of binomial distribution fitting of binomial distribution and testing of goodness of fit. Normal distribution, characteristics of normal distribution, fitting Chi-Square distribution - application of chi-square test of goodness of fit, comparison of a number of frequency distribution, finding association and relationship between attributes.

Calculation of coefficient of correlation (Karl Person's formula) Rank correlation and determination of rank correlation coefficient, calculation of regression coefficient. Regression lines, Test of significance of large samples. Significance test of sample mean, comparison of large sample significance test for proportions, significance. test of difference between means of two sample - samples from same population (universe), sample from different population.

Financial limit for unknown mean.

Test of significance of small sample; t-distribution , use of t-distribution to test the significance of the mean of the sample testing the significance of the difference between the two sample mean, paired samples when the size of sample same.

Integration of rational function, Integration of Integral of Trigonometrical transformation, substitution.

Definite integral's: Properties of definite integrals, Evaluation of definite integrals.

Areas of curves given by Cartesian equation (without tracing). Volumes of solids of revolution (Cartesian equation only). Solutions of differential equation of first order and first degree of the following:

In which Variables are separable, Homogeneous reducible to Homogeneous Equation, Linear Equation from Equation reducible to Linear Equation form.

Linear equations with constant coefficients.

Auxiliary equation having different roots, equal roots, imaginary roots. Particular integrals.

Section B (21-24 Periods) : **Differentiation And integration**

Differentiation : Simple cases, product of two functions, quotient of two functions, function of a function, inverse functions, logarithmic differentiation, implicit function, parametric equation, and Transformation, Differentiation from first principle.

Simple application Velocity, acceleration, increments and their ratios, rate of increase, Approximate Calculation.

Successive differentiation, use of De Moive's theorem, trigonometrical transformation, application of Leibnitz’s theorem.

Equation of tangent and normal to the curves, angle of intersection of curves. Length of sub tangent, subnormal.

Partial differential coefficients, Total differential coefficient, application of Euler's theorem on Homogeneous function.

Maxima and minima of the continuous function (applying working rule) two variables connected by a relation.

Integration: As inverse of differentiation, integral of product of constant and a function, of sum.

Integration by substitution, by parts, Decomposition into a sum, successive reduction.

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B.PHARM. PART – III

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B.3.1 Pharmacognosy & Phytochemistry - III

Commerce's in crude drugs: Collection, preparation, drying and storage of drugs with special emphasis on factors influencing quality of drugs. Cultivation of medicinal plant.

Biogenesis of medicinally important glycosides and alkaloids.

Classification and general treatment of alkaloids and glycosides of different categories.

Systematic study of crude drugs : Including synonyms, biological geographical sources, identification (Microscopic characteristics of drugs underlined), Chemical constituents, chemical tests, uses, adulteration and evaluation of glycosidal, Alkaloidal and drugs belonging to following groups :

Anthraquinone glycosidal drugs: Senna, Aloe, Rhubarb, Cascara.

Saponin Glycosidal drugs: Dioscorea, Solanum, Licorice, Senega, Ginseng.

Cyanogenetic Glycosidal drugs: Wild Cherry.

Coumarins and Furanocoumarin glycosidal drugs: Psoralea.

Miscellaneous Glycosidal drugs: Gentian, Quassia, Saffron.

Indole Alkaloidal drugs: Ergot, Nux- Vomica, Rauwolfia, Catharanthus.

Isoquinoline Alkaloidal drugs: Ipecac, Opium.

Tropane Alkaloidal drugs: Stramonium, Hyoscyamus, Datura, Belladonna, Duboisia.

Quinoline Alkaloidal drugs: Cinchona

Pyridine Alkaloidal drugs : Areca, Lobelia, Nicotiana

Imidazole Alkaloidal drugs: Pilocarpus

Quinazoline Alkaloidal drugs: Vasaka

Steroidal Alkaloidal drugs :Ashwagandha, Kurchi, Veratrum.

Proto- Alkaloidal drugs: Ephedra, Colchicum.

Terpenoid Alkaloidal drugs Aconite

Sources Chemical Nature & Uses of following Enzyme : Papain, Pancreatin, Urokinase, Diastase, Pepsin, Trypsin Penicillinase, Hyaluronidase.

Study of Drugs of Marine Origin.

An overview of steroidal drug precursors from plants.

Practicals :

1. Identification and evaluation of drugs (in theory) in whole and powdered from by Microscopy and Morphology and Chromatographic Technique.

2. Phytochemical test for the crude drugs.
3. Exercises on extraction of important phytoconstituent.
4. Visit of Drugs of herbal garden.
5. Study of drugs of herbal Museum.

Book Recommended:

1. Pharmacognogy: Trease & Evans.
2. Pharmacognogy: Tyler & Brady
3. Pharmacognogy: Wallis
4. Pharmacognogy: C. K. Kokate.

B.3.2 Dispensing Pharmacy

Prescription: Definition, parts, handling, sources of errors in prescription, knowledge of Latin terms commonly used in prescription writing and their translation into English.

Compounding of Medication : Powders, Tablets, Capsules, Tablet triturates Pills, Lozenges, Ointments, Creams, Pastes, Jellies, Suppositories, Suspensions, Emulsion, Mixture, Sprays, Inhalations, Paints, Labeling of dispensed products.

Incompatibilities: Physical, chemical and therapeutic incompatibility and their correction.

Posology: Factors influencing dosage.

Community Pharmacy Organization and structure of retail and wholesale drug store - types of drug stores and design-Legal requirements for establishment, maintenance of drug store, Dispensing of proprietary products, Maintenance of records of retail and whole sale.

First-Aid - Emergency treatment in shock, snake-bite, burns, poisoning, heart diseases, fractures, resuscitation methods Elements of minor surgery and dressings.

Practical:

Practice in Dispensing of not less than 100 prescriptions comprising of Solutions, Mixtures, Powders, Tablets, Capsules, Lozenges, Ointments, Creams, Pastes, Jellies, Suppositories, Suspensions, emulsions, Sprays, Inhalations, Paints, Incompatibilities.

Books Recommended :

1. Dispensing of medication: Hoover.
2. Prescription Pharmacy: Sprowls(ed.)
3. Cooper and Gunn's dispensing for Pharmaceutical Students: Carter.
4. The Concise Pharmaceutical Dispensing: Jain and Sharma.
5. Health Education and Community Pharmacy: Jain.

B.3.3 Pharmacology And Toxicology - II

Pharmacology of Cardiovascular System:

(a) Pathophysiological basis of Hypertension, Congestive heart failure, Angina, Cardiac Arrhythmias, and Atherosclerosis.

(b) Pharmacology of Antihypertensive, Cardiotonic, Antianginal, Antiarrhythmic and Hypolipedemic Drugs.

Pharmacology of Endocrine system: Thyroid-antithyroid drugs, insulin and oral hypoglycemics, glucagons, adrenocortical steroids, pituitary hormones, Estrogens, progesterone, androgens, anabolic steroids and oral contraceptives.

Chemotherapy: General principles of chemotherapy. Sulphonamides, antibiotic, antiprotozoal drugs, antimalarials, antiamoebic, antifungal and anti-viral drugs, chemotherapy of tuberculosis and leprosy , chemotherapy of cancer and immunosuppressant drugs.

Autocoids : (a) Histamine, 5-HT and their antagonists.

(b) Prostaglandins, Prostacyclin, Thromboxanes , leucotrienes and plaetlet anctivating factors. Drugs acting on Skin: Drugs for Psoriasis, antiseborrhoeics, acne- vulgaris.

Pharmacology of Vitamins & Minerals.

Bioassays : Principles of Bioassays, Bioassays of Digitalis, Insulin , d-tubocurarine, Acetylcholine, Histamine, 5-HT, Oxytocin.

Principles of toxicology:

a. Definition of poison, General principles of treatment of poisoning with special reference to Barbiturates, Opium, Organophosphorous and Atropine Poisoning.
b. Heavy Metals and Heavy Metal Antagonists.

Practicals:

a. Bioassay of Acetylcholine, Histamine and d-tubocurarine using appropriate

isolated tissue preparations.

b. Evaluation of CNS acting drugs.
c. Study of ionotropic and chronotropic effects of drugs on Frog heart.
d. Study of dose response curves and calculation of affinity constants.
e. Calculation of P A-2 for antagonists.

Books Recommended:

1. Text Book of pharmacology - Barar
2. Pharmacology and Pharmacotherapeutics:- Satoskar and bhandarkar.
3. The pharmacological Basis of Therapeutics –Goodman and Gilman, pergamon press
4. Hand Book of Experimental Pharmacology – S.K. Kulkarni, Vallabh Prakashan, Delhi.
5. Screening Methods in Pharmacology- Turner, Academic Press.

B.3.4 Pharmaceutical Chemistry - IV

Biochemistry and its importance in Pharmaceutical sciences.

Biochemical organization of the cell, production of cell energy, ATP and its biological significance. Biochemical importance of colloidal systems, Donnan effect.

Enzyme : Classification, nomenclature, factors affecting enzyme action, enzyme kinetics, mode and mechanism of enzyme action and inhibition, iso-enzymes and their importance in diagnosis.

Vitamins as co-enzymes and their significance, metals as co-factors.

Carbohydrate Metabolism : Classification, glycolysis, citric acid cycle, glycogenesis and glycogenolysis. Hexose monophosphate shunt, uronic acid pathway, blood sugars and its regulation.

Lipid Metabolism : Oxidation of fatty acids, biosynthesis of fats, ketogenesis and ketosis. Metabolism of cholesterol. Essential fatly acids and Eicosanoids phospholipids, sphingolipids.

Biological oxidation and reduction, respiratory chain, oxidative phosphorylation. Enzyme and co-enzymes of bioredox system.

Metabolism of Amino Acids and Proteins : General biochemical reaction of aminoacids like transamination, deamination and decarboxylation, metabolism of sulphur containing amino acids, urea cycle, Nitrogen balance, Biosynthesis of bile salts and bile pigments.

Metabolism of nucleic acids :Biosynthesis and catabolism of purines and pyrimidines containing nucleotides.

Biosynthesis of DNA and its replication, mutation and repair mechanism.

An introduction to genetic engineering, biosynthesis of RNA, genetic *code* and protein synthesis.

Liver and kidney function tests of biochemical importance. Detoxification mechanism like oxidation, hydrolysis, reduction & conjugation.

Practicals :

1. The practicals will involve analysis of food, urine (both normal and abnormal constituents) and other body fluids. Estimation of glucose, creatinine, cholesterol, amino acids, and proteins in body fluids.

2. Isolation and purification of Enzymes.
3. Qualitative estimation of Carbohydrates, Preparation of standard buffer solution (Phosphate, Citrate, Carbonate & measurement .of its pH)
4. Estimation of RNA/ DNA.
5. Qualitative estimation of Amino Acid, Lipid & Protein.

Book Recommended.

1. D. W. Martin, P. A. Mays & V. M. Redwell, Harpers review of biochemistry, Lunge medical publication.
2. Harpers review of Biochemistry, langue Medical publication.
3. A. L. Lehringer, Biochemistry, Worth publisher Inc.
4. A. L. Lehringer, Principle of Biochemistry, CBS Publishers and Distributors.
5. L. striae, Biochemistry, W. H. Freeman & Co. San Francisco
6. B. Harrow and A. Mazur, Text book of Biochemistry, W. B. Saunders Co Philadelphia.
7. Text book of biochemistry - West & Todd.
8. Elements of biochemistry- O. P. Agrawal Goel Publishing house, Meerut
9. Laboratory Manual in biochemistry by J. Jayaraman, New age Int. Pvt. Ltd., New Delhi.
10. Comprehensive Viva and Practical Biochemistry by A. C. Deb, New Central Book Agency, Calcutta.

B.3.5 Applied Microbiology and Biotechnology

Historical back ground of the science of microbiology : Ancient theories concerning the origin of life, contribution of great scientists to this science, scope of microbiology.

General techniques of microbiology: Preparation and sterilization of media, stains and staining techniques, enumeration of microbes etc.

Classification of microbes and their taxonomy: Actinomycetes, bacteria, ricketsiae, spirochetes and viruses.

Structure of bacterial cell: Eucaryotic and Prokaryotic.

Nutrition, cultivation, isolation and identification of bacteria, actinomycetes, fungi, viruses.

Sterilization, methods and mechanisms, validation of sterilization methods, sterility testing of pharmaceutical products.

Disinfection, factors influencing disinfectants, dynamics of disinfection, evaluation of disinfectants and antiseptics.

Microbial attack and host defence, virulence and pathogenicity, primary and specific defense mechanisms of body, infection and its transmission, interferons.

Immunology and Immunological preparations: Principles, antigens and haptens, immune suystem, cellular and humoral immunity, immunological tolerance, antigen-antibody reactions and their applications.

Hypersensitivity, active and passive immunization products their preparation, standardization and storage. Microbial standardization of antibiotics, vitamins, aminoacids.

genetic Engineering: Transformation, conjugation, transduction, protoplast fusion and gene cloning and their applications, hybridoma and monoclonal antibodies. Study of common drugs produced by biotechnology

Bacterial enzymes: Techniques of immobilization of enzymes, kinetics and factors affecting enzyme kinetics. Study of enzymes such as hyaluronidase, penicillinase, streptokinase and' streptodornase, amylases and proteases etc. Immobilization of bacteria and plant cells.

Practical:

Experiments based on microscopy, general techniques of microbiology, sterilization, disinfection, microbial assays, monoclonal antibodies: Immobilization of enzymes, bacteria and plant cells.

Books Recommended:

1. G. Gunn's and SJ. Carter" Cooper & Gunn's Tutorial Pharmacy", 6^{1h} ed., Pitman Medical Publishing Co., London 1972.
2. W.B. Hugo and AD. Russell" Pharmaceutical Microbiology", 4th Ed., Black well scientificpublications, oxford, 1987.
3. Microbiology- Davis, Dulbecco, Eisen.
4. "Remington's pharmaceutical sciences" Gennaro, AR. Ed. 18th ed., Mack Publishing Co.Easton, Pa, USA,1990.
5. L.M. Prescott, G.P.Jarley, D.A. Klein, "Microbiology" 2nd ed. Wm. C. Brown Publishers, Oxford, 1993.
6. S.P.Vyas & V.K.Dixit, "Pharmaceutical Biotechnology" 1st ed, CBS Publishers & Distributors, New Delhi, 1998.
7. N.K. Jain, "Pharmaceutical Microbiology". Vallabh Prakashan Delhi.
8. K.Kieslich, Ed. "Biotechnology" Vol. Ga, Verlag Chamle, Switzerland, 1984.
9. G. Reeves "Lecture Notes on Immunology "Blackwell Scintific Publication, Oxford, 1987.
10. Laboratory Manual of Bacterilogy -Salle.

B.3.6 Pharmaceutical Chemistry–V (Medicinal Chemistry –1)

Basic Principle of Medicinal Chemistry: Physico-chemical aspects (Optical, geometric, & Bio-isosterism) of drug molecule and biological action Solubility & partition coefficient. Selected physio-chemical properties- ionization, hydrogen bonding, chelation, redox potentials, surface activity & drug recepter interaction.

Drug Metabolism: Phase I and Phase II Pathways of drug biotransformation and conjugation

The following topics shall cover nomenclature, classification, Synthetic procedures or the compounds mentioned under each category, Structure activity relationships (Where stated) Mode of action and therapeutic uses

Anaesthetics- Halothane, thiopental sodium, Lidocaine, Dibucaine, diperodon hydrochloride, benzocaine, procaine, cocain, butacaine sulphate, metabutethamine hydrochloride.

Hypnotic and Sedatives- Allobarbitone, Pentobarbitone, acetyl carbamate, glutethimide, amobarbitone, ethchlorvynol and Methaqualone. SAR in barbiturates.

Anti convulsant- Phenobarbitone, Phenytoin, Paramethadione, Phensuximide, primidone, Sodium Valpronate and Ethosuximide.

Tranquillizers chlorpromazine, chlordiazepoxide, Diazepam, Haloperidol Chlorcyclizine and Reserpin S.A.R. in Phenothiazines.

Analgesics, Antipyretics and Anti-inflammatory Agents - Morphine, Codeine, Nalorphine, Naloxone, mepridine hydrochloride, Methadone hydrochloride, Antipyrine, Aminopyrine, Paracetamol, Mefenamic acid, Phenylbutazone, Indomethacin, Naproxen, Ibuprofen and Aspirin.

Antihistaminic Agents - Diphenhydramine hydrochloride, Dimenhydrinate, Cyproheptadine, antazoline, Chlorpheneraminc maleate and pyrilamine maleate, hydrogen blocker-Cimetidine, ranitidine and famotidine.

Diuretics Mersalyl, Aminophylline, Acetozolamide, chlorthizide, Ethacrynic acid triamterene Chlorthalidone, Furosemide, Spironolactone and Bendroflumethiazide. SAR of mercurials and Benzothiazides.

Anti-hypertensive Agents Piperoxan, dibenamine, Tolazoline hydrochloride. Propranolol, Diazoxide, Hexamethonium bromide, Guanethidine sulfate, Methyl dopa, Prazocin hydrochloride, Clonidine hydrochloride, Hydralazine hydrochloride.

Adrenergic & Cholinergic Agents- Epinephrine, Norepinephrine, Ephedrine, Psudoephedrine metaraminobitartrate, Naphazoline hydrochloride, pilocarpinenitrate, Neostigmine bromide, Physostigmine salicylate and Acetylcholine. SAR of phenylethylamine analogs.

Central Nervous Stimulants - Caffeine, Nikethamide, Pentylene tetrazol, Amitryptylene, Imipramine and Dextromethorphan hydrobromide potassium Guaicosulfonate and Levopropoxyphen

Expectorants & Antitussive Agents: Acetylcysteine, Guaifenesin, Terpinhydrate, Dextromethorphan Hydrobromide, Potassium Guaicosulphate and Levopropoxyphen.

Gastro- Intestinal Drugs-A general survey of GI Drugs.

Books Recommended:

l.Burger's Medicinal Chemistry, John willey & Sons, New York.

2.Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical

Chemistry, Philadelphia.

3.Foye, W D, Principles of' Medicinal Chemistry, Lee and Febiger, Philadelphia

4.Remington's Pharmaceutical Sciences, Mack publishers Co., Easton, Pensylvania.

5. Kar, A, medicinal Chemistry, willay Eastern Ltd, New Delhi.

B.3.7 **Pharmaceutical Technology & Cosmeticology**

Preformulation studies

(a) Study of physical properties of drug like physical form, particle size, shape density, wetting, dielectric constant, solubility, dissolution and organoleptic properties and their effect on formulation, stability and bioavailability.
(b) Study of chemical character of drug molecule like hydrolysis, oxidation, reduction, recemization, polymerization, etc. and their influence on stability of product.

Liquid Dosage Forms: introduction, type, additives used in formulations, vehicle, stabilizers, preservatives, suspending agents, emulsifying agent, solubilizers, colors, flavors, etc Manufacturing, packaging and evaluation, of clear liquids, suspensions and emulsions official in Indian Pharmacopoeia.

Semisolid Dosage Forms Definition, type, mechanism of drugs, penetration through skin, factors influencing penetration, semisolid bases and their selection, general formulation of semisolids, manufacturing procedure, evaluation and packaging.

Suppositories: Ideal requirements, bases, manufacturing procedure, packaging and evaluation

Tablets:

(a) Formulation of different types of tablets, granulation methods, technology of production of granules on large scale by various techniques, physics of tablets making, tablets compression machinery of different types and the equipments employed, evaluation of tablets.

(b) Coating of tablets: Types of coating, film forming materials, formulation of coating solution, equipments for coating, coating process evaluation of coated tablets.

Capsule: Advantage and disadvantages of capsule dosage form, material for production of hard gelatin capsules, size of capsules, methods of capsule production, soft gelatin capsule shell and capsule content, importance of base absorption and minim/gm factors in soft gelatin capsules, quality control, stability testing and storage of capsule dosage forms.

Ophthalmic preparation: requirements, formulation, methods of preparation, containers, evaluation.

Pharmaceutical Aerosols: definition, propellants, general formulation, manufacturing, packaging and evaluation methods, pharmaceutical applications.

Packaging of Pharmaceutical product: packaging components, types of specifications and methods of evaluation stability aspects of packaging and packaging equipments, factors influencing choice of container, legal and other official requirements for containers, package testing.

Cosmeticology & cosmetic preparation: fundamentals of cosmetic science, structure & function of skin & hair, formulation, preparation and packing of cosmetic for skin, hair, dentifrice and manicure preparations like nail polish, lipsticks, eye lashes, etc.

Practical:

preparation and evaluation of tablets capsules, solutions, emulsions, suspensions suppositories ointments, ophthalmic preparation, cosmetic for

skin, hair, dentifrice, manicure preparation, nail polish. Lipsticks etc.

Book Recommended :

1. Gilbert, S. Banker and Cristopher, T. Rhodes - Modern Pharmaceutics Drugs and Pharmaceutical Science Series Vol. 7, 1979, M & D Inc., New York.
2. Leon Lachman - The Theory and Practice of Industrial Pharmacy, 2nd edition, indian Edition 1976, K. M. Verghese Co. Bombay.
3. E. A. Rawlins - Text Book of Pharmaceutics, 81h edition, 1977, Bailliere Tindall.
4. A. Osol (editor) Remington's Pharmaceuticals Science1985, Mack Publishing Co. Eastern, Pa.
5. S. J. Carter - Cooper and Gunn's, Tutorial Pharmacy, 61h edition 1072, Pitman Medical.
6. Pharmacopoeia of India - 4th Ed., 1996.
7. British Pharmacopoeia, 1994.
8. J, C. Mac Chesney. "Packaging of Cosmetics and Toiletries Newness-Butterworth, London, 1974.
9. M. S. Balsam & E. Sagarin " Cosmetics and Toiletries' 2nd edition, vol. 1-3, John Wiley and Sons, New York.
10. E. Sagarin - cosmetic science and Technology, vol 1-3, 2nd edition. 1974.
11. J. S. Jellinek - formulation and function of Cosmetics, 1970.

B.3.8 Practice of Pharmacy

(Forensic Pharmacy & Community pharmacy)

Section A: Forensic Pharmacy (80%)

Historical background of drug legislation in India.

The Pharmacy Act.

The Drugs and Cosmetics Act & Rules.

The Medicinal and Toilet Preparations (Excise Duties)Act & Rules.

The Drugs and Magic Remedies (Objectionable Advertisements) Act & Rules.

The Narcotic Drugs and psychotropic substances Act & rules.

The Poisons Act

The Drugs (Prices Control) Order

The Patents Act.

The Designs Act.

The Trade and Merchandise Marks Act.

The Monopolies and Restrictive Trade Practices Act & Rules.

The Medical Termination or Pregnancy Act & Rules.

Section B: Community Pharmacy (20%)

Organization and Structure of retail and wholesale drug store, types of drug stores and their design, legal requirements for establishment, maintenance of drug store, dispensing of proprietary products, Maintenance of records of retail and wholesale.

Communicable Diseases Causative agents, modes of transmission, prevention and control:

(a) Respiratory infection: chicken pox, measles, influenza, diphtheria, whooping cough, tuberculosis.
(b) Intestinal infection; poliomyelitis, hepatitis, cholera, typhoid, food poisoning, hookworm infection.
(c) Arthropod borne infection: plague, malaria, filariasis.
(d) Surface infection: rabies, trachoma. tetanus leprosy.
(e) Sexually transmitted disease: syphilis, gonorrhoea, AIDS.

Book Recommended:

1. Report of drugs enquiry committee.
2. Bare act pertaining to syllabus.
3. A text book of Forensic Pharmacy: Jain, N. K.
4. Forensic Pharmacy - Mittal, B. M.
5. Remington's Pharmaceutical Sciences.
6. Health Education and Community Pharmacy: Jain, N. K.

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B. Pharm. Part - IV

B.4.1 Pharmacognosy & Phytochemistry-III

(Including Ayurveda)

Study of Indigenous Traditional Drugs: Botanical sources (including alternative/ controversial sources), Clinical uses, chemical constituents, pharmacological action & authentication of following drugs - Amla (Phyllanthus embelica), Bahera (Terminalia balerica), Kantakari (Solanum xanthocarpum), Malkangni (Celastrus paniculatus), Tylophora (Tylophora Indica), Bhilwa (Semicarpus anacardium). Satavar (Asparagous recemosus), Bach (Acorus calamus), Rasna (Pluchea lanceolata), Punarnava (Boerhaavia diffusa), chitrak (Plumbago zeylanicum), Apamarg (Achyranthus aspera), Shankhpushpi (Convolvurus microphyllus), Guduchi (Tinospora cordifolia), Brahmi (Centella asiatica), Lahsun (Garlic, Allium sativum), Guggal (Commiphera mukul), Kalmegh (Andographis paniculata), Tulsi (Ocimum sanctum), Valerian (Valerian officianalis), Gokhru (Tribulus terrristris), Harad (Myrobalan Terminaschebula), Vidang (Embellica ribes), Artemisia (Artemisia annua), Chirata (Swertia chirata), Arjuna (Terminalia arjuna), Ashoka (Saraca indica) & Banafsha (Viola odrata).

Introduction to Ayurvedic Dosage Form:

Preparation and standardization of Ayurvedic preparation such as Ashvas, Aristha, Avaleha, Churna etc.

General Methods of Extraction, Isolation, Identification & Characterization of Phyto-constituents Carbohydrates, Glycosides, Phenolic Compounds, Steroids and Alkaloids.

Isolation of the following phyto-constituents (including industrial methods):

Morphine, Quinine, Reserpine, Sennosides, Digitalis glycosides, Diosgenin, Menthol, Thymol, Rutin & Psoralen.

Study of Hallucinogenic and Poisonous plants, Mycotoxins and Toxic Mushrooms, Allergen and Allergenic Preparations.

Herbs as health foods and as cosmetics.

An introduction to Tissue Culture and its scope in production of phyto-pharmaceuticals.

An overview of plants as Antitumor agents, Bitters, Sweeteners and Photosensitizing agents.

Practicals:

1. Identification and Evaluation of Indigenous drugs by Morphology and Microscopy.
2. Exercises on extraction and isolation Extract of Caffeine Piperine, Diosgenine Sennosides, Strychnine & Brucine
3. Exercises on Evaluation of drugs by chromatography eg. Cinchona for quinine, Rauwolfia for reserpine, Amla for Vitamin-C & Mentha oil for menthol.
4. Exercises on Evaluation of herbal formulation:
    a. Drying of Ashvas & Aristha
    b. Determination of Extractive values for Avahleh and Churna Chavanprash & Triphla
    c. Evaluation Exercises following; exercises on marketed preparation. eg. Tine Belladonna, Tine Nux Vomica & Tine

Vasaka.

5. Study of drugs of Herbal Museum
6. Visit of Medicinal Plant Garden for live interaction.
7. Experiments on Plant Tissue Culture.

Books Recommended:

1. Pharmacognosy- Tyler, Brady, Robbers.
2. Pharmacognosy- Trease and Evans.
3. Indian Materia Medica- Nadkarni.
4. Indian Medicinal plants- ICMR Publication.
5. Pharmacognosy- S.S. Handa

B.4.2 Biopharmaceutics & Pharmacokinetics

GIT Absorption of Drugs: Mechanism, physio-chemical, Biological and pharmaceutical factors affecting drug absorption through GIT. Techniques for the GIT absorption assessment.

Biopharmaceutical study of drugs: Introduction to Biopharmaceutics, distribution, metabolism and elimination of drugs, biopharmaceutical study of drugs. Blood level concentration biological half life, elimination rate constant. Apparent volume of distribution.

Bioavailability and bioequivalence: Definitions, federal requirements, methods of determination of bioavailability using blood and urinary excretion data. Protocol design for bioavailability assessment. Methods for bioequivalence determination.

Pharmacokinetic: Introduction to pharmocokinetics including history and their role in related disciplines.

Compartment Models: Definition, Basis of classification, Model selection criteria.

One compartment open model with first order elimination kinetics, pharmacokinetics of single dose administration as applied to intravenous (rapid/bolus) and oral administration, intravenous transfusion superposition principle and multiple intravenous and oral administration, pharmacokinetic basis of sustained release formulations.

Two compartment open model with first order elimination kinetics, pharmacokinetics of single and multiple dose administration, as applied to intravenous (rapid / bolus) and oral administration intravenous infusion, pharmacokinetic basis or sustained release formulations.

Absorption kinetics: Curve fitting, Wagner -Nelson, Loo-Riegelman methods and Deconvolution methods for estimation of absorption rate constants

Dosage regimen: Dosage regimen adjustment in patients with and without renal failure

Non-Compartmental Analysis: Statistical moments. Application bioavailability determination

Non Linear pharmacokinetics: Michaelis Menten's kinetics, pharmacokinetic characteristics In-vivo estimation of Km and Vm, Unit impulse response Application in bioavailability determination.

Practicals:

Practicals based 0n ADME process, bioavailability. Bioequivalence Protein binding, compartment models, Non-linear pharmacokinetic analysis, experiments should be performed on animal and human volunteers

Books Recommended:

2. Hand book of Basic Pharmacokinetcs - Ritchel W.A. Drug Intelligence Publication, M. Hamilton, 1977.

3. Fundamentals of Clinical Pharmacokinetics- wagner J .c., Drug Intelligence Publication, m Hamilton. 1975

3. Remington's Pharmaceutical Sciences- Gennaro A. R., ed., 19th Edition, Mack Publishing Co., Easton Pa. 1995

4. Clinical Pharmacokinetics- Rowland M & Tozer N 2nd ed., Marcel Dekker New York 1982

5. Pharmacokinetics Gibaldi M. & Perrier, D, 2nd Ed .. Marcel Dekker, New York, 1982

6. Pharmacokinetics for the Pharmaceutical Scientist - Wagner, J. C., Technomic Publishing AG, Switzerland, 1993.

7. Biopharmaceutics and Pharmacokinetics Notari R.E., 2nd ed Marcel Dekker, New York, 1975.

B.4.3 Hospital & clinical Pharmacy

Organisation and structure organization of a hospital and hospital pharmacy, responsibilities of a hospital pharmacist, pharmacy and therapeutic Committee, budget preparation and implementation. Hospital formulary contents, preparation and revision of hospital formulary.

Drug store management and inventory control.

a. Organisation of drug store, types of materials stocked storage conditions.

b. Purchase and inventory control- principles-purchase procedures-purchase order- procurement and stocking

Drug Distribution System In Hospitals.

a. Out patient dispensing- methods adopted.

b. Dispensing of drugs to inpatients Types of drug distribution systems. Charging. policy-labeling.

c. Dispensing of drugs to ambulatory patients.

d. Dispensing of controlled drugs.

e. Central Sterile supply unit and its management: Types of materials for sterilization- packing of materials prior to sterilization-sterilization equipments -supply of sterile materials.

f. Manufacture of sterile and nonsterile products policy: waking on manufacturable items, demand and costing- faculty requirements, Manufacturing practice, master formula card, production control

manufacturing records.

g. Drug Information service : Sources of information on drugs, diseases, treatment schedules, procurement of informations - noncomputerized services (e.g. MEDLINE), computer systems for prescription tiling drug profile, patient medication profile, cases on drug interaction and adverse reactions, radiosynthetic cases, etc., Retrieval of information: medication error.

h. Nuclear Pharmacy: Introduction to radioisotopes and radio pharmaceuticals: radio active half Life Units of radio activity-production of radio pharmaceuticals, methods of isotopic tagging - preparation of radio isotopes in laboratory using radiation dosimetry, permissible radiation dose, level, radiation hazards and their prevention specifications for radio active laboratory.

I. Drug Research Programme : Basic clinical pharmacokinetics, drug delivery system and therapeutics consideration, clinical toxicology, New Drug Development , Clinical Trial & post marketing surveillance.

J. Drug use during pregnancy, elderly, infancy, drug induced diseases, essential drugs, therapeutic drug monitoring.

k. Diagnostic & Laboratory reagents / kits contrast medias.

l. Definition and management of,

a. CVS disorders: hypertension, congestive heart failure, angina, myocardial infraction, arrhythmias.
b. CNS disorders: Epilepsy, parkinsonism, Schizophrenia, Alzheimer, Depression.
c. Respiratory disorders: Asthma,
d. GIT disorders: peptic ulcer, acidity, hepatitis, cirrhosis.
e. Endocrine disorders: diabetes mellitus.
f. Infection diseases: cancer, tuberculosis, leprosy, urinary tract infection.
g. Joint and connective tissue disorders: rheumatic diseases, gout, hyperuricaemia.

B.4.4 Industrial Management Including Marketing

Plant location and layout of an industry various factors affection locational aspects, layout of building and equipment, product layout Vs Process layout, compliance of pollution control measures. Elementary knowledge of factories act.

Planning and decision making: definition, importance of planning, steps involved indecision making objectives, strategies policies and programme.

Management by objective - MBO process, objectives, multiplicity.

Production, planning and control, scientific purchasing, quality control, problem of productivity, stores, Organization, location of store, receiving, inspection and issue of materials, control of stored and stocks, stored discounting and records.

Personnel management: selection, appointment, training, transfer, promotion

and demotion, remuneration, job evaluation, human relations.

Pharmaceutical marketing functions: buying, selling, transportation, storage, finance, feedback information, channels of distribution, wholesale, retail, departmental store, multiple shop and mail order, business.

Sales forecasting: Various methods, analysis, limitations and advantages.

Salesmanship principles of sales promotion, advertising, ethics of sales, merchandising, literature, detailing.

Market Research Recruitment, training, evaluation compensation to the pharmacist

Finance: Principles of economics with special reference to the laws of demand and supply, demand curves, layout welfare, general principles of insurance and inland and foreign trade, procedure of exporting and importing goods,

Accountancy: Principles of account, Ledger posting and journal entries, preparation of trial balance, columns of a cash book. Band recoiliation statement, rectification of errors, profit and loss account, balance sheet, purchase, keeping and pricing of stocks. Treatment of cheques, Bills of exchange, promissory notes and hundies, documentary bills.

Books Recommended:

1. Principles and practice of management - Peter Drucker
2. Principles of management - Koontz O'Donnel
3. Business organization and management - Shukla
4. Business Organization - Ghosh
5. Principles of Industrial organization- Kimball and Kimball
6. Double entry book keeping ---Batliboi
7. Professional Pharmacy- Jain and Sharma
8. Factories Act

B.4.5 Pharmaceutical Analysis - III

The students should be made well acquinted with the use of following techniques as applied to assay of drugs in quality assurance programme.

Solvent extraction methods, counter current distribution technique.

The use nonaqueous methods for the estimation of drugs.

Chromatography techniques, column, paper, TLC, Ion exchange, Gels filtration. Basis of GLC and HPLC (Instrumentation excluded)

Use of visible and UV spectriophotometry, spector flurometry, nephelometry, turbidometry, amperometry and polarography.

Atomic absorption spectrophotometry- Flame photometer,

Numerical problems based on above

Polarography and amperometry

Practicals: based on

1. Gravimetric Analysis.
2. Non aqueous methods

3. Diazotization.

4 Extraction methods

5. Spectral methods
6. As applied to drugs and drug mixtures.

Books Recommended:

1. Vogel- T.B. of Quantitative Chemical Analysis.
2. Practical Pharmaceutical Chemistry - A.H. Beckettt and I.S. Stenlake, Part I & II, The Athlone Press, London University.
3. Paper Chromatography and Electrophoresis by block Durrun.
4. A text book of pharmaceutical analysis by K.A. Connors.
5. Pharmaceuticals Analysis by J. Higuchi and E.B. Hansen, Inter Science publisher John Willey and Sons New York, London, Sidney.

B.4.6 Pharmaceutical Chemistry – VI

(Medicinal Chemistry II)

A general discussion shall include classification under each topic and physiological, biological and therapeutic- importance of the compounds mentioned . A few lectures shall be devoted in the general treatment of steric aspects in relation to the biological activity.

Steroids : Isolation, color reaction, and nomenclature of sterols. Chemistry of cholesterol (excluding stereochemistry of the side chain and synthesis) and conformational analysis.

Steroidal Hormone : Synthesis of Testosterone, progesterone, oestrone and cortisone acetate from diosgenin and cholesterol. Structure activity relationship of cortex hormone.

Nonsteroidal Estrogen: Diethylstilbosterol, (DES), Dienesterol, Hexoesterol.

Vitamins: constitution and physiological importance of vitamin A, thiamine, riboflavin, ascorbic acid and folic acid. Pantothenic acid, pyridoxine tocopherol.

Antibiotics : constitution and therapeutic importance of penicillines and chloramphenicol; chemistry or streptomycin. A study of tetracycline, neomycin, nystatin, bacitracin, cycloheximide, griseofulvin and cyclosporin. Structure activity relationship in chloramphenicol.

Sulphonamides : Mode or mechanism of action, physiochemical parameters and bacteriostatic activity of sulphonamides. Synthesis and uses of sulphadiazine, sulphaguanidine, sulphamerazine, sulphadimidline, sulphamethoxazole, sulphathiazole & sulphasomidine. Drug combinations. Sulphonamides as hypoglycemics.

Antimycobacterial Agents :A general survey of antitubercular antileprosy drugs. Synthesis, mechanism of action of PAS, isoniazid, pyrazinamide and sulphones. SAR in hydrazide series and sulphones.

Antimalarials : synthesis and therapeutic importance of pamaquin, primaquin,. chloroquin, amodiaquin, quinacrine, chloroquanide and pyrimethamine. SAR in 4 and 3 aminoquinolines.

Antiamoebics : synthesis and therapeutic importance of biallylamicol, mantomide and tinidazole. Combined therapy in amoebiasis. A study of emetine, conessine and antibiotics as Antiamoebics.

Neoplastic Drugs: A study of alkylating agents and anti metabolites in therapy of neoplastic diseases.

Antiviral agents : the scope in therapy of adamantine derivatives, thiosemicarbazones, pyrimidines and purine analogues and benzimidazoles.

Eicosaonoids : biosynthesis of prostaglandin's and their importance. General survey of importance compounds used as anthelmintics, antifungal agents, urinary antiseptics, disinfectants and antiseptics.

Drug Design: principles of drug design including *QSAR* & molecular modeling.

Practicals :

Synthesis involving some name reactions, Heterocyclic nuclei and some simple drugs

Book Recommended:

1. Wilson & Giswold : text book of organic medicinal and pharmaceutical Chemistry.
2. Burger: Medicinal Chemistry.
3. Finar: Organic chemistry vol-II.
4. Fieser and Fieser: steroids.
5. Malone, Dyson and Purey : May's chemistry of synthetic drugs.

B.4.7 Pharmaceutical Technology-II

(Including Biological Pharmacy)

Parenteral products:

a. preformulation factors, route of administration, water for injection, pyrogenicity, non aqueous vehicles, isotonicity and methods of its adjustments.
b. Formulation details, containers and closure and selection.
c. Prefiling treatment. washing of containers and closure, preparation of solution and suspensions, filing and closing of ampoules and vials infusion fluid equipments for large scale manufacture and evaluation for particulate matter.
d. Aseptic techniques, source of contamination and methods of prevention. Design of aseptic area, laminar flow benches services and maintenance.
e. Sterility testing of pharmaceuticals.

Micro - encapsulation

Types of microcapsules, importance of micro-encapsulation in pharmacy, microencapsulation by phase separation and co-acervation, multiorifice, spray drying spray congealing, polymerization, complex emulsion, air suspension technique, coating pan and other techniques.

sustained and controlled drug delivery : design and development, physio-chemical, biological and pharmacokinetic properties influencing design and performance of controlled release product, materials and methods used in their formulation, dose designing. In vitro and in vivo evaluation.

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

Quality control assurance (including Good Manufacturing Practice)

Surgical products : Definition, primary wound Dressing, absorbents – surgical cotton, surgical gauzes etc. bandages, adhesive tape, protective cellulosic headstates, official dressing, absorbale suturescatgut and other, nonabsorable sutures and others medical prosthetics and organ replacement material.

Biological Pharmacy : Glandular products, preparation of pure extracts or isolation of pure substances and their dosage forms-pituitary, adrenal, pancreas, thyroid, parathyroid, ovary, liver, stomach, urine, blood products and plasma substitutes.

Collection, processing and storage of : Whole human blood, concentrated human RBCs, dried human plasma, protein fraction, dried human serum, dried fibrinogen, human thrombin, human normal immunoglobulin, human fibrin foam, plasma substitutes – ideal requirements, PVP, dextran 40 to 100.

Biologicals obtained by fermentation : fermentation, general requirements, media, equipments, principles and production of penicillin, 6 APA, semi synthetic penicillin's, streptomycin, tetracycline's, erythromycin, vitamin C, vitamin B-2, riboflavin, citric acid, lactic acid, alcohol, glycerol, acetic acid, butyric acid.

Antibiotics : historical development of antimiotics, antimicrobial spectrum and methods used their standardization, fermenter and its design, control of different agents. design of fermentation process Isolation of fermentation products with special reference to penicillines, streptomycins and tetracyclines and vitamin B-12. Antibiotics resistance.

Practicals :

Preparation and evaluation of injections, sterility testing sustained release formulations, biological products, enteric coating, evaluation of surgical products.

Book Recommended :

1. Herbert A. Liebermann, Leon Lachman and J.B. Schwartz "Pharmaceutical Dosage forms" Tablets, Vol. I, II, III Marcel Dekker Inc, New York, 1989.
2. H.C. Ansel & N.G. Popovich "Pharmaceutical Dosage forms and drug delivery system" 5th edition, Lea & Febiger, Philadelphia, 1990.
3. Remington's Pharmaceutical Sciences.
4. American pharmacy- sprowls and beal.
5. Industrial pharmacy- lachman& others.
6. Physical pharmaceutics- shotton & ridway.
7. Bentley's "text book of pharmaceutics"- Rawlins.
8. Professional pharmacy- jain & sharma.
9. Industrial microbiology- Steiner.

B.4.8 Library Assignment/ Industrial Tour / Project Report

Syllabus incharge : Mr. Girish Chandra Soni