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## BACHELOR OF PHARMACY (B. PHARM.)

### DETAILED SYLLABUS

#### YEAR-I

#### PHARMACEUTICS-1: INTRODUCTION TO PHARMACY (THEORY)

##### **. Pharmacy Profession:**

Pharmacy as a career, Evaluation of Pharmacy profession, earlier period, Middle to Modern Ages.

Introduction to Pharmacopoeias with special reference to Indian Pharmacopoeia, B.P.; U.S.P.; and International Pharmacopoeia.

##### **2. Metrology**

Imperial, Metric and S.I., Weights and measures, Interconversion

##### **3. Classification of dosage forms:**

Solids, Semisolids & Liquid dosage form.

Principles involved in the preparation of the following pharmaceutical products official in I.P., and their uses.

Purified water, Deionized water, Distilled water and water for injection

Aromatic water

Solutions

Spirits

Glycerines

Syrups

Elixirs

Lotions

Mucilages

Liniments

##### **4. Pharmaceutical Additives :**

Diluents, Vehicles, bases, solvents, Organoleptic additives, surfactants and their applications.

##### **5. Size reduction and Size Separation**

Definitions, factors affecting size reduction; principles, laws and factors affecting energy requirements, different methods of size reduction, study of Hammer mill, Fluid energy mill and disintegrator. Various methods & equipments employed for size separation eg. sieving,, , sedimentation, centrifugal elutriation microscopic methods etc.

##### **6. Mixing and Homogenisation**

Liquid mixing and powder mixing, mixing of semisolids, study of different types of

mixers used in pharmaceuticals.

Number of lectures: 4

##### **7. Clarification and Filtration:**

Definitions, theory and Factors affecting Filtration, Types of filter media, Filter Aids, and Selection of filters.

Equipments like gravity filter, pressure filter, vacuum filters, filter press, leaf filters, continuous rotary drum Filter, edge filter, sand filter, Membrane filters. Centrifugal types filters; batch, semicontinuous & continuous type.

##### **8. Heat Processes:**

a. Evaporation Factors affecting evaporation, study of evaporating stills and evaporating pans. Heat transferring evaporators, Vapor compression evaporators, evaporation under reduced pressure.

b. Distillation: Importance of distillation in Pharmacy, methods of distillation. Brief introduction to freeze drying, sublimation, Desiccation and Exsiccation, Efflorescence and its importance.

Number of lectures: 10

##### **9. Extraction and Galenicals :**

Extraction processes, study of percolation and maceration and their modifications, Applications in the preparation of tinctures & Extracts.

Number of lectures : 4

##### **PRACTICAL**

1. Preparation of following classes of products, involving the use of calculations in metrology (at least 2 products from each category where applicable)

Aromatic waters  
 Injections  
 Solutions  
 Spirits  
 Glycerine  
 Syrups  
 Elixirs  
 Lotions  
 Mucilages  
 Liniments  
 Suppositories  
 Tablets  
 Powders  
 Capsules

2. Study of one monograph from the latest edition of Indian Pharmacopoeia Demonstration of equipments (working procedure) for

a. Size Reduction and Size Separation

Mixing and Homogenization  
 Clarification and filtration  
 Evaporation  
 Distillation  
 Percolation

## PHARMACEUTICS-II: UNIT OPERATIONS

### 1. Introduction

Introduction to Pharmaceutical Engineering, Unit Operations concept and requirement; Materials and energy balances.

### 2. Conveying of Solids:

Belt Conveyors; Chain conveyors; Screw conveyors and Pneumatic conveyors.

### 3. Materials of Pharmaceutical Plant Construction, Factors affecting the material selection for Pharmaceutical plants:

Physical, chemicals, Mechanical and economical. Suitability of different materials for different plants i.e. ferrous metals-Cast iron, steel, stainless steel; Non-ferrous metals - copper and alloys, aluminum and alloys, lead, tin, silver, nickel and alloys, chromium, zinc; Non-metals glass, stoneware, slate brick, concrete asbestos, plastics, rubber, timber, ceramics and enamel.

Corrosions : Types, causes, theories and methods of prevention of corrosion.

### 4. Environmental Pollution and safety hazards :

Mechanical, chemical, electrical fire and dust hazards; safety requirements; fire Extinguishers; accident records. Environment control and Effluent treatment.

### 5 . Flow of fluids :

Fluid statics and dynamics, Basic equations, law of conservation in fluid flow;

Measurement of pressure manometers; Types of flow, Reynold's number and its significance; distribution of velocities in a pipe; friction losses; pipe fittings and joints.

Measurement of fluid flow - Principles, and construction of venturimeter, orifice meter, pitot tube, weirs, rotameter, and positive displacement meter - current meter and disc meter. Flow controls - Plug cock, Globe valves, Gate valves, and water hammer, unidirectional valves, Automatic regulating valve.

Pumps - Reciprocating pumps, positive displacement pumps, rotary pumps - volute and centrifugal pumps.

Blowers-Compressors, evacuators

### 6. Heat transfer :

Modes of heat transfer; heat transfer coefficient; OHTC; Convection - concept of film overall coefficient, Evaluation of Individual film coefficient; radiation - Stefan Boltzmann law; heating media, equipments, lagging. Fuels - solid, liquid, gases. Steam as heating medium - properties and uses of steam, steam traps, pressure reducing valve, steam heated heat exchanger, lagging, condensation etc. heating by electricity.

### 7. Distillation :

Theory of distillation - vapor liquid equilibrium relationship, volatility and relative volatility, Azeotropic -and Zeotropic mixture, phase diagrams etc; Rectification and construction of columns; molecular distillation; steam distillation; Enthalpy composition diagram and determination of number of theoretical plates; HETP.

### 8. Refrigeration :

Theory of refrigeration, refrigeration current cycle, equipments employed for large-scale refrigeration.

Air conditioning - humidification and dehumidification, cooling towers - Principles and applications; different types.

Humidity - Determination methods, methods of increasing and decreasing humidity. Application of humidity control in

Pharmaceutical Industries.

### 9. Drying

Theory of drying - principles, equilibrium moisture content, rate of drying; Drying of dilute solutions and suspensions - drum dryer, spray dryer; Drying of solids - convection type tray dryer, tunnel dryer, rotary dryer, fluidized bed dryer, vacuum oven, freeze dryer, radiant heat dryers, Automation in drying process.

### 10. Leaching and Extraction :

Solid-liquid extraction, percolation, agitation; Liquid-liquid extraction; small and large scale equipment; problems of crude drug extraction; Theories of extraction of drugs, properties of solvents; Extraction methods - small and large scale, factors affecting, the choice of extraction, recovery of solvents from mare

### 11. Purpose of Engineering Drawing:

Use of precision drawing instruments and drawing materials, lines of Engineering and their conventions. Lettering : Printing letters and Figures, construction of ellipse, parabola, Hyperbola, cycloid and involute.

### 12. Element of Projection:

Free hand sketching, study of isometric objects into orthographic views, sections in orthographic projections. Orthographic and isometric projections of simple geometrical solids like cylinder, cone, cube, prism and pyramids.

#### EXPERIMENTS:

Experiments based upon theoretical portion preferably on the following:

- 1 Effect of thickness of filter media, hydrostatic pressure size of filter media etc. on filtration rate.
2. Rate of drying, Equilibrium moisture content determination of factors affecting rate of drying.
3. Effect of number of balls and speed of ball mill on the grinding rate in ball mill.

Comparison of single stage and multiple stage extraction in solid-liquid extraction Study of Reynold's number and flow of fluids.

- 6 . Estimation of overall heat transfer coefficient in distillation unit
  7. Determination of flow rate by Orifice and Venturimeters.
  8. Calibration of pressure gauge with manometers.
- Efficiency of a simple distillation unit and effect of insulating materials on the efficiency.
- Determination of efficiency of a steam distillation unit.
11. Determination of humidity by Psychometric method and physical - method.
  12. Determination of hardness of water.
- Effect of driving fluids, on efficiency of ejector pumps.
14. Calibration of rotameters.
  15. Factors affecting liquid displacement in air lift pumps.

Freeze drying of a solution of antibiotic. Suspension of lacto - bacilli and evaluation.

## PHARMACEUTICS-III : DISPENSING PHARMACY

### 1. Prescriptions

Reading and understanding of prescriptions  
Modern methods of prescribing; common Latin abbreviations

### 2. Metrology

Reducing and Enlarging recipes; percentage calculations %  
W/V, V/V, & w/w

Alcohol dilutions, use of Alligation methods; proof spirit

Isotonic solutions, mEq units

Displacement Value of suppositories

### 3 Posology

Dose and dosage of drugs Factors influencing dose.

Calculations of doses on the basis of age, sex and surface area

### 4. Powders :

Types of powders; their merits and demerits; compounding, storage and packaging of

- Effervescent powders

- Granules, cachets and tablet triturates

- Dusting powders

#### 5. Liquid Dosage forms :

Preparation, merits, demerits storage and packaging of solutions and mixtures to pharmaceuticals-

#### 6. Emulsions and Suspensions :

Emulsions - Definition; types and identification; merits and demerits; use of emulsifying agents and stability of Emulsions

Suspensions - Definition; Types; merits & demerits; use of suspending agents; Flocculated & Deflocculated suspensions; stability of suspensions

#### 7. Semi-Solid Dosage forms :

Ointment bases; Dispensing; demerits and packaging

Aspects of Ointments

Pastes, Jellies, Poultices

Suppositories and Passeries

#### 8. Tablets :

Types of tablets; merits and demerits storage and packaging

#### 9 Capsules :

Hard and soft Gelatin Capsules -their merits and demerits; storage and packaging

#### 10. Sterile Dosage forms :

Definition; Types and their merits and demerits -Elementary study of the formulation characteristics of the following types :

- Injectable preparations

- Ophthalmic and ENT Products

- Total Parenteral nutrition

- Dialysis fluids

General requirements of sterile

dosage forms. Handling, packaging, storage and dispensing of sterile dosage forms

#### 11. Introduction to Ayurvedic/Unani Tibb dosage forms

#### 12. Incompatibility in Prescriptions :

Physical, chemical, biological and therapeutic incompatibility

Labeling instructions and precautions while dispensing various dosage forms

#### 14. Current Patent and Proprietary Products

Study of the following classes of patent and Proprietary products; Generic and selected brand names; Indications; contra indications; ADR; available dosage forms; dose and packing

-Antihypertensive drugs

-Antiamoebic drugs

-Antihistaminic, Antiemetics,

-Antacids and Ulcer healing drugs

-Anti-diarrhoeals and laxatives

-Respiratory drugs

-Antibiotics

-Analgesics - Antipyretics

#### PRACTICAL

##### 1. Student's Orientation.,

Introduction to the laboratory equipment, weighing methodology, general instructions and handling of prescriptions, labeling instructions

##### 2. Compounding and Dispensing of Prescriptions:

At least 50 prescriptions, representing the following classes of products, should be compounded and dispensed:

Powders; capsules; tablets; mixtures; Emulsions; Lotions & Liniments; Ointments; creams; pastes; suppositories; ENT preparations; Incompatibilities; Miscellaneous products

##### 3. Current Patent and Proprietary Products:

A study of current patent and proprietary products. Students should be trained in patient counseling by discussing specific problems in major classes of patent and proprietary products

#### 4. Prescription Reading and Pricing:

Minimum of 20 prescriptions from the clinical practice

Legal and Ethical aspects of Dispensing and compounding of prescriptions:

The students should be trained about these aspects evaluated by questionnaires.

Demonstration of Immunological products and pharmaceutical products involved in family planning programs.

### PHARMACEUTICAL CHEMISTRY 1 (ORGANIC CHEMISTRY)

#### 1. Basic Principles and concepts of Organic Chemistry:

Atomic and molecular orbitals, dipole moment, resonance, inductive and electromeric effects, intramolecular and intermolecular hydrogen bonding, acids and bases.

#### 2. Stereochemistry:

Introduction, optical activity, stereoisomerism, specification of configuration, reactions involving stereoisomers, Baeyers Strain Theory and conformational analysis.

Structure, nomenclature, preparation and reactions/properties of the following groups of compounds (including mechanism of reactions wherever necessary).

#### 3. Aliphatic & Alicyclic Hydrocarbons:

Alkanes, alkenes, alkynes, cycloalkanes.

#### 4. Aliphatic Halohydrocarbons:

SN<sup>1</sup> and SN<sup>2</sup> reactions, chloroform, carbon tetrachloride, trichloroethylene and haloethane.

#### 5. Aliphatic Alcohols:

Primary, secondary and tertiary alcohols, methanol, ethanol, proof spirit, denatured

alcohol, methylated spirit, determination of alcohol in pharmaceutical preparations, di & trihydric alcohols: glycols, glycerol, ethylene glycol, propylene glycol, glyceryl trinitrate, allyl alcohol, acetaldehyde, dimercaprol, ethobexadol, polyethylene glycols, polyoxyl 40 stearate, polysorbate.

#### 6. Ethers:

Thioethers, divinyl ether, solvent ether, anaesthetic ether.

#### 7. Aldehydes and Ketones:

Formaldehyde, trioxymethylene, paraformaldehyde, acetaldehyde and its polymers, chloralhydrate, dichloro phenaxone, methenamine manderate.

#### 8. Saturated Monocarboxylic Acids and Esters..

Preparation and properties of formic acid, acetic acid and derivatives, propionic acid, butyric acid, valeric acid, palmitic acid and stearic acid ethylacetate, ethyl acetoacetate ethyl nitrate, pentaerythritol tetranitrate, dioctyl sodium sulphosuccinate, ethyl oleate, sodium lauryl sulphate, acylhalides, lactic acid, lactides, lactones, glucuronic acid and gluconic acid.

#### 9. Di & Tricarboxylic Acids:

Oxalic acid, malonic acid, succinic acid and their amide and imide derivatives, maleic acid and fumaric acid, malic acid, glutaric acid, tartaric acid, citric acid and adipic acid.

#### 10 Aliphatic Amines and Related Compounds:

Alkylamines 8-hydroxy and 3-alkylamines, diamines, urea and ureides, dextropropoxyphene hydrochloride, cramiphen hydrochloride, dicyclamine hydrochloride mustine hydrochloride, ethylenediamine hydrate, sodium calcium edetate, cyclamic acid calcium cyclamate, sodium cyclamate, thiambutosine.

#### 11. Carbanions:

Reactions involving carbanions: malonic ester, synthesis of carboxylic acids, acetoacetic ester, synthesis of ketones, Decarboxylation of  $\beta$ -ketoacids and malonic acids, direct and indirect alkylation of esters and ketones, alkylation of carbonyl compounds via enamines, et,  $\alpha,\beta$ -unsaturated carbonyl compounds (conjugate addition) including Michael and Diels- Alder reaction.

### PRACTICAL

#### 1. Lassaigne's test for N,S and halogens.

#### 2. Identification of organic compounds based on solubility and functional group test.

Performance of qualitative test for alkaloids, steroids carbohydrates, glycosides, proteins and

amino acids.

4. Test for identity of selected drugs: atropine, caffeine, quinine, glucose, sucrose, barbiturates, ascorbic acid & sulphanilamide.

### PHARMACEUTICAL CHEMISTRY II

**(INORGANIC MEDICINAL PHARMACEUTICAL CHEMISTRY)**

Sources of impurities in pharmaceutical substances and their control

The following topics will be treated covering an outline of methods of preparation, tests for identity, assay procedure and pharmaceutical uses of compounds covered under following headings:

Pharmaceutical aids and necessities: Acids, bases, buffers, antioxidants, water and pharmaceutically acceptable glass.

Major intra and extra cellular electrolytes: Major physiological ions, electrolytes used in replacement therapy, physiological acids-base balance, electrolytes used in acid-base therapy, electrolyte combination therapy.

Essential and trace ions: Copper, zinc, chromium, manganese, molybdenum, selenium, sulfur and iodine.

Gastrointestinal agents: Acidifying agents, antacids, protective and absorbents, saline cathartics.

Radiopharmaceutical used in medicine: Therapeutic application of isotopes, diagnostic application of isotopes, radio assay methods in medicine (preliminary knowledge).

Topical agents: Antimicrobials and astringents.

Dental products: Anticaries agents and dentifrices.

Miscellaneous Inorganic Pharmaceutical agents: Inhalants; respiratory stimulants, expectorants and emetics, antidote, tableting aids and suspending agents.

**PRACTICAL**

Limit tests for impurities in pharmaceutical compounds.

Quantitative analysis-assay of the following compounds will be done: solution of ammonia, boric acid, sodium bicarbonate, sodium carbonate, ferrous sulphate, strong and weak iodine solutions, copper sulphate, chlorinated lime, sodium chloride, ammonium chloride, sodium sulphate, calcium gluconate, magnesium sulphate, arsenic trioxide, bismuth oxychloride, bismuth subnitrate.

**PHARMACOGNOSY-1**

1. Introduction, development, present status, future and scope, of Pharmacognosy. Scope and significance of biology in Pharmaceutical Sciences Modern concept of Biology viz. molecular, Physiological and biochemical concept.

Introduction to different group of plant constituents and their tests, Definitions of selected botanical and Pharmacological terms.

4. Principles of classification of plants with special reference to:

i) Algae: Rhodophyta (Agar, Alginic acid )

Fungi: Eumycetes (Ergot, Yeast, Mushrooms)

iii) Gymnosperm: Pinaceae, Gnetaceae.

Angiosperm: Apocynaceae, Compositae, Convolvulaceae Labiateae, Rubiaceae, Rutaceae,

Solanaceae, Scrophulariaceae, Umbelliferae, Leguminosae.

Study of plant tissue and ergastic cell inclusion with a view to identify & authenticate powder crude drugs with emphasis on anatomical structures of bark, stem (Monocot, Dicot).

6. Different systems of classification of crude drugs.

Different system of medicine practiced in India with specific reference to Unani, Ayurvedic and Homoeopathic medicines.

Factors involved in the production of drugs from wild and cultivated sources including cultivation, collection, drying storage, commerce and quality control.

Biological source, chemical tests for identity and salient microscopic features of commercial fibres used as surgical dressings and filtering aids. Cotton, silk, wool and rayon.

10. Natural Pesticides and insecticides.

**PRACTICAL**

1. Taxonomic study of families included in theory. Microscopic studies. Basic tissues, anatomy of bark, stem (Dicot, Monocot), root (Dicot, Monocot), seed, leaf and fruit. Trichomes, stomata, Calcium oxalate crystals.

3. Study of surgical fibers and dressings.

General chemical test for plant constituents such as alkaloids, glycosides, tannins, saponins, resins and proteins.

**HUMAN ANATOMY & PHYSIOLOGY (THEORY)****I. INTRODUCTION**

Definition and scope of anatomy, physiology and related sciences. Anatomical terms in relation to parts of the body, system and organs.

Study of human skeleton.

**II. CELL**

1. Structures and their functions

2. Genetic control of cell function

### **III. TISSUES OF THE BODY**

Types of tissues and their functions

Physiology of muscle contraction

3. Neuromuscular transmission

### **IV. MEMBRANE**

General principles of membrane permeability, transport

2. Mechanisms and electrophysiology of membrane

### **V. NERVOUS SYSTEM**

1. General anatomy and physiology of neurons, synapses, neurohumoral transmission

2. Central nervous system, its various parts and their functions

RAS, Limbic system, Physiology of sleep, CSF, Sensory and motor pathway

4. Autonomic nervous system

5. Reflex arc, conditioned and unconditioned reflexes

### **VI. CARDIOVASCULAR SYSTEM AND BLOOD**

1. Structures and functions of heart and blood vessels

Heart sounds, ECG, Cardiac cycle, Blood pressure and its regulations

3. Circulation

4. Lymphatic system

5. Blood composition and functions

Blood groups, Rh factor, blood transfusion.

### **VII RESPIRATORY SYSTEM**

Gross anatomy of respiratory passages

Regulation and mechanism of breathing and pulmonary function test.

Transportation of gases.

Hypoxia, Anoxia, Dyspnoea, artificial respiration

### **VIII DIGESTIVE SYSTEM**

Gross anatomy of the alimentary canal

Physiology of digestion

Liver and pancreas

### **IX ENDOCRINE SYSTEM**

Physiological consideration of thyroid, parathyroid, pancreas, pituitary, suprarenal and gonads.

### **X REPRODUCTIVE SYSTEM**

Structure and function of male female reproductive organs.

Spermatogenesis

Puberty, ovulation, menstrual cycle, reproductive cycles

Pregnancy, lactation and menopause.

### **XI URINARY SYSTEM**

General disposition of organs of excretory system

Physiological consideration of urine formation and factors controlling it .

Micturition Regulation of body fluid constituents and their volumes,.

### **XII SPECIAL SENSES**

Physiology of hearing, taste, smell and vision.

Structure and functions of skin

Regulation of body temperature

### **PRACTICAL**

I

Study of human skeleton and bones.  
 Study of models of organs of various body systems.  
 Study of surgical instruments

## II HISTOLOGY

Handling of microscope  
 Identification of various tissues

## III HAEMATOLOGY

Estimation of hemoglobin  
 Total RBC count  
 Total WBC count  
 Differential leukocyte count (DLC)  
 Platelets count  
 Determination of blood group and Rh factor.  
 Determination of ESR.(demonstration)  
 Determination of blood clotting and bleeding time  
 Identification of plasmodium species in the human blood

## IV MUSCLE PHYSIOLOGY

Study of equipments used in experimental physiology.  
 Study of simple muscle curve  
 Muscle fatigue, effect of load and after load.  
 Effect of temperature on muscle contraction

## V RESPIRATION

Pulmonary function test using spirometer.

## VI NERVOUS SYSTEM

Study of reflex action  
 Recording of body temperature by various techniques  
 Recording and interpretation of EEG.

## VII. CARDIOVASCULAR SYSTEM

Determination of blood pressure by palpatory and auscultating methods  
 2. Recording ECG and its interpretation

## YEAR- II

### PHARMACEUTICAL MATHS AND BIO STATISTICS

#### A. Statistics and Calculus

Condensation of the data collected; various forms of distribution tables.  
 Pictorial representation of frequency distribution in histograms and frequency polygons.  
 Measures of central tendency.  
 Measures of dispersion-range, mean deviation and standard deviation, coefficient of variation.  
 Significance tests-test of significance and chi-square test of significance.  
 Correlation between two variables  
 Interpolation.  
 Probability.  
 Use of log-log graph.  
 Limits of algebraic functions.  
 Lim Sin  $0/0$ ; axioms on limits; of trig. Functions.  
 Differential coefficient of a function; derivatives of  $x^n$ , NoR.  
 Derivative formula of sum and difference of two functions generalizing it for more than two; derivative of product of two functions-generalizing it for the product of 3 functions; derivatives of quotient of two functions.  
 Derivative of trigonometrical functions and inverse functions.  
 Derivative by method of substitution.  
 Derivative of function of a function.  
 Derivative by method of substitution.  
 Derivative of function of a function.  
 Parametric functions; implicit function; log. Differentiation.  
 Higher order derivatives.  
 Partial derivatives.  
 Total differentials and total derivatives, higher order , partial derivative  
 Tangent and normal, velocity and acceleration



Approximate values, maxima and minima,  
 Derivation of formulae of integration from derivative formula  
 Integration of sum and difference of two functions  
 Integration by substitution, integration by parts,  
 The relationship of integration to summation  
 Definite integration, interpretation of definite integration, as an area, area of circle.

R and B (beta) functions  
 Double integrals,  $\iint (x,y) dydx$  over a particular region and its interpretation  
 Ordinary differential equations of the first order  
 Linear differential equations with constant coefficient  
 Simultaneous differential equations.

## **PHARMACEUTICAL MICROBIOLOGY INCLUDING BIOLOGICAL PHARMACY**

### **1. Introduction:**

History of Microbiology its branches and its importance; general microbiological

techniques, identification, staining, enumeration etc. General classification of micro - organisms & study of bacteria, moulds, yeasts, viruses & actinomycetes -Nutrition, cultivation, Isolation and identification; Effect of moisture, temperature, ion, light and pH on the growth of micro - organisms; bacteriological media; Bacterial metabolism - EMP and TCA pathways; Salient features of common communicable disease producing microbes; study of different types of microscopy; bacterial resistance.

### **2. Immunology :**

Introduction, Types of Immunity, Immunological products like sera, vaccines, toxoids: Phagocytosis, antigens, antibodies, components; Immune systems-humoral immunity, cellular immunity, privileged graft, sites, graft host reaction; tolerance, immunogenetics; Types of reactions and their application.

Preparation and standardization of Immunological products e.g. BCG vaccines, diphtheria toxoids, small pox vaccine, poliomyelitis vaccine; tetanus anti-toxin, diagnostic biologicals; General method of the preparation of bacterial vaccines, toxoids; viral vaccine; rickettsial vaccines; anti-toxins; serum-immune blood derivatives and other products relative to immunity; Interferon.

### **3. Disinfection**

Factors influencing disinfection; dynamics of Disinfection; disinfectants, antiseptics and their evaluation.

### **4. Sterilization methods and Principles :**

Methods of sterilization; Physical, Chemical, Heat, radiation, gaseous, filtration. Evaluation of the efficiency of sterilization methods; Equipments employed in large scale sterilization. Examples of the materials sterilized by different methods. Sterility indicators.

### **5. Sterility testing of pharmaceutical products:**

Sterility testing of products according to IP, BP and USP. Sterility testing of parenteral products - solids, liquids; Ophthalmic and other sterile products according to the I.P., B.P. and U.S.P. Sterility testing of sterile surgical devices; dressings, implants, absorbable, haemostats, surgical ligatures and sutures, surgical catgut etc.

### **6. Aseptic Technique :**

Designing of aseptic area, laminar flow equipments; study of different sources

of contamination aseptic area and methods of prevention.

### **7. Fermentation Technology:**

Fermentation methods and general requirements; study of media, equipments, sterilization methods, aeration process, stirring, etc. Large scale production fermenter design and its various controls. Study of the production of - penicillins, citric acid, fungal diastase and Dextran.

### **8. Microbiological Standardization**

Microbiological methods for standardization of antibiotics, vitamins and amino acids;

Immunoassay; Assessment of a new antibiotic and testing of antimicrobial activity of a new substance.

### **9. Microbial spoilage and preservation of Pharmaceutical products:**

Types of spoilage; factors affecting the microbial spoilage of pharmaceutical products.,

sources and types of microbial contaminants; assessment of microbial contamination and spoilage; preservation of pharmaceutical products using antimicrobial agents; Evaluation of microbial stability of formulations.

### **10. Control of microbial contamination during manufacture :**

General aspects-environmental cleanliness and hygiene, quality of starting materials, process design, quality control and documentation.

### **11. Glandular products**

Preparation of extracts and isolation of pure substances for the preparation of dosage

forms, e.g. Pituitary, Adrenal, pancreas, Thyroid, Parathyroid, Ovary, liver, stomach etc.

## **PRACTICAL**

Exercise illustrating the course contents of theory including :

Preparation of various types of culture media

Studying of different laboratory equipments and processing e.g. B.O.D. incubator, laminar flow, aseptic hood, autoclave, hot air sterilizer, deep freezer, refrigerator, microscopes etc.

Subculturing of aerobic and anaerobic bacteria, fungus and yeast, Nutrient stabs and slants preparations.

Various staining methods-simple, Grams staining and acid fast staining, structural staining etc.

Isolation of pure culture of micro-organisms and identification of micro-organisms.

Evaluation of sterilizing techniques.

Evaluation of antiseptic and disinfectants e.g. RWC, FDA method and chick martin.

Sterility testing-different methods as per IP/BPIUSP

Hanging drop slide preparation

Biochemical reactions-starch hydrolysis, nitrate reduction, litmus milk test, gelatin liquification and haemolysis of blood.

Microbial viable count in a pharmaceutical product, total count of bacteria

Thermal death time

Microbiological assay of antibiotics & vitamin B12

Test for limit of alkalinity of glass

Pyrogen testing

Standardization of surgical dressings and sutures and ligatures

Studying the effect of Temperature, pH on the medium etc. on growth.

Isolation of an antibiotic producer.

Bacteriophage isolation and characteristics

Standard analysis of water & Biochemical oxygen demand

Normal throat flora

Studying of the environment microflora and testing of aseptic area e.g. dextrose injection, calcium gluconate injection, oily injections, injections of vitamins etc.

## PHARMACEUTICS-V: PHYSICAL PHARMACY

### 1. Complexation and Drug action:

Metal complexes, Organic molecular complexes, Inclusion compounds, methods of analysis, crystalline structure of complexes, thermodynamic treatment of stability constants, protein binding.

### 2. Kinetic and Drug Stability:

Rates and orders of reactions, influence of temperature and other factors on reaction rates, Decomposition and stabilization of Medical agents, Accelerated stability analysis.

### 3. Surface and interfacial phenomenon:

Surface and interfacial tension, surface free energy, measurement of surface and interfacial tension, spreading coefficient, complex films, adsorption phenomenon, adsorption at solid/liquid interface.

Surface activity, general classification of surfactants, hydrophilic-lipophilic system, solubilization, factors affecting solubilization, mechanism of solubilization, pharmaceutical applications of solubilization, co-solubilization. Micelle formation, factors affecting micelle formation, determination of critical micelle concentration. Detergency, Emulsification, Wetting agent, foaming agent, Antifoaming agent. Medicinal and Pharmaceutical application of surfactants.

### 4. Colloids and Macromolecular system :

Introduction, Types of colloidal systems, optical properties of colloids, kinetic properties

of colloids, Electrical properties of colloids, stabilization. Interaction of colloids.

### 5. Rheology:

Fundamentals of Rheology, Introduction, Types of flow, quantitative measurement of flow, mechanical models to illustrate viscoelasticity, Thixotropy, Measurement of thixotropy, Thixotropy in formulations, Rheology of disperse systems, Application of Rheology to Pharmacy, Methods of measuring viscosity.

### 6. Micromeritics:

Introduction, importance in Pharmacy, fundamental properties of collection of particles

like particle size, particle size distribution, particle shape, particle volume, particle number, surface area, methods for determining particle size, surface area and particle volume, derived properties of loose powder, flow properties of powders, Angle of repose, factors affecting flow of powders.

### 7. Coarse Dispersions:

Suspensions - Interfacial properties of suspended particles, settling in suspensions,

formulation of suspension, Emulsions; theories of emulsification, physical stability of emulsions, preservation of emulsions, rheologic properties of emulsions, phase equilibria and emulsion formulation.

### 8. Diffusion and Dissolution:

Steady state diffusion, procedures and apparatus, Dissolution, drug release, diffusion principles in biologic systems, . vapor sorption and transmission and thermodynamics of diffusion.

## PRACTICALS

Preparation and properties of simple complexes

Design, Conduction and reporting of accelerated testing in studying chemical stabilization against hydrolytic decomposition of

drugs.  
 Determination of surface and interfacial tension ,  
 Preparation and properties of colloids.  
 Viscosity determination of Newtonian and Non-Newtonian liquids by one point and multipoint viscometers.  
 Determination of HLB value of surfactant by saponification method.  
 Determination of HLB value by modified Griffin acacia emulsion method.  
 Determination of spreading coefficient of organic liquid by stalagamometer.  
 Determination of particle size by optical method.  
 Determination of particle size by sieving method and efficiency of screening operation.  
 Determination of particle size by sedimentation method using and Anderson pipette.  
 Determination of flow properties of powder through the tube as a function of length of tube, diameter of orifice of tube and pressure head.  
 Experiments demonstrating the measurement of angle of repose of powders and the factors affecting.  
 Determination of CMC (Critical Micelle Concentration) of surfactants by surface tension methods.  
 Experiments demonstrating the usefulness of solubilizing agent in forming a clear liquid phase of two immiscibles liquids (Ternary phase diagram) .  
 Qualitative and quantitative study of adsorption phenomenon.  
 Determination of bulk density of pharmaceutical solid  
 Any other new experiment that can be included from time to time in support of the theoretical aspects of the course.

### PHARMACEUTICAL CHEMISTRY III: PHARMACEUTICAL ANALYSIS-1

#### (INORGANIC CHEMISTRY)

**1. Introduction:** Significance of quantitative analysis in quality control, different techniques of analysis.

#### 2. Acid-base titrations

Theories of acidimetry and alkalimetry, classification, direct titration of strong acids, weak acids, strong bases & weak bases.

Preparation and standardization of acids and bases. Some exercises related to the determination of acids & bases. Some official assay procedures e.g. boric acid, hydrochloric acid, phosphoric acid, sodium hydroxide, calcium carbonate, ammonium hydroxide, nitric acid, sulfuric acid.

#### 3. Oxidation & reduction titrations:

Concepts of oxidation and reduction, redox reactions, strengths & equivalent weights of oxidizing and reducing agents, redox indicators, potassium permanganate titrations, iodometry & iodimetry, ceric ammonium sulphate titrations, potassium iodate titrations. Pharmaceutical applications, preparation and standardization of redox titrants e.g. sodium thiosulphate etc. Some exercises related to determination of oxidizing and reducing agents in a given sample shall be covered.

#### 4. Precipitation titrations

Preparation & standardization of titrants like silver nitrate, ammonium thiocyanate; titrations according to Mohr's and Volhard's methods; ammonium and potassium thiocyanate titrations; indicators; applications in pharmaceutical analysis.

#### 5. Diazotisation titrations

Different conditions involved in diazotisation of different amines, end point determination, pharmaceutical analytical applications such as in the assay of sulfonamides.

#### 6 Gravimetric analysis

Introduction, precipitation techniques, supersaturation, coprecipitation, digestion, washing of the precipitates, filtration paper and crucibles, ignition, specific examples of Gravimetric estimations like barium as barium sulphate, aluminum as aluminum oxide, calcium as calcium oxalate, magnesium as magnesium pyrophosphate. Other organic precipitants.

#### 7. Non-aqueous titrations

Theoretical considerations, scope and limitations, acid base equilibria in non-aqueous media, titration of weak bases, titration of weak acids. Pharmaceutical products should be selected for illustration e.g. ephedrine, methyldopa, adrenaline acid tartrate etc.

#### 8. Complexometric titrations

Types of Complexometric titrations, metal ion, indicators, factors influencing the stability of complexes and applications e.g. calcium gluconate, bismuth carbonate, bismuth subnitrate.

#### PRACTICAL

Acid base titrations: Preparation and standardization of acids and bases, some exercises related to the determination of acids and bases separately and in mixture form. Some official assay procedures e.g. of boric acid, ascorbic acid shall also be covered.

Oxidation-reduction titrations: Preparation and standardization of some redox titrants e.g. potassium permanganate, potassium dichromate, iodine, sodium thiosulphate etc. Some exercises related to the determination of oxidizing and reducing agents in the sample shall be covered. Exercises involving use of potassium iodate, potassium bromate, 2,6-dichlorophenol indophenol, ceric ammonium sulphate shall be performed.

Precipitation titrations: Preparation and standardization of titrants like silver nitrate and ammonium thiocyanate, titrations according to Mohr's and Volhard's methods.

Gravimetric analysis: Determination of water of hydration, some exercises related to Gravimetric estimation of metal ions such as barium, magnesium & calcium shall be covered.

**PHARMACEUTICAL CHEMISTRY IV: ORGANIC CHEMISTRY INCLUDING HETEROCYCLIC AND MEDICINAL CHEMISTRY)**

1. Aromatic Compounds: Structure and resonance of benzene, aromatic character, mechanism of electrophilic aromatic substitution, orientation effects in electrophilic substitution, nucleophilic aromatic substitution.

2. Preparation, properties and actions of. Phenols sulphonic acids and derivatives, carboxylic acids, carboxamides, nitro compounds, amines, diazonium salts, aryl halides and ketones.

3. Poly nuclear aromatic hydrocarbons: Naphthalene, phenanthrene and anthracene.

4. Heterocyclic compounds: Study of fundamentals of heterocyclics, nomenclature, methods of synthesis and important chemical reactions of the following:

Five-membered heterocycles: furan, thiophene, pyrrole, thiazole, oxazole, imidazole, pyrazole, triazole and tetrazole.

Six-membered heterocycles: Pyridine, pyridazine, pyrimidine, pyrazine and pyrones. Benz-fused heterocycles: Quinoline, isoquinoline, indole, acridines and xanthone.

5. The following topic shall be treated covering outlines of synthetic procedures (of selected drugs), uses, structure activity relationship including physicochemical and steric aspects and mode of action.

Sedatives and hypnotic, thyroid hormones and antithyroid drugs, coagulants and anticoagulants, local anesthetics, general anesthetics, opiod analgesics, CNS stimulants, antiseptics and disinfectants, sulfonamides and surfactants.

**PRACTICAL**

1. Identification of organic compounds and preparation of simple derivatives. Synthesis based on O- and N-acetylation, nitration and bromination.

**PHARMACOGNOSY-II**

1. Modern concept of Pharmacognosy, sources of drugs from biological, marine and plant tissue culture.

2. Classification and chemistry of carbohydrates. Study of drugs dealing with biological sources, geographical distribution, collection, commercial production, chemical constituents, chemical tests for identity, substitutes, adulterants and uses of the following drugs.

Starches, Acacia, Tragacanth, Sterculia, Guar gum, Plantago and Honey.

3. Study of lipids, their chemistry, classification & biogenesis, lipid containing drugs dealing with general methods of extraction & purification of fixed oils, biological source, chemical constituents, tests for identity and uses of the following:

Arachis oil, Castor oil, Sesame oil, Cotton seed oil, Olive oil, Chaulmoogra oil, bees wax.

4. Drugs of animal origin: Shellac, Cochineal, cantharides, spermaceti, wool fat.

5. Tannin containing drugs. Catechu (Black & Pale), Tannic acid, Myrobalan, Katha industry in India.

6. Protein containing drugs: General chemistry and study of amino acids, Gelatin.

7. Plant allergens and allergenic substances.

8. Hallucinogens, narcotics and common poisonous plants of India.

9. General study of formation of secondary metabolites". Biogenesis of primary metabolites and importance of photosynthesis in formation of primary metabolites and their relationship to the formation of secondary metabolites (Calvine Cycle, TCA cycle, shikimic acid pathway, Embden Merrhoffs pathway, acetate hypothesis, isoprenol compound biosynthesis).

10. Evaluation of crude drugs.

**PRACTICAL**

1. Microscopic and chemical study of the following powdered drugs.

Leaf - Senna, Datura

Stem - Ephedra

Root - Rauwolfia

Seed - Nux-vomica, plantago

Bark - Cinchona Fruit - Fennel

2. Identification of the drugs on the basis of their organoleptic and chemical tests included in 2,3,4 & 5.

**PATHOPHYSIOLOGY, TOXICOLOGY AND HEALTH EDUCATION**

**I General aspect of pathophysiology** - Atrophy, necrosis, pain, irritation, inflammation, shock, allergy

**II. Pathophysiology and clinical assessment of -**

1. Disorders of cells and tissues - hypoplasia, hyperplasia, hypertrophy, metaplasia, neoplasia and general considerations

2. Disorders of blood cells - leukopenia, leukemia, erythrocyte disorders (anemia polycythemia etc.), hemorrhagic diseases (thrombocytopenia, fibrinogen deficiency, purpura etc.)

3. Disorders of blood vessels and heart - atheroma, arteriosclerosis, aneurysms, thrombophlebitis, embolism, varicose veins, congestive cardiac failure, ischaemic heart disease, rheumatic heart diseases, arrhythmia, hypertension, Burger's disease

4. Disorders of the respiratory tract - tonsillitis, bronchitis, bronchial asthma, emphysema, cough.

5. Disorders of the digestive tract - gastritis, peptic ulcers, pancreatitis, cirrhosis of the liver, jaundice
6. Disorders of the urinary system - glomerulonephritis, renal calculi
7. Disorders of the nervous system and special senses- Multiple sclerosis, hypoxia, dementia, Parkinsons' disease, chorea, Alzheimer's disease, migrain, depression, .schizophrenia
8. Disorders of the reproductive system - Impotency, infertility, cryptorchism
9. Disorders of bone, joints and cartilages - Osteoporosis, gout, arthritis, ricketts
10. Disorders of eye - glaucoma and cataract

### III. Toxicology

Definition, scope and its branches  
 Teratogenicity and Carcinogenicity  
 Toxicity of heavy metals and their antidote  
 Management of poisoned patients

### IV. Health Education

Spread and prevention of communicable disease- AIDS, Sexually Transmitted Disease, Small pox, measles, influenza, diphtheria, whooping cough, meningitis, tuberculosis, polio-millias, viral hepatitis, cholera, typhoid, diarrhea, amoebiasis, malaria, filariasis, rabies, tetanus, leprosy.

Control of population explosion, national family program means of contraception (mechanical, chemicals, surgical, Immunological, physical and physiological).

Immunisation – various vaccines, toxoids and their uses.

## PHARMACOLOGY-I (THEORY)

### I. General Pharmacology

Definition, scope and branches of pharmacology. Historical development with special reference to India  
 Sources of drugs  
 Routes of drugs administration and drug delivery systems  
 Dynamics of absorption, distribution and excretion of drugs  
 Basic pharmacokinetic parameters employed in the use of drugs, their bioavailability and biotransformations, metabolizing enzymes as targets of drugs action (induction and inhibition)  
 Mechanisms of drugs action, drug receptors and cellular signaling systems  
 Drug antagonism and synergism  
 Drug dependence and related conditions  
 Adverse drug effects and their monitoring, Iatrogenic diseases  
 Pharmacogenetics

### II. Pharmacology Of Autonomic Nervous System

Cholinergic receptors, cholinergic drugs (parasym-pathomimetics, cholinomimetics, anticholinesterases), anticholinergic drugs  
 Adrenoceptors, sympathomimetics, adrenoceptors blockers and adrenergic neurone antagonists  
 Drugs action on autonomic ganglia (ganglionic stimulants, ganglion blocking agents)  
 Neuromuscular blocking agents and centrally acting muscle relaxants

### III. Autocoids

Histamine, Antihistaminic  
 Serotonin, agonists and antagonists  
 Arachidonic acid metabolites  
 Angiotensin, Plasmakinins, VIP, neurotensin, substance P, PAF

### IV Drugs In Ocular Pharmacology

Mydriatic and miotic agents and drugs used in glaucoma

## PRACTICAL

1. Study of instruments used in experimental Pharmacology, smoking and fixing a kymograph
2. Handling of laboratory animals
3. Techniques of drug administrations in animals
4. Influence of route of administration of drugs on drug response
5. Experiments on isolated tissue preparations
  - i. To record the CRC of acetylcholine using frog rectus
  - ii. To record CRC of acetylcholine using guinea pig ileum
  - iii. Determination of dose ratio
  - iv. Study of competitive antagonism using acetylcholine and histamine as agonist
  - v. Potentiation of acetylcholine responses with anticholinesterases

- vi. Identification of an agonist using isolated tissue (frog rectus abdominus muscle, guinea pig ileum)
- vii. Determination of pD<sub>2</sub> value
- 6. Study of drug absorption in vitro
- 7. Determination of intraocular pressure in rabbits

### COMPUTER APPLICATIONS

#### 1. History of Computer development and respective generations:

Abaceer, Napier, Bonar, Slide rule, PASCAL'S calculator. Need to use computers, applications in pharmacy and in general

#### 2. Computer Classification:

Mainframe, Mini, and Micro computers, comparison of Analogue and Digital computers, Hardware and software, calculator and computer.

#### 3. Operating Systems:

Introduction to types of operating systems, UNIX, MS-DOS etc. RAM, Virtual Memory etc.

#### 4. Type of Languages:

conventional languages, Their advantages, limitations; C, PASCAL, FORTRAN, Programming of these languages

#### 5. Introduction to Computer Networks:

Architecture of seven layers of communications

#### 6. Introduction to Data Structure:

Like Queues, list, trees, Binary trees algorithms, Flow chart, Structured Systems Analysis and development, Ingress-SQL, Gateways etc. Statistics, methodologies, computer Graphics; Introduction

#### 7. Basic language:

Constraints and Variables: Character set, constraints, variables, Naming the variables getting data into memory, LET, INPUT, READ, DATA, Print Statement.

#### Expressions:

Arithmetic expression, Hierarchy of operations, Rules of Arithmetic, Evaluation of expressions, Relational expressions  
Logical operations, Library functions.

#### Printer control:

Comma and semicolon control, the TAB function. PRINT, LPRINT.

Jumping, Branching and Looping:

GOTO, IF ..... THEN, ON ..... GOTO, FOR ..... NEXT Statements.

Functions and Subroutines:

User defined functions, subroutines, subscripted variables.

#### 8. Programming (Tutorial)

'C', PASCAL, FORTRAN

### YEAR-III

### PHARMACEUTICS-VI : HOSPITAL AND CLINICAL PHARMACY INCLUDING DRUG INTERACTIONS

#### Part 1-Hospital Pharmacy

1. Status of health delivery systems in India. Definition and role of hospitals in the health delivery systems. Types of hospitals.
2. Hospital Pharmacy, Definition, functions and objectives of hospital pharmacy, Location, Layout & flow chart of material and men, personnel and facilities required, including equipments.
3. Drug distribution system in Hospitals:
  - a. Out patients
  - b. In patients: Detailed discussion of
    - i. Unit dose dispensing
    - ii. Floor ward stock system & satellite pharmacy services
    - iii. Central sterile services; bed side pharmacy
    - iv. Prepackaging
4. Establishment of an OTC counter & dispensing; personnel, space; equipment; apparatus and other facilities required for; Methods to achieve safe and efficient and speedy dispensing of drugs.
5. Maintenance of records of issue and use of Narcotics and Dangerous drugs, Ward stock medicines and emergency drugs.
6. Medical Stores:
 

Objectives, Layout facilities; Procedures for procurement of drugs and supplies from medical stores depot,

manufacturer, distributor, local market; procedure and limits of emergency purchase.

7. Pharmacy Therapeutics Committee:

Constitution and functions of Pharmacy therapeutics committee, Hospital formulary system and their organization, Functions and composition.

8. Drug Information service and drug information bulletin

9. Manufacturing of pharmaceuticals in Hospitals

a. Sterile Manufacture

Large and small volume parenterals; facilities, requirements, layout, production planning, manpower requirements

b. Non-sterile manufacture.

Liquid orals, external bulk concentrates

10. Nomenclature and uses of surgical instruments, hospital equipments and health accessories

**Part II - Clinical Pharmacy and Drug Interactions**

11. Introduction to clinical pharmacy practice

Definition and scope

Common daily terminology used in the practice of medicine

12. Functioning and working of clinical pharmacy unit; manpower requirements

13. Methodology and techniques of Analysis of drug contents and their metabolites in blood and other biological fluids and to correlate the therapeutic efficacy with drug concentrations in biological fluids

14. Biological half life; pKa values, pH-partition coefficient and stability with reference to clinical applications

15. Pharmacists and patient counseling including specific examples

16. Drug interactions

a. Definition and Introduction

Mechanism of drug interactions

b. Drug - Drug Interactions with reference to Analgesics, Diuretics, Cardiovascular drugs, Gastrointestinal agents, Vitamins and Hypoglycemic drugs

17. Adverse drug reactions

a. Definition and significance

b. Drug Induced disease and teratogenicity

18. Drugs in clinical toxicity:

Introduction, general treatment of poisoning, systemic antidotes, Treatment of poisoning due to insecticides, heavy metals, narcotics, barbiturates, organophosphorous compounds

19. Drug dependence, Drug abuse, addictive drugs and their treatment, complications

**PRACTICAL**

1. Laboratory testing for drugs and their metabolites in Urine/Blood

2. Preparation of parenterals products by the following methods

Asceptic technique, involving sterilization by filtration Involving terminal steam sterilization

3. Demonstration of some common surgical instruments, hospital equipments and health accessories

4. Common daily terminology used in the practice of medicine

5. Monograph on drug interactions (at least one monograph for each student)

6. Sterilization of following classes of products

a. All glass syringes, with metallic needles

b. Surgical dressings

c. Surgical Equipments

d. Surgeon's Gloves (Rubber)

e. Ointment bases (Petroleum based)

f. Powders (Starch, talcum)

Any other experiment illustrative of theory

**PHARMACEUTICS-VII : FORENSIC PHARMACY AND ETHICS**

**1. Historical Background:**

Drug legislation in India, Code of Ethics for Pharmacists

## 2. Drug Laws:

(A detailed study : Case study (actual/simulated) inclusive of recent amendments)

- a. Prevention of cruelty of animals act
- b. Pharmacy Act 1948
- c. Drugs and cosmetic Act 1940, Rules 1945
- d. Narcotic Drugs and Psychotropic substance Act, and Rules thereunder
- e. Drugs and Magic Remedies (Objectionable Advertisements) Act 1954
- f. Medicinal and Toilet Preparations (Excise Duties) Act 1955, Rules 1976
- g. Poison Act
- h. Factory Act
- i. Delhi shops and Establishment Act
- j. Medical termination of pregnancy Act
- k. The Drug (price control) order
1. The Insecticide Act

## Drug Store Management:

Organization of Drug store, location and layout, Inventory and stock control and retail, (Purchasing, receiving, inspection and issue of materials).

Storage of materials (Non-parenterals, Parenterals), Stock control, Records, Accounting, Computer utilization in Pharmacy Practice. Pricing policy : (basis for prices, Documentation, Methods - percentage mark up method, Dispensing Fee method, Per Diem charge method, Combination and Modifications of standard methods etc.)

## PHARMACEUTICS-VIII : FORMULATIVE PHARMACY AND COSMETICOLOGY

### 1. Preformulation studies:

Physical Properties - Polymorphism, solubility, Rheology, Salt formation and partitioning

Effects.

Chemical Properties - Hydrolytic degradation, oxidation, Drug substance - Excipient interaction, other changes

Biologic and Pharmacologic - Properties of dosage forms

### 2. Monophasic and Biphasic dosage forms

Interfacial Phenomena, forces and energetic in disperse phases. Industrial formulation

of Emulsion and suspension preparations

### 3. Blood Products

Classification and preparation on large scale, preparation of plasma expanders, preservation and storage of blood products, official in I.P.

### 4. Radio Pharmaceuticals:

Radioactivity, production of Radionuclides, Radiation hazards, Radiological safety, Medical applications of Radiopharmaceutical

### 5. Raw materials used for Cosmetic preparations:

Surfactants, Humectants, Cream bases, Aerosol propellants, perfumes, colors

### 6. Hair care products

Introduction, hair structure, shampoos, conditioners, styling aids, setting lotion, hair creams, bleaches and hair dyes.

### 7. Skin care products :

Introduction, anatomy and physiology of skin, formulation of skin cleaners, moisturizers, sun screen products, acne products.

### 8. Color cosmetics:

Introduction, lip colors, nail polish, face make up, eye make up.

### 9. Dental products:

Dentrifrices, oral rinses, tooth powder, tooth paste.

### 10. Personal hygiene products:

Toilet soaps, shaving soaps, antiperspirants , deodorants.



**PRACTICAL**

1. Preparation and quality control of
  - a) Cold cream
  - b) Vanishing cream
  - c) Cleansing lotion and cream
  - d) Moisturizing cream
  - e) Skin tonics
  - f) Hair creams for hair conditioning
  - g) Shampoos
  - h) Hair colorants
  - i) Depilatory
  - j) Shaving creams and sticks
  - k) Tooth powders
  - l) Tooth pastes
  - m) After shave lotions and other cosmetics
2. Experiments to illustrate comparative study of suspending agents, emulsifying agents, antioxidants and preservatives

**PHARMACEUTICAL CHEMISTRY-V, PHARMACEUTICAL ANALYSIS II  
(PHYSICAL CHEMISTRY & PRINCIPLES OF INSTRUMENTAL ANALYSIS)**

**SECTION- A**

1. Ionisation and ionic equilibria: Arrhenius theory, degree of ionisation and Ostwald dilution law, common ion effect, buffer solutions and preparation of pharmaceutical buffer solution, approximate calculation of buffer capacity excluding the derivation of Vanslykes equation of buffer capacity, buffers in pharmaceutical and biological systems, solubility products.
2. Hydrogen ion concentration, determination of pH values (potentiometric and colorimetric), indicators, sulphonaphthalein indicators, screened indicators, natural colouring matters, theories of indicators.
3. Solutions: Lowering of vapour pressure and Raoult's Law, osmosis and osmotic pressure, measurement of osmotic pressure, isotonic solutions, pharmaceutical applications of osmosis, theories of semipermeable membranes, colligative properties, elevation of boiling point and its experimental determination, depression of freezing point and its determination, distribution law and solvent extraction method, electrolyte and non electrolytes, Debye-Huckel theory, ionic equilibria in blood, characterization of acid base functional groups.
4. Catalysis. Homogeneous and heterogeneous catalysis, acid base catalysis, theories of catalysis, poisoning and applications of catalysis.
5. Chemical kinetics: Order and molecularity of a reaction, examples of 1st and 2nd order of reaction, method of determining order of a reaction.
6. Thermodynamics: First law of thermodynamics, work done in expansion of gases, internal energy, enthalpy, heat capacity.

**SECTION B**

7. Potentiometric analysis: Potentials of galvanic cells, potentiometric acid- base titrations potentiometric pH determination, precipitation and complex formation, oxidation-reduction titrations, applications in pharmacy.
8. Conductometric analysis. Definitions of units in conductometric titrations. determination of water analysis of salt solutions, measurement of conductance, high frequency (oscillometric) method, applications.
9. Aquametry: Brief account of aquametry, physical methods for water determination in brief, thermal methods, azeotropic distillation, refractive index, spectrophotometric method, gas chromatography, electrochemical methods, chemical methods of water determination, Kari Fischer's method of moisture determination, other chemical methods involving the use of organic and inorganic reagents.
10. Spectrofluorimetry: Fluorescence, spectrofluorimetry and analytical factors.
11. Principles of turbidimetry.
12. Polarimetry: Its principles and applications; polarization types of molecule analysed; optical rotation; effects of concentration, wavelength, solvent, temperature on optical rotation; polarimeter, light source, sample cells.

**PRACTICAL**

Experiments based on surface tension, viscosity, partition coefficient, kinetics, solubility product, critical solution temperature. Exercises involving polarimetry, refractometry and pH-determination.

**PHARMACEUTICAL CHEMISTRY VI (MEDICINAL CHEMISTRY-1)**

1. Principles of medicinal chemistry including drug absorption, distribution and elimination, physico chemical and steric aspects and drug receptor interaction and rational drug design, drug metabolism.

2. The following topics shall be treated covering outline of synthetic procedures (of selected drugs), uses, structure activity relationship including physicochemical and steric aspects and mode of action.

Adrenergic hormones and drugs, cholinergic and anticholinesterases, antispasmodic agents, anticonvulsant, psychopharmacological agents; antipsychotic agents, antidepressants, and anti-anxiety agents; uricosurics (antigout), muscle relaxants, histamine and antihistamines, antiparkinsonism drugs, diuretics, non-steroidal anti-inflammatory agents, hypoglycemic agents, hallucinogens, diagnostic agents, expectorant and antitussives.

#### **PRACTICAL**

Synthesis of compounds of medicinal interest including synthesis involving two steps and synthesis of heterocyclic compounds.

#### **PHARMACEUTICAL CHEMISTRY VII (NATURAL PRODUCTS)**

1. General methods of isolation of natural products, belonging to different groups.

2. An account of the chemistry of mono, di- and polysaccharides: arabinose, mannose, glucose, fructose, sucrose, maltose, lactose, cellulose, starch, glycogen and dextran. Study of the naturally occurring glycosides (excluding cardiac glycosides) Indican, ruberythric acid, amygdalin, salicin, sinigrin, arbutin and methyl arbutin.

3. Proteins and amino acids.. Classification, general methods of preparation and properties of amino acids, general nature of proteins, classification of proteins, C-terminal and N-terminal amino acid determination. Structural features of DNA and RNA (excluding three dimensional structure).

4. Terpenoids.. Classification, isolation and structure determination of some important terpenoids: Limonene, pinene, cineole, menthol, menthone, camphor, thymol & citral.

5. Alkaloids: Isolation, general methods of determination of structure, estimation of functional groups, structure elucidation and syntheses of some selected simple members, ephedrine, nicotine, atropine, cocaine, quinine, cinchonine, papaverine, morphine, reserpine, ergotamine.

6. Xanthine bases: Isolation, structure determination and synthesis of Caffeine, theophylline and theobromine.

7. Study of the chemistry of lipids (fats, oils and waxes); phospholipids.

8. Chemistry of flavones and isoflavones (Preliminary studies).

#### **PRACTICAL**

1. Analysis of fixed oils:, determination of acid value, saponification value and iodine value.

2. Isolation of a few naturally occurring compounds such as caffeine, from tea leaves.

3. Estimation of following organic groups: hydroxyl (alcoholic and phenolic), aldehyde, amino & carboxylic groups.

#### **PHARMACOGNOSY-III**

Study of volatile oil containing following drugs with regard to the nature occurrence, chemistry and biogenesis. Pharmacognostic study of drugs underlined.

1. Hydrocarbons: Pepper, , turpentine. 2. Alcohol: Mentha, Coriander , Cardamom. 3. Aldehyde: Cinnamon, Cassia, Lemon Peel, Lemon grass, Citronella, Cumin. 4. Ketone: Caraway, Dill, Spearmint. 5. Phenol: e1Qy-c 6. Phenolic ethers: Anise, Star Anise, Fennel, Nutmeg. 7. Oxides: Eucalyptus, Chenopodium.

2. Commercial production, export potential and world trade in oil of mentha, Eucalyptus oil and oleoresins from pinus species and lemon grass oil.

3. Nature, occurrence, chemistry, collection and preparation of drugs containing. 1. Balsams : (Tolu balsam; Peru balsam, Benzoin). 2. Acid resins: (Colophony). 3. Gum resin: Myrrh, Asafoetida . 4. Resins; Colocynth, Ginger, Turmeric, Capsicum, Cannabis, podophyllum (Pharmacognostic study of drugs underlined).

4. Biological source, preparation and uses of the following enzymes: Diastase, papain, Maltase, Bromelain, ficin.

5. Quantitative microscopy.

6. Factors affecting drug constituents.

7. Drug adulteration.

#### **PRACTICAL**

1. Identification through morphological, sensory and chemical characteristics of drugs included in 1 and 3.

2. Chemical evaluation of oil of Mentha, lemon grass oil, Clove oil.

3. Quantitative microscopy of leafy drugs.

4. Field collection of medicinal and aromatic plants and preparation of herbarium sheets

Monograph on one of the plants collected during Pharmacognosy tour.

#### **PHARMACOLOGY-II (THEORY).**

##### **I. DRUGS ACTING ON CENTRAL NERVOUS SYSTEM**

1. Synaptic transmission in the CNS

2. General anaesthetics, Dissociative and neurolept- anaesthesia

3. Hypnotics and sedatives
4. Alcohol
5. Antiepileptics
6. Psychopharmacological agents
7. Antiparkinsonian drugs
8. Non-steroidal analgesics, anti-inflammatory and anti-pyretic agents, drugs used in gout
9. Narcotic analgesics, opioid poisoning and treatment
10. Drug abuse and drug addiction
11. CNS stimulants
11. Local anesthetics

#### **II. DRUGS ACTING ON CARDIOVASCULAR SYSTEM**

1. Cardiac glycosides and positive inotropic agents
2. Antiarrhythmic drugs
3. Antihypertensive drugs
4. Coronary vasodilators and Drugs used in Angina
5. Hypolipidemic drugs
6. Fibrinolytic agents

#### **III. DRUGS ACTING ON THE BLOOD AND BLOOD FORMING AGENTS**

1. Coagulants
2. Anticoagulants
3. Haematinics (iron, vitamin B<sub>2</sub> and Folic acid)
4. Plasma expanders

#### **IV. DIURETICS**

#### **V. DRUGS ACTING ON GASTROINTESTINAL SYSTEM**

Purgatives

Antidiarrhoeal drugs

Antacids and treatment of peptic ulcers

Emetics and anti emetics

Digestants and drugs used for dissolution of gallstones.

#### **VI. DRUGS ACTING ON RESPIRATORY SYSTEM**

Expectorant

Antitussive bronchodilators

Drugs used in common cold

#### **PRACTICAL**

Stages of chloroform and ether anesthesia with and without premedication

Study of phenobarbitone induced hypnosis (Demonstration)

Determination of analgesic activity (codeine/aspirin)

Study of anticonvulsant

Study of local anesthetic activity

Surface anesthesia on activity rabbits

Infiltration anesthesia using guinea pigs

Nerve block anesthesia

Study of drugs on perfused frog heart

Study of drugs on isolated frog heart

Identification of unknown drugs using frog heart

Study of effect of purgative in frog/mice/rat.

Study of drugs on blood vessels (frog)

Effect of drug on ciliary movements

**BIO CHEMISTRY (THEORY)****I. ENZYMES**

1. Classification of enzymes

General mechanisms of enzyme action

Factors affecting the velocity of enzyme catalysed reaction

Activators and inactivators of enzymatic reactions

Application of metabolic antagonism

**II. BIOLOGICAL OXIDATIONS**

1. Oxidation-reduction chains in nature

2. Oxidative Phosphorylation

**III. METABOLISM OF CARBOHYDRATE**

Anaerobic metabolism of Glucose

Aerobic metabolism (Kreb's cycle)

HMP pathway

Regulation of blood glucose concentration

Glycogenesis

Glycogenolysis

Gluconeogenesis

**IV. METABOLISM OF LIPIDS**

1. Fatty acid metabolism

2. Oxidation of fatty acids

3. Biosynthesis of fatty acids

4. Synthesis and degradation of Triglycerides

5. Hormonal influence on the mobilisation of fat in adipose tissue

6. Ketosis

**V. METABOLISM OF PROTEINS**

Amino acid degradation and U" cycle

Metabolism of tyrosine and Tryptophan

**VI. PROTEIN SYNTHESIS**

1. Transmission and expression of genetic information

2. DNA genetic role

3. DNA Structure and replication

4. RNA and transcription

5. Gene-protein relationship

6. Control of Protein Synthesis

**VII. METABOLISM OF NUCLEIC ACIDS**

Metabolism of purines and Pyrimidines

**VIII. METABOLISM OF INORGANIC ELEMENTS**

Calcium, Phosphorous, magnesium, Trace elements

**IX. BASIC PRINCIPLES OF MOLECULAR BIOLOGY****PRACTICAL**

1. Estimation of glucose in blood

2. Estimation of Liver glycogen

3. Estimation of protein in Serum

4. Determination of Creatinine and Creatine in blood and Urine

5. Estimation of Chloride in Serum and Urine

6. Estimation of free fatty acids in Serum

7. Estimation of Uric acid in Serum and Urine
8. Determination of acid and alkaline phosphate
9. Determination of SGOT and SGPT
10. Determination of blood Cholesterol
11. Estimation of RNA and DNA
12. Determination of Serum bilirubin
13. Electrophoretic separation of serum proteins
14. Fat determination in milk

**YEAR-IV  
PHARMACEUTICAL BIOTECHNOLOGY (THEORY)**

Brief introduction to biotechnology with reference to Pharmaceutical sciences

Genetic Engineering : Structure, function and properties of genetic material. Basic principles of genetic engineering, DNA recombination, Application in medicine.

Enzyme and cell immobilization method for immobilization, Applications.

Plant biotechnology : Natural plant products, their uses, plant cell. Cultures for the production of useful chemicals, plant tissue culture, protoplast fusion, totipotency, direct gene transfer.

Medical technology : Blood products, Immunoglobulins by hybridoma technology, synthesis of monoclonal antibody, biopolymers, derivative of biopolymers and their application in medicine.

**PHARMACEUTICS-IX: PHARMACEUTICAL MANAGEMENT**

**1. Personnel Management and Industrial Relations:**

Objectives and functions of personnel department, Employment and development of personnel. Industrial Relations: Problems of labour management relations, courses of Industrial disputes, Remedies, Industrial Dispute Act, Trade Union, Grievance and Grievance Handling procedure, Causes of grievances, Need for grievance procedure, Grievance redressal machinery

**2. Motivation:**

Objectives, Rules of Motivation, Motivation steps, Types of motivation, Non-financial motivators, Theories of motivation: McGregor's Theory X and Y, Herzberg's Time factor theory, McClelland's Need for Achievement theory Vroom's Expectancy theory, Behavioural theory, Employee- Centred approach

**3. Communication:**

Importance, Nature of communication, oral vs. written Media of Communication, Barriers to communication, Communication failure, Achieving effective communication

**4. Purchasing and Store Keeping.**

Objectives, Organisation and responsibilities of purchasing department, methods of purchasing, Centralised and Decentralised purchasing

Types of stores Depot, Location and Layout of a store, problems and Development

**5. Materials management.**

Materials handling, Equipment, Inventory management, Economic ordering quantity, ABC analysis, Value analysis, classification and codification of stores, obsolete, surplus and scrap management, lead time, inventory carrying costs, safety stock, solutions to problems relating to EOQ.

**6. Drug Supply:**

Planning and management, supply process and its pitfalls, planning for drug supply, planning models, steps to develop a formulary, predicting drug requirements, procurement cycle and its methods, designing training programs to improve pharmaceutical logistics

**7. Pharmaceutical Marketing..**

Goals, theories of selling process, company market, systems, market and sale forecasting, market test method, statistical Demand analysis, Types of sales organizations, Salesmanship, Qualification of a salesman, Channels of Distribution Advertising, Presentation and analysis of statistical data. (Charts, frequency distribution)

**8. Establishment of a pharmaceutical factory:**

Choice of site, trends in location of a plant, plant facilities, layout of stores in an industry, layout of Injectable unit or sterile area, tableting department and area requirement for each department

**PHARMACEUTICS-X: BIOPHARMACEUTICS AND PHARMACOKINETICS**

**A. Biopharmaceutics:**

1. Introduction to biopharmaceutics, definition, historical development of the subject, Fundamental principles and concepts. Definitions and explanation of the various terms connected with the study of biopharmaceutics like Bioavailability, Bioequivalence and chemical equivalence, therapeutic equivalence etc.

## 2. Drug Absorption:

Various mechanisms, physico-chemical factors affecting drug absorption, biological factors in drug absorption, dosage form considerations in gastro-intestinal absorption

Number of lectures 5

## 3. Drug disposition:

Distribution in blood, plasma-protein binding, cellular distribution, drug penetration to cell, drug excretion renal, biliary, salivary and biotransformation

## 4. Bioavailability:

Concept of bioavailability and comparative bioavailability Methods of estimation of bioavailability using blood level and urinary excretion data.

## B. Pharmacokinetics:

1 Introduction to pharmacokinetics, importance in bioavailability and clinical practice and concepts. Definition and explanation of terminologies used.

2 Absorption, distribution, metabolism and excretion of drugs. Biological half-life, apparent volume of distribution. Fluid compartments and circulatory system

3 Compartments models- concepts and their importance in the study of pharmacokinetics. One compartment open model. Determination of drug /metabolite levels on administration of single and multiple dose in plasma and urine after i.v. injection. Oral administration and first order absorption. Percent absorbed time plot and absorption rates based on one compartment model.

4 Two compartments open model, pharmacokinetics of single and multiple dose administration as applied to intravenous (rapid) and oral administration, intravenous transformation.

5 Pharmacokinetic basis of sustained release formulations.

## PRACTICAL

1. Establishment of standard curve of a drug substance.

2. Disintegration and Dissolution of peroral tablets.

3. Influence of vehicle on drug availability from topical dosage forms in-vitro.

4. Release of drug from suppository base.

5. Evaluation of antacid products, by acid neutralizing capacity and Rosset-Rice test methods.

6. Comparative in-vitro release rate studies of marketed formulations.

7. Determination of bioavailability of marketed formulations by plasma concentration method.

8. Determination of bioavailability of marketed formulations by urinary excretion method.

9. Drug release from capsules, effect of diluents etc.

10. Effect of protein binding by egg albumin; dialysis method.

11. Determination of pharmacokinetic parameters and determination and evaluation of bioavailability of drug administered by IV, IM and P.O.

12. Practice numericals based on the portions covered under theory syllabus.

## PHARMACEUTICS-XI: PHARMACEUTICAL TECHNOLOGY

## 1. Mixing :

Fluid mixing, mechanism and types of flow, equipments.

Solids mixing, mixing mechanism, equipment.

## 2. Capsules :

Hard gelatin capsules; formulation of shell and contents, capsule production, filling operation and equipment employed.

Soft gelatin capsules : Manufacture, processing and quality control.

## 3. Microencapsulation :

Importance and application, techniques, equipment employed.

## 4. Tablets :

Production of tablets, additives and components, preparation of components for compression, forms of compressed tablets, evaluation.

Tablet coating.

Sugar coating, film coating, Air suspension coating, film defects

## 5. Measurement of tablet punch forces:

Transmission of forces through a powder. Distribution of forces within the powder mass, Effect of pressure on the relative volume, Adhesion and cohesion of particles strength of granules and tablets. Factors affecting the strength of tablets.

## 6. .Pharmaceutical aerosols:

Components, formulation, types of systems, manufacturing, operation of an aerosol package, quality control and testing, oral, Inhalation, Nasal and topical Aerosols, Future developments.

## 7. Controlled drug delivery system :

Introduction, Terminology, Drug Targeting, Design and Fabrication of oral controlled release drug delivery system. Introduction to implantable and transdermal Therapeutic system

## 8. Sustained action dosage form:

Drug replacement rate, unit drug dose, mechanisms, formulation and manufacture of sustained action dosage form.

## 9. Packaging technology:

Types of containers; materials used, closures,. unit dose packaging, strip packaging materials, packaging of solid, parenterals, and ophthalmic dosage forms

## 10. Good manufacturing practices for pharmaceuticals:

Status and applicability of regulation, current good manufacturing practices in manufacturing, processing, packaging & holding of drugs, production and process controls, ISO 9000 certification.

## PRACTICAL

## 1 Preparation of tablets by the following techniques

a. Wet granulation (Aqueous)

b. Wet granulation (non-aqueous)

c. Dry granulation (Slugging)

## 2. Coating of tablets - sugar coating and film coating

## 3 Strip packing of tablets

## 4. Quality control of tablets

## 5. Filling and sealing of hard capsules

## 6. Quality control of capsules

## 7. Preparation of sustained release dosage forms employing various techniques

## 8. Preparation of an aerosol dosage form and its evaluation

## 9. Preparation of microcapsules by employing various tech.

## 10. Any other experiments illustrative of the theory of syllabus

## PHARMACEUTICAL CHEMISTRY-VIII (PHARMACEUTICAL ANALYSIS III)

1. Chromatography: Fundamental principles of chromatography, adsorption, partition, column, paper, thin-layer chromatography, gas chromatography, electrophoresis high performance liquid chromatography. Instrumentation with particular reference to quantitative estimation of drugs and biopharmaceutical agents. Theory of ion exchange, type of exchangers, ion-exchange equilibria, ion-exchange separation, applications in pharmaceutical analysis.

2. Visible and ultraviolet absorption spectrophotometry: Principles of visual and UV absorption spectrophotometry, qualitative and quantitative analysis, Instrumentation.

3. Nuclear Magnetic Resonance: An introduction to the theory of NMR, chemical shifts, spin spin coupling, NMR instrumentation, structure elucidation and qualitative analysis of drugs.

4. Infrared spectrophotometry: Origin of infrared spectra and regions, qualitative and quantitative analysis, instruments and applications.

5. Mass spectrometry: Basic principles, instrumentation, the mass spectra, determination of molecular formula, molecular ion peak, fragmentation, mass spectra of some simple molecules.

6. Flame photometry: Origin of spectra, atomization and ionization, instrumentation, background emission, qualitative and quantitative applications in pharmaceutical analysis.

7. Atomic absorption spectroscopy: Theory of absorption of radiant energy by atoms, equipment, analytical applications.

8. Emission spectroscopy: Theory of emission spectra, equipment, qualitative and quantitative applications.

9. Polarography: Introduction, theoretical consideration, organic polarography, dropping mercury electrode, basic principles of polarographic instruments, methods of analysis, experiments including amperometric titrations.

10. Analysis of drugs with particular reference to instrumental methods as included in Indian Pharmacopoeia.

Antibiotics: Benzylpenicillin, tetracyclin, chloramphenicol.

Vitamins: Ascorbic acid, thiamine, vitamin A,

Barbiturates: Phenobarbitone.

Sulphonamides: Sulphanilamide, Sulphadiazine.

#### PRACTICAL

1. Experiments based on thin-layer and paper chromatography.
2. Analysis of drugs by instrumental methods as included in Indian Pharmacopoeia.

#### PHARMACEUTICAL CHEMISTRY IX (MEDICINAL CHEMISTRY II)

1. Steroids: Nomenclature, stereochemistry, classification, isolation methods, chemistry (excluding synthesis) of cholesterol, diosgenin, stigmasterol, ergosterol, beta-sitosterol and steroidal alkaloids.
2. Steroids and related drugs: Androgens & anabolic agents, esterogens and progestational agents (oral contraceptives) and adrenocorticoids.
3. Cardiac glycosides, coronary dilators, hypotensive, anti-arrhythmic, antifibrillatory and antilipidemic agents.
4. The following topics shall be treated covering outline of synthetic procedures (of selected drugs), uses, structure activity relationship including physicochemical and steric aspects and mode of action: antibiotics, antimalarials, antiamoebic, drugs used for trypanosomiasis and other protozoan diseases, anthelmintics, antifungal agents, antineoplastic agents, antiviral agents (including treatment of AIDS) antitubercular drugs, medicinal dyes.
5. Chemistry of vitamins (excluding the detailed study of constitution).
6. Prostaglandins

#### PRACTICAL

Two or three step synthesis of some compounds of medicinal interest.

#### PHARMACOGNOSY-IV

1. Study of drugs containing glycosides: Nature, Occurrence, Chemistry and Biogenesis.

Anthraquinone glycosides: Cascara, aloe, Rhubarb, Senna Cardiac glycosides: Digitalis, Strophanthus, Squill, Thevetia.

Bitter glycosides: Quassia.

Saponin glycosides: Dioscorea, Quillia Flavonoid glycosides: Ruta graveolens

2. Study of drugs containing alkaloids: Nature, Occurrence, Chemistry and Biosynthesis. Pyridine-piperidine alkaloids: Nicotine, areca nut. Tropane alkaloids: Belladonna, Hyoscyamus, Stramonium, Duboisia.

Quinoline alkaloids: Cinchona

Isoquinoline alkaloids: Opium, Ipecac

Indole alkaloids: Nux-vomica, Ergot, Rauwolfia, Catharanthus.

Steroidal alkaloids: Kurchi, Solanum

Alkaloidal Amines: Ephedra, Colchicum.

3. Botanical source, history, clinical uses, chemical, constituents, authentication and standardization of traditional drugs such as Tylophora indica, Tribulus terrestris, Allium sativum, Achyranthus aspera, Centella asiatica, Boerhaavia diffusa, Phyllanthus embellica, Azadirachta indica, Ocimum sanctum, Commiphora mukul, Swertia chirata, Withania somnifera.
4. Study of general aspects of plant tissue culture techniques and their contribution to phytopharmaceuticals. Plant growth regulators.
5. Processes of plant extraction and chromatographic techniques as applicable to phytopharmaceuticals.
6. World wide trade, commercial potential and demand of crude drugs with reference to phytochemical industry in India.

#### PRACTICAL

1. Identification of drugs in 1,2 and 3 based on morphological and sensory characters.
2. Microscopy of drugs underlined in 1 and 2 and chemical tests wherever applicable.
3. Extraction and preparation of T.L.C. profile of some volatile oil containing drugs.
4. Preparation of T.L.C. profile of alkaloidal extracts of Datura, Nux-vomica, Rauwolfia. and Cinchona.
5. Extraction of piperine from Piper nigrum, total alkaloids of Cinchona (Gravimetric method) and Sennosides from Senna.
6. Project work.

#### PHARMACOLOGY-III (THEORY)

##### I. CHEMOTHERAPY

General principles of chemotherapy

Sulfonamides, Quinolones and other chemotherapeutic agents

Antiprotozoal drugs



Antimalarials

Antiamoebics

Antifungal and antiviral drugs

Anti-helmintics

Chemotherapy of Tuberculosis and leprosy

Chemotherapy of cancer

immunomodulators

## II. PHARMACOLOGY OF ENDOCRINE SYSTEM

1. Pituitary hormones

2. Thyroid - antithyroid drugs

3. Insulin, oral hypoglycemics and glucagon

4. Adrenocortical steroids and their antagonists

5. Sex hormones, contraceptives and drugs used in infertility

6. Drugs regulating calcium homeostasis

## III. BIOASSAYS

1. General principles and methods of Bioassays

2. Official methods of bioassay :

Insulin, Heparin, Oxytocin, d-tubocurarin, Vasopressin, Digitalis, ACTH Glucagon, Gonadotrophin

## IV. EVALUATION OF NEW DRUGS

1. Acute, subacute and chronic toxicity tests

2. Teratogenicity & Carcinogenicity

3 Clinical trials

## V. VITAMINS

### PRACTICAL

Bio-assay of following by using appropriate isolated tissue preparation Acetylcholine, histamine, adrenaline, Oxytocin.

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