SYLLABUS

BACHELOR OF PHARMACY
(B.PHARM.)
1\textsuperscript{St} Year and 2\textsuperscript{nd} Year
(Effective from Session 2013-2014)
### SEMESTER-I

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CA = Class Attendance, TA = Teacher Assessment.
## SEMESTER-II

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**THEORY**

1. **BOP-121**  
   Pharmaceutical Chemistry-II  
   (Organic Pharmaceutical Chemistry)  
   Periods: L = 3, P = 0  
   Sessions: 5, 5  
   Exam: 20  
   Total: 30  
   Credit: 4

2. **BOP-122**  
   Pharmaceutical Chemistry-III  
   (Pharmaceutical Physical Chemistry)  
   Periods: L = 3, P = 0  
   Sessions: 5, 5  
   Exam: 20  
   Total: 30  
   Credit: 4

3. **BOP-123**  
   Anatomy, Physiology and Pathophysiology-II  
   Periods: L = 3, P = 0  
   Sessions: 5, 5  
   Exam: 20  
   Total: 30  
   Credit: 4

4. **BOP-124**  
   Pharmacognosy-I  
   Periods: L = 3, P = 0  
   Sessions: 5, 5  
   Exam: 20  
   Total: 30  
   Credit: 4

5. **BOP-125**  
   Pharmaceutical Biostatistics  
   Periods: L = 3, P = 0  
   Sessions: 5, 5  
   Exam: 20  
   Total: 30  
   Credit: 4

**PRACTICAL/PROJECT**

6. **BOP-121P**  
   Pharmaceutical Chemistry-II (Organic Pharmaceutical Chemistry) Practical  
   Periods: L = 0, P = 4  
   Sessions: -  
   Exam: 30  
   Total: 70  
   Credit: 4

7. **BOP-122P**  
   Pharmaceutical Chemistry-III (Pharmaceutical Physical Chemistry) Practical  
   Periods: L = 0, P = 4  
   Sessions: -  
   Exam: 30  
   Total: 70  
   Credit: 4

8. **BOP-123P**  
   Anatomy, Physiology and Pathophysiology-II Practical  
   Periods: L = 0, P = 4  
   Sessions: -  
   Exam: 30  
   Total: 70  
   Credit: 4

9. **BOP-124P**  
   Pharmacognosy-I Practical  
   Periods: L = 0, P = 4  
   Sessions: -  
   Exam: 30  
   Total: 70  
   Credit: 4

10. **BOP-125P**  
    Pharmaceutical Biostatistics Project  
    Periods: L = 0, P = 2  
    Sessions: -  
    Exam: 30  
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### SEMESTER-III

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AUC-001/AUC-002 **Human Value & Professional Ethics/Cyber Security**

**Human values & Professional Ethics/Cyber Security will be offered as a compulsory audit course for which passing marks are 30% in End Semester Examination and 40% in aggregate.**
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*Human values & Professional Ethics / Cyber Security will be offered as a compulsory audit course for which passing marks are 30% in End Semester Examination and 40% in aggregate.
An outline of methods of preparation, tests of identification and special tests (if any), of the individually mentioned inorganic pharmaceuticals.

**Unit I**
Sources of impurities & their control. Limit tests for iron, arsenic, lead, heavy metals, chloride and sulphate.

**Pharmaceutical aids and necessities:** Pharmaceutically acceptable glass. Water (Purified water, Water for injection, Sterile water for injection). Acids and bases (Sodium hydroxide, Phosphoric acid).

**Unit II**
**Topical agents:** Protectives (Calamine, Titanium dioxide, Talc, Kaolin). Astringents (Zinc sulphate, Alums). Anti-infectives (Boric acid, Hydrogen peroxide, Iodine, Povidone-Iodine, Potassium permanganate, Silver nitrate).

**Dental products:** Dentifrices, anti-caries agents (Sodium fluoride).

**Gases and vapors:** Inhalants (Oxygen), anesthetics (Nitrous oxide).

**Unit III**
**Gastrointestinal agents:** Acidifying agents (Dilute hydrochloric acid). Antacids (Bismuth subcarbonate, Aluminium hydroxide, Calcium carbonate, Magnesium hydroxide, Magnesium oxide{ light and heavy}, Magnesium carbonate{ light and heavy}, Combination antacids. Cathartics (Disodium hydrogen phosphate, Magnesium sulphate). Protective and Adsorbents (Activated charcoal, Aluminium sulphate).

**Miscellaneous agents:** Expectorants (Ammonium chloride, Potassium iodide). Antioxidants (Sodium metabisulphite).

**Unit IV**
**Major intra and extracellular electrolytes:** Physiological ions, electrolytes used for replacement therapy (Sodium chloride, Potassium chloride, Calcium gluconate, Calcium lactate, Magnesium chloride), physiological acid-base balance (Sodium dihydrogen phosphate, Sodium acetate, Sodium bicarbonate), combination therapy including ORS.
**Essential and trace elements:** Iron and haematinics (Ferrous fumarate, Ferrous gluconate, Ferrous sulphate, Ferric ammonium citrate). Mineral supplements (Cu, Zn, Cr, Mn, I).

**Unit V**

**Inorganic radiopharmaceuticals:** Radioactivity, units of radioactivity and radiation dosimetry, measurement of radioactivity, hazards and precautions in handling of radiopharmaceuticals, clinical applications of radiopharmaceuticals.

**Co-ordination compounds and complexation:** Co-ordination theory, chelates and their pharmaceutical importance, poison antidotes (Sodium thiosulphate), novel applications of metals in pharmacy.
Suggested Practicals

1. To perform limit test of chloride, sulphate, iron, heavy metal and arsenic in the given sample. Identification tests for acidic and basic radicals.

2. Preparation of following compounds:
   - Boric acid
   - Magnesium sulphate
   - Heavy magnesium carbonate
   - Calcium Carbonate
   - Alum
   - Zinc sulphate.

BOOKS RECOMMENDED:

3. Atherden L.M., Bentley and Driver’s Text Book of Pharmaceutical Chemistry, Oxford University Press.
5. Svehla, G. and Sivasankar, B. Vogel's Qualitative Inorganic Analysis, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
**BOP-112**

**PHARMACEUTICS-I (GENERAL PHARMACY)**

**Unit I**

**History of pharmacy and Pharmacopoeia:** Origin & development of pharmacy, scope of pharmacy, introduction to Pharmacopoeias - IP, BP, USP & International Pharmacopoeia. Introduction to National Formularies and Extra Pharmacopoeia. Typical parts of a monograph of Indian pharmacopoeia. An introduction to contents of the IP.

**Unit II**

**Prescription:** Definition, types of prescription, handling of prescription, legality of prescription and specific Latin terms used in modern day prescription (sos, od, bd, tid, qid)

**Pharmaceutical additives:** Coloring, flavoring & sweetening agents, co-solvents, preservatives and their applications.

**Unit III**

**Pharmaceutical calculations:** Posology, calculation of doses for infants; Enlarging and reducing recipes, percentage solutions, alligation method, alcohol dilution, proof spirit, basic concept of isotonicity. Weights and measures, weighing of solids and measurement of liquids.

**Unit IV**

**Introduction to Pharmaceutical dosage forms:** Classification, formulation methods of powders, mixtures and syrups and elixirs.

**Definitions:** Solutions, spirits, infusions, paints, elixirs, mouth washes, gargles, lotions, liniments, pastes, ointments, creams, inhalations, dusting powders and lozenges.

**Unit V**

**Size Reduction:** Definition, principles and laws governing size reduction, factors affecting size reduction. Study of hammer mill, ball mill and fluid energy mill. Introduction to sieving methods, laws and factors affecting energy requirements for size reduction, different methods of size reduction.

**Mixing:** Theory of mixing, solid-solid, solid-liquid & liquid-liquid mixing equipments.
BOP-112P

PHARMACEUTICS-I (GENERAL PHARMACY) PRACTICAL

Suggested Practicals

I: Preparation of following classes of Pharmaceutical dosage forms (involving the use of calculations in metrology) as official in IP, BP, USP/NF.

a) Aromatic Waters
   1. Chloroform Water BP
   2. Concentrated Peppermint Water BP
   3. Rose Water NF

b) Mixtures
   1. Chalk Mixture, Paediatric BP
   2. Light Magnesium Carbonate and Kaolin Mixture

c) Syrups
   1. Simple Syrup BP/USP/IP
   2. Ferrous Sulphate Syrup USP

d) Powders
   1. ORS Powder IP
   2. Absorbable Dusting Powder USP/N
   3. Effervescent Compound Powder (BPC)

II. Study of the role of pharmaceutical additives in formulations

a. Colouring agent: 1. Compound Sodium Chloride Mouthwash BP
   2. Phenol Gargle BPC

b. Flavouring agent: 1. Orange Tincture IP
   2. Potassium Citrate Mixture BP

c. Sweetening agents: 1. Simple Elixir IP

d. Cosolvents: 1. Camphor Water IP
   2. Compound Iodine Throat Paint IP(Mandl’s Paint)
e. Preservatives:  
1. Zinc Sulphate and Zinc Chloride Mouthwash BPC 
2. Calamine Lotion 

f. Surfactants:  
1. Cresol with Soap Solution IP 
2. Turpentine Liniment BP 

III: Experiments to illustrate principles of size reduction using Ball Mill.  
Effect of size of balls, number of balls and time on the efficiency of ball mill. 

IV: Experiments to illustrate mixing efficiency. Solid-Solid mixing. 

BOOKS RECOMMENDED: 
10. Jain N.K., Modern Dispensing Pharmacy, 2nd Ed.
ANATOMY, PHYSIOLOGY & PATHOPHYSIOLOGY- I

Unit I
Introduction to human body and organization of human body.
Functional and structural characteristics of cell.
Detailed structure of cell membrane and physiology of transport process.
Structural and functional characteristics of tissues- epithelial, connective, muscle and nerve.

Unit II
Muscular system: Anatomy & physiology of skeletal and smooth muscle, energy metabolism, types of muscle contraction, muscle tone.

Unit III
Demography and family planning, medical termination of pregnancy.
First aid: Emergency treatment of shock, snake bites, burns, poisoning, fractures and resuscitation methods

Unit IV
Sense organs: Basic anatomy and physiology of the eye (vision), ear (hearing), taste buds, nose (smell), and skin (superficial receptors).

Unit V
Communicable diseases: Brief outline, their causative agents, modes of transmission and prevention (Chicken pox, measles, influenza, diphtheria, whooping cough, tuberculosis, poliomyelities, helminthiasis, malaria, filariasis, rabies, trachoma, tetanus, leprosy).
BOP-113P

ANATOMY, PHYSIOLOGY & PATHOPHYSIOLOGY -I PROJECT

Suggested Practicals

1. Preparation of charts/ models of the following:
   A. Joints,
   B. Sense organs (eye, ear, taste buds, skin, nose)
   C. Resuscitation methods
   D. Malaria life cycle
   E. Neurotransmission
   F. Structure of cell
   G. Transport across cell membrane
   H. Mechanism of muscle contraction
   I. Human Skeleton
   J. Structure of neuron

2. Preparation of charts/ models on selected topics from the course content.

BOOKS RECOMMENDED:

1. Marieb E.N. Human Anatomy and Physiology, Benzamin Cummings (Pearson Education Inc.).
2. Park K., Preventive and Social Medicine, Banarsidas Bhanot.
PHARMACEUTICAL ANALYSIS-I

Unit I
Significance of quantitative analysis in quality control different techniques of analysis, preliminaries and definitions, precision and accuracy. Fundamentals of volumetric analysis, methods of expressing concentration, primary and secondary standards.

Unit II
**Acid base titrations:** Acid base concepts, role of solvent, relative strengths of acids and bases, ionization, law of mass action, common-ion effect, ionic product of water, pH, hydrolysis of salts, Henderson- Hasselbach equation, buffer solution, neutralization curves, acid base indicators, theory of indicators, choice of indicators, mixed indicators, polyprotic system.

Unit III
**Oxidation reduction titrations:** Concepts of oxidation and reduction, redox reactions, strengths and equivalent weights of oxidizing and reducing agents, theory of redox titrations, redox indicators, oxidation reduction curves, iodimetry and iodometry, titrations involving ceric sulphate, potassium iodate, potassium bromate, potassium permanganate.

Unit IV
**Precipitation titrations:** Precipitation reactions, solubility products, effect of acids, temperature and solvent upon the solubility of precipitate. Argentometric titrations and titrations involving ammonium or potassium thiocyanate, mercuric nitrate indicators, Gaylussac method, Mohr’s method, Volhard’s method and Fajan’s method.

Unit V
**Gravimetric analysis:** Precipitation techniques, solubility products, the colloidal state, supersaturation, coprecipitation, post-precipitation, digestion, washing of the precipitate, filtration, filter papers and crucibles, Ignition, thermogravimetric curves, specific examples like barium as barium sulphate, aluminium as aluminium oxide, organic precipitants.
PHARMACEUTICAL ANALYSIS- I PRACTICAL

The students should be introduced to the main analytical tools through demonstration. They should have a clear understanding of a typical analytical balance, the requirements of a good balance, weights, care & use of balance, methods of weighing, and errors in weighing. The students should also be acquainted with the general apparatus requiring various analytical procedures.

1. Standardization of analytical weights and calibration of volumetric apparatus.
2. Acid Base Titrations: Preparation and standardization of acids and bases, some exercises related with determination of acids and bases separately or in mixture form, some official assay procedures, e.g. boric acid, should also be covered.
3. Oxidation Reduction Titrations: Preparation & standardization of some redox titrants e.g. potassium permanganate, potassium dichromate, iodine, sodium thiosulphate etc. Some exercises related to determinations of oxidizing & reducing agents. Exercises involving potassium iodate, potassium bromate, iodine solution and ceric ammonium sulphate.
4. Precipitation Titrations: Preparation and standardization of titrants like silver nitrate and Ammonium thiocyanate, titrations according to Mohr’s, Volhard's and Fajan’s methods.
5. Gravimetric Analysis: Preparation of Gooch crucible for filtration and use of sintered glass crucible. Determination of water of hydration, some exercise related to gravimetric analysis should be covered.

BOOKS RECOMMENDED:
6. The Pharmacopoeia of India.


**BOP-115**

**COMPUTER FUNDAMENTALS**

**Unit I**
Definition and overview of computer, computer classification, computer organization, computer code, input devices, output devices, storage devices. Computer software, types of software. overview of computer networks, LAN, MAN, WAN. Internet, network topology. Internetworking: Bridges, repeaters and routers.

**Unit II**

**Introduction:** Operating system and function, evolution of operating system, batch, interactive, time sharing and real time system. Single user operating system and multi-user operating system. Basics in MS-DOS, internal and external commands in MS-DOS.

**Unit III**
Introduction to MS-OFFICE-2007, word 2007 document creation, editing, formatting table handling, mail merge. Excel-2007, editing, working retrieval, important functions, short cut keys used in EXCEL.

**Unit IV**
MS-Power point 2007-Job Profile, elements of Power point, ways of delivering presentation, concept of Four P’s (planning, preparation, practice and presentation) ways of handling presentations e.g. creating, saving slides show controls, adding formatting, animation and multimedia effects. Database system concepts, data models schema and instance, database language. Introduction to MS-Access 2007, main components of access tables, queries, reports, forms table handling, working on query and use of database.

**Unit V**
Computer applications in pharmaceutical and clinical studies, uses of internet in pharmaceutical industry.
Suggested Practicals

Software Lab to be used for the following:-

2. MS-Office 2003 (MS Word, MS Power point, MS Excel, MS Access).
4. Internet Features (E-mail, Browser etc.).

BOOKS RECOMMENDED:

   UBS Publishers Distributors Ltd.
SECOND SEMESTER

BOP-121

PHARMACEUTICAL CHEMISTRY-II (ORGANIC PHARMACEUTICAL CHEMISTRY-I)

Unit I
Introduction, classification and nomenclature of organic compounds. Electron displacements in organic chemistry (such as; inductive effect, resonance, hyperconjugation). Reaction intermediates (such as; free radicals, carbocations, carbanions, carbenes and nitrenes). Stereochemistry including geometrical isomerism, optical isomerism, specification of configuration and conformational analysis.

Unit II
Introduction to aliphatic organic compounds and some of their characteristic reactions with mechanisms such as; alkanes (free radical substitution), alkenes, alkynes and dienes (electrophilic and free radical additions), cycloalkanes (types of strain including Baeyer strain theory), alkyl halides and alcohols (nucleophilic substitution and nucleophilic elimination), amines, aldehydes and ketones (nucleophilic addition), carboxylic acids and their derivatives.

Unit III
Introduction to aromatic organic compounds, aromaticity, structure of benzene, electrophilic and nucleophilic substitution, orientation and reactivity in electrophilic aromatic substitution, arenes, phenols. Polynuclear hydrocarbons (naphthalene, anthracene).

Unit IV
Name reactions including reaction mechanisms and synthetic applications of; Meerwein-Ponndorf-Verley reduction, Oppeneaur oxidation, Beckmann rearrangement, Hofmann rearrangement, Mannich reaction, Diels Alder reaction, Cannizzaro reaction, Aldol condensation, Benzoin condensation.

Unit V
α, β- Unsaturated carbonyl compounds. Compounds containing active methylene group and their synthetic importance (acetoacetic ester and malonic ester). Organometallic (organolithium and organomagnesium) compounds and their synthetic importance. Aryl diazonium salts and their synthetic importance.
Suggested Practicals

1. Identification of elements and functional groups in given sample.
2. Purification of solvents like benzene, chloroform, acetone and preparation of absolute alcohol.
   - Picric acid.
   - Aniline.
   - Acetanilide.
   - Aspirin.
   - Hippuric acid.
   - P-Bromo acetanilide.
   - Iodoform.
   - Oxalic Acid.

BOOKS RECOMMENDED:

PHARMACEUTICAL CHEMISTRY-III (PHARMACEUTICAL PHYSICAL CHEMISTRY)

Unit I
Atomic structure and chemical bonding: atomic structure, atomic orbital, molecular orbital, hybridization, covalent (sigma and pi) bond, electrovalent and co-ordinate bond.
Chemical kinetics: Zero, first and second order reaction, complex reactions, elementary idea of reaction kinetics, characteristics of homogenous and heterogeneous catalysis, acid base and enzyme catalysis.

Unit II
Distribution law: Distribution law & application to solvent extraction.
Matter, properties of matter: Physical properties (surface tension, parachor, viscosity, rheochor, refractive index, optical rotation, dipole moment) and chemical constituents. Liquid complexes, liquid crystals, glassy state, solids-crystalline, amorphous and polymorphism.

Unit III
Thermodynamics: Fundamentals, first, second, third and zeroth law, Joule-Thompson’s effect, absolute temperature scale, conversion of temperature between different scales.
Thermo chemistry: Definition & conventions, heat of reaction, heat of formation, heat of solution, heat of neutralization, heat of combustion, bond energies.

Unit IV

Unit V
Adsorption: Definition, types and mechanism of adsorption, difference between physical and chemical adsorption, pharmaceutical applications of adsorption
Phase equilibria: Phase, component, degree of freedom, sublimation critical point, phase rule (excluding derivation).
Cooling curves and Phase diagrams for one &two component system involving eutectics, congruent & incongruent melting point (examples-water, sulphur, KI-H2O, NaCl-H2O).
Suggested Practicals

1. Determination refractive index of given liquids.
2. Determination of specific rotation of sucrose at various concentrations and determine the intrinsic rotation.
3. Determination of rate constant of simple reaction.
4. Determination of cell constant, verify Ostwald dilution law and perform conductometric titrations.
5. Determination of surface tension.
6. Determination of partition co-efficient.
7. Determination of viscosity.
8. Determine the parachor value.
9. Determine the rheochor value.
10. pH Determination by different methods.
11. Determination of solubility.

BOOKS RECOMMENDED:

1. Engel Thomas Reid Philip. Physical Chemistry, Pearson Education.
ANATOMY, PHYSIOLOGY & PATHOPHYSIOLOGY-II

Unit I

Central nervous system: Anatomy of different parts of brain and spinal cord, reflex action, electroencephalogram, specialized functions of the brain. Cranial nerves and their functions.

Unit II

Autonomic nervous system: Physiology of the autonomic nervous system. Neuro transmitters, Mechanism of neurohumoral transmission.

Unit III

Haemopoietic system: Composition & function of blood & its elements, erythropoiesis, blood groups, blood coagulation, Anemia.

Lymphatic system: Composition, formation and circulation of lymph, lymph node and spleen, thymus and pathophysiology of hypersensitivity and allergy.

Unit IV

Urinary system: Anatomy & physiology of urinary system, physiology of urine formation, acid- base balance, pathophysiology of renal feature, glomerulonephiritis, urinary tract infection

Unit-V

Digestive system: Parts of digestive system, their structure and functions. Various gastro-intestinal secretions and their role.

Pathology of Peptic Ulcer, Ulcerative colitis, Crohn's disease, Zollinger- Ellison syndrome, Hepatitis, Cirrhosis of liver, Pancreatitis
BOP-123P

ANATOMY, PHYSIOLOGY & PATHOPHYSIOLOGY-II PRACTICAL

Suggested Practicals

1. Microscopic study of different tissues.
2. Haematological experiments:
   A. Estimation of haemoglobin in blood.
   B. Determination of bleeding time, clotting time.
   C. R.B.C. Count.
   D. Total leucocyte count (TLC), Differential leukocyte count (D.L.C.)
   E. E.S.R. and blood group
3. Recording of body temperature, pulse rate and blood pressure.

BOOKS RECOMMENDED

10. Sood, R. Medical Laboratory Technology: Methods and Interpretation, Jaypee Brothers, New Delhi.
PHARMACOGNOSY – I

Unit I
Definition history, scope & development of pharmacognosy.

Source of drug: Biological, marine, mineral and plant tissue culture as source of drugs.

Classification of drugs: Alphabetical, morphological, taxonomical, chemical and pharmacological, chemotaxonomy.

Unit II
Plant Description: Morphology and anatomy of leaves, woods, barks, inflorescences and flowers, fruits and seeds.

Unit III
Propagation, cultivation, collection, processing and storage of crude drugs
A. Factors influencing cultivation of medicinal plants, Type of Soils & fertilizers of common use.
B. Pest management and natural pest control agents.
C. Plant hormones and their applications.
D. Polyploidy, mutation and hybridization with reference to medicinal plants.
E. Poly Houses/ Green houses for cultivation.

Unit IV
Quality control of crude drugs: Adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical and biological methods of evaluation including quantitative microscopy.

Unit V
Systematic pharmacognostic study of following-
Carbohydrates and derived products: Agar, Guar-gum, Acacia, Honey, Isabgol, Pectin, Starch, Sterculia and Tragacanth.

Lipids: Beeswax, Castor oil, Coca butter, Kokum butter, Hydnocarpus oil, Cod liver oil, Shark liver oil, Linseed oil, Wool fat, Rice-bran oil, Lard and Suet.
Suggested Practicals

1. Morphological characteristics of plant parts mentioned in theory.
2. Microscopical measurements of cell & cell contents Starch grains, Calcium oxalate Crystals & Phloem fibres.
3. Determination of leaf constants such as stomatal index, stomatal numbers, vein islet numbers, vein termination number and palisade ratio.
4. Identification of crude drugs belonging to carbohydrates and lipids.
5. Preparation of herbarium sheets.

BOOKS RECOMMENDED

BOP-125

PHARMACEUTICAL MATHEMATICS AND BIOSTATISTICS

Unit I
Limit of functions, differentiation of logarithmic, trigonometric and exponential function (not proof), chain rule, integration as reverse of differentiation, method of substitution.

Unit II
Linear differential equation with constant coefficients: complementary function and particular integral ($e^{ax}$, $x^n$, Sin ax, Cos ax).

Unit III
Methods of collection of data, diagrammatic representation of data (Pie, Histogram, Bar diagram), types of sampling; mean, median, mode and standard deviation.

Unit IV
Karl Pearson’s coefficient of correlation, regression, method of least square of straight line, t test, $\chi^2$ test, F test.

Unit V
Probability: Simple probability, addition and multiplication of probabilities, binomial, Poisson’s and normal distributions.
PHARMACEUTICAL MATHEMATICS AND BIOSTATISTICS PROJECT

1. Collection of data by survey methods.
2. Classification and tabulation of data.
3. Frequency distribution table for collected data (discrete and continuous).
4. Calculation of mean, median, mode, standard deviation and coefficient of variation for collected data.
5. Graphical representation of frequency distribution of collected data (histogram, frequency polygram, frequency curve and ogive).
6. Chi-square testing for data analysis.

BOOKS RECOMMENDED

1. Blair R.C., Taylor, R.A. Biostatistics for the Health Sciences, Dorling Kindersley India Pvt., Ltd.
2. Gupta S.P. Statistical Methods, Sultan Chand & Sons.
5. Prasad G. Textbook of Integral Calculus, Pothishala Pvt. Ltd.
PHARMACEUTICAL CHEMISTRY-III (HETEROCYCLIC AND BIOORGANIC CHEMISTRY)

Unit I
Heterocyclic compounds: Nomenclature, chemistry, preparation, properties and pharmaceutical importance of pyrrole, furan, thiophene, pyridine, pyrimidine, imidazole, pyrazole, thiazole, benzimidazole, indole, phenothiazines.

Unit II
Carbohydrates: Classification, reactions, structure elucidation, identification of-
   Monosaccharides- Glucose, fructose.
   Disaccharides- Sucrose, lactose, maltose.
   Polysaccharides- Starch.

Unit III
Amino acids and proteins: Classification, identification, general methods of preparation and reactions, isoelectric point, peptide bond, types of protein structure, protein separation and purification, end group analysis, introduction to solid phase peptide synthesis.

Unit IV
Nucleic acids: Classification, structures (primary, secondary, tertiary and quaternary) and functions of DNA and RNA, genetic codes.
Oils, fats and waxes: Structure and properties, analysis (acid value, iodine value, saponification value, Reichert-Meissl value).

Unit V
Vitamins: Classification, structure elucidation (only individually mentioned compounds) and physiological functions of water and fat soluble vitamins: Thiamine, niacin, ascorbic acid and retinol.
Polymers and polymerization: Classification, synthesis, reactions and pharmaceutical applications.
BOP-231P

PHARMACEUTICAL CHEMISTRY-III (HETEROCYCLIC & BIOORGANIC CHEMISTRY)

PRACTICAL

Suggested Practicals

1. Synthesis of heterocyclic nuclei such as Pyrazole, Imidazole, Thiazole, Indole, Benzimidazole, Phenothiazines.
2. Synthesis of compounds involving name reactions such as; Mannich reaction, Claisen-Schmidt condensation, Schiff’s base formation.
4. Identification of proteins by different color reactions.
5. Analysis of oils, fats and waxes (such as; acid value, saponification value, iodine value).
6. Stereomodels of proteins (primary, secondary and tertiary).
7. Determination of molecular weight of compounds (Rast's Camphor Method) polymers (Ostwald’s Viscometer Method).

BOOKS RECOMMENDED


Unit-I
**Stoichiometry:** Introduction, unit processes, material and energy balance, primary and secondary quantities, equilibrium state, rate process, steady and unsteady states, basic laws.

**Automated process control systems:** Process variables, temperature, pressure, flow level and their measurements. Elements of automatic process control and introduction to reactors.

Unit II
**Water systems:** Raw water, soft water, purified water, water for injection, quality requirement and treatment of water. Washing, cleaning and standardization of cleaning.

**Filtration and centrifugation:** Theory of filtration, filter aids, filter media, industrial filters including filter press, rotary filter, edge filter. Factors affecting filtration. Principles of centrifugation, industrial centrifugal filters and centrifugal sedimenters.

Unit III
**Drying:** Moisture content and mechanism of drying, rate of drying and time of drying calculations, classification and type of dryers, dryers used in pharmaceutical industries: tray dryer, fluidized bed dryer, spray dryer and special drying methods.

Unit IV
**Heating, ventilation and AC systems:** Basic concepts and definition, wet bulb and adiabatic saturation temperatures, psychrometric chart and measurement of humidity, application of humidity measurement in pharmacy, equipment for dehumidification operations. Principles and applications of refrigeration and air conditioning.

Unit V
**Material of construction:** General study of composition, corrosion, resistance, properties and applications of the materials of construction with special reference to stainless steel and glass.

**Industrial hazards and safety precautions:** Mechanical, chemical, electrical, fire and dust hazards. Industrial dermatitis, accident records.
Suggested Practicals

1. Study of factors affecting rate of filtration
   a) Effect of different filter media.
   b) Effect of viscosity of filtrate.
   c) Effect of pressure.
   d) Effect of thickness of cake.
   e) Effect of filter aids.

2. Study of factors affecting rate of drying
   a) Surface area.
   b) Temperature.

3. Determination of rate of drying, free moisture content and bound moisture content.

4. Study of principle of centrifugation for
   a) Liquid–liquid separation and stability of emulsions.
   b) Solid–liquid separation and stability of suspension.

5. Determination of dry bulb and wet bulb temperatures and use of psychrometric charts.

BOOKS RECOMMENDED

PHARMACEUTICS-III (HOSPITAL & COMMUNITY PHARMACY)

Unit I
Hospital formulary: Contents, preparation and revision of hospital formulary.

Unit II
Central sterile supply units and their management: Types of materials for sterilization, packing of materials prior to sterilization, sterilization equipments, supply of sterile materials.

Unit III
1. Definition, scope of community pharmacy. Roles and responsibilities of community pharmacist.
2. Community pharmacy management
   i. Selection of site, space layout, and design.
   ii. Staff, Materials- coding, stocking.
   iii. Legal requirements.
   iv. Maintenance of various registers.
3. OTC Medication: Definition, OTC medication list and counseling.

Unit IV
Pharmacoeconomics and pharmacoepidemiology: Brief introduction.
Communication skills & Patient counseling. Patient information leaflets- content, design, layouts, advisory labels. Patient compliance- definition, factors affecting compliance, role of pharmacist in improving the compliance. Rational drug therapy.

Unit V
Drug information service: Sources of information on drugs, treatment schedules, procurement of information, computerized services (e.g. MEDLINE), retrieval of information, medication error.
Records and reports: Prescription filling, drug profiles, patient medication profile, cases on drug interaction & adverse reactions, idiosyncratic cases etc.
BOP-233 P

PHARMACEUTICS-III (HOSPITAL & COMMUNITY PHARMACY) PRACTICAL

Suggested Practicals

1. Sterilization of packaging material.
2. Validation of sterilizing equipment.
3. Designing of patient information leaflet.
4. Preparation of Master Formula Record.
5. Sterilization and evaluation of surgical materials.
7. Categorization and storage of pharmaceutical products based on legal requirements of labeling and storage.
8. Study of OTC medication. List and available brands.
10. Study of various pathological reports of blood and urine.

BOOKS RECOMMENDED

7. Indian Pharmacopoeia, Ministry of Health and Family Welfare, Published by Govt. of India.
9. Thompson J. E., Contemporary Pharmacy Practice, Lippincott Williams & Wilkins.
ANATOMY, PHYSIOLOGY & PATHOPHYSIOLOGY-III

Unit I
**Respiratory system:** Anatomy & function of respiratory structures, mechanism of respiration, regulation of respiration, pathophysiology of asthma, pneumonia, bronchitis, emphysema, tuberculosis.

Unit II
**Cardiovascular system:** Functional anatomy of heart, conducting system of heart, cardiac cycle, ECG (Electrocardiogram). Pathophysiology of hypertension, angina, CHF, myocardial infarction, cardiac arrhythmias, ischaemic heart disease, arteriosclerosis.

Unit III
**Reproductive system:** Male & Female reproductive systems. Menstruation, pathophysiology of sexually transmitted diseases, spermatogenesis, oogenesis, pregnancy.

Unit IV
**Endocrine system:** Anatomy & Physiology of pituitary, thyroid, parathyroid, adrenal, pancreas. Control of hormone secretion, pathophysiology of hypo & hyper secretion of endocrine glands & their disorders, e.g.- Diabetes mellitus.

Unit V
**Cell injury:** Causes of cell injury, pathogenesis & morphology of cell injury. Cellular Adaptation- atrophy, hypertrophy, aplasia, metaplasia & dysplasia, pathophysiology of neoplasm.

**Inflammation:** Basic mechanisms involved in the process of inflammation and repair: Alterations in vascular permeability and blood flow, migration of WBCs, mediators of inflammation. Brief outline of the process of repair.
**BOP-234P**

**ANATOMY, PHYSIOLOGY & PATHOPHYSIOLOGY-III PROJECT**

1. The preparation of charts/models of following:
   a. Various parts of respiratory system- nose, pharynx, trachea, lungs etc.
   b. Parts of cardiovascular system, heart, conducting system of heart etc.
   c. Cardiac cycle, ECG.
   d. Male reproductive system.
   e. Female reproductive system.
   f. Spermatogenesis.
   g. Oogenesis.
   h. Phases of pregnancy.
   i. Different types of endocrine glands.

**BOOKS RECOMMENDED**

2. Robbins S.L., Kumar V., Basic Pathology, WB Saunders Company.
BOP-235

PHARMACOGNOSY- II

Unit I

**Introduction to different systems of medicine:** Brief introduction and principles of Ayurvedic, Unani, Siddha and Homeopathic systems of medicine. Introduction to Herbal Pharmacopoeia with special reference to arishtas, asavas, gutikas, tailas, churnas, lehyas and bhasmas.

Unit II

**Medicinal plants:** Introduction to medicinal plants with biological source, macro and microscopy, chemical constituents and uses of Kalmegh, Aswagandha, Bael, Guggulipid, Ginseng, Tulsi, Neem.

**Pharmaceutical aids:** Study of Pharmaceutical aids like talc, diatomite, kaolin, bentonite, fullers earth, gelatin and natural colours.

Unit III

**Resins:** Study of drugs containing Resins and Resin Combination like Podophyllum, Cannabis, Capsicum, Shellac, Asafoetida, Balsam of tolu, Balsam of peru, Benzoin, Turmeric, Ginger.

**Enzymes:** Biological sources, preparation, Identification tests and uses of following enzymes– Diastase, Papain, Penicillinase, Hyalluronidase, Streptokinase.

Unit IV

**Aromatic plants:** Introduction to aromatic plants with biological source, macro and microscopy, chemical constituents and uses of Mentha, Coriander, Clove, Fennel, Geranium oil, Lemon grass, Citronella, Cumin, Eucalyptus, Nutmeg, Cardamom.

**Fibres:** Study of fibers used in pharmacy such as cotton, silk, wool, jute, asbestos.

Unit V

Suggested Practicals

1. Microscopic study of plant epidermal trichomes, stomata, veins, endodermis, sclereids, fibers, xylem, phloem.
   Measurement of Trichomes, Fibres and Stomata using camera lucida.
2. Identification & morphology of Mentha, Lemongrass, Nutmeg, Turmeric, Ginger, Cannabis.
3. Morphology & microscopy of Coriander, Cinnamon, Fennel, Clove.
5. Study of Cotton, Silk and Wool along with their chemical tests.

BOOKS RECOMMENDED

1. Trease G.E. & Evans W.C., Pharmacognosy, Elsevier India Pvt. Ltd.
8. Dutta A.C., Botany, Oxford University Press.
FOURTH SEMESTER

BOP-241

PHARMACEUTICAL CHEMISTRY-IV (MOLECULAR BIOLOGY & BIOCHEMISTRY)

Unit I

Unit II
Nucleic acids: Biosynthesis of purine and pyrimidine nucleotides (De Novo and Salvage pathway).

Unit III

Unit IV
Biosynthesis of nutritionally non-essential amino acids, catabolism of amino acid nitrogen, catabolism of carbon skeleton of amino acid (Aromatic: Tyrosine, Tryptophan; Aliphatic: Histidine, Asparagine, Glutamine, Glycine). Conversion of amino acids to specialized products (Epinephrine, GABA, Creatinine, Glutathione).

Unit V
Cholesterol biosynthesis. Regulation of carbohydrate & lipid metabolisms. Role of sugar in nucleotides biosynthesis, biosynthesis of ketone bodies and their utilization. The respiratory chain, its role in energy capture and control. Mechanism and energetic of oxidative phosphorylation.
SUGGESTED PRACTICALS
1. Separation of amino acids by chromatography (paper and thin layer chromatography).
2. Separation of lipids by TLC.
3. Titration curve for amino acids.
5. Quantitative estimation of glucose using glucose oxidase enzyme.
6. Enzymatic hydrolysis of glycogen by $\alpha$ and $\beta$ amylases.
7. Effect of temperature on the activity of $\alpha$ amylase.
8. Qualitative analysis of inorganic as well as organic constituents of urine.
10. Estimation of cholesterol in blood samples.
11. Estimation of urea in blood samples.
12. Estimation of ketone bodies in blood samples.

BOOKS RECOMMENDED
BOP-242

PHARMACEUTICS-IV (PHYSICAL PHARMACY)

Unit I

**Drug stability:** Degradative pathways, influence of temperature, light, solvent, catalytic species and other factors on drug stability, accelerated stability study, expiration dating.

**Buffers:** Buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity.

Unit II

**Micromeritics and powder rheology:** Particle size and distribution, average particle size, number and weight distribution, methods for determining particle volume, optical microscopy, sieving, sedimentation, measurement, particle shape, specific surface, methods for determining surface area (air permeability and adsorption method), derived properties of powders, porosity, packing arrangement, densities, bulkiness and flow properties.

Unit III

**Surface and interfacial phenomenon:** Liquid interface, surface and interfacial tension, surface free energy, measurement of surface and interfacial tension, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB classification, solubilization, detergency, adsorption at solid-liquid interfaces, complex films, electrical properties of interface and applications.

Unit IV

**Viscosity and rheology:** Newtonian systems, law of flow, kinematic viscosity, factors affecting viscosity of formulations, non-Newtonian systems: Pseudoplastic, dilatant, plastic and thixotrophy, determination of viscosity by falling sphere, rotational viscometers.

Unit V

**Dispersion systems**

**Colloidal dispersions:** Brief introduction to colloids: types and application in pharmacy.

**Suspensions:** Settling in suspensions, theory of sedimentation, effect of Brownian movement, sedimentation of flocculated particles, sedimentation parameters, wetting of particles, controlled flocculation, flocculation in structured vehicles, rheological considerations.

**Emulsions:** Theories and physical stability.
SUGGESTED PRACTICALS

1. Determination of particle size, Particle size distribution and surface area using various methods of particle size analysis.
2. Determination of derived properties of powders like density, porosity, compressibility, angle of repose etc.
3. Determination of surface/ interfacial tension, HLB value and critical micellar concentration of surfactants.
4. Study of rheological properties of various types of systems using different Viscometers.
5. Studies of different types of colloids and their properties.
6. Preparation of various types of suspensions and determination of their sedimentation parameters.
7. Preparation and stability studies of emulsions.
8. To study the influence of various factors on the rate of reaction.
10. Experiments involving tonicity adjustments.

BOOKS RECOMMENDED:

Unit I
Introduction to cosmetics, classification of cosmetics.

**Functional excipients:** Colorants, plasticizers, humectants, thickeners, perfumes.

Brief study of skin structure, dermal/ percutaneous absorption.

Unit II
Toxicity studies on cosmetic products; corrosiveness, skin irritation, repeated dose toxicity, carcinogenicity, photo-induced toxicity.

**Formulation and evaluation of following cosmetics:** Cold cream, vanishing cream, lotions, cleansing lotion, moisturizers, powders, face wash, face pack. Role of exfoliating agents, anti ageing and SPF.

**Baby care products:** Soaps, shampoo, creams, lotion, powder.

Unit III
**Formulation development of cosmetic products:** Shampoo, conditioners, hair colors, depilatories, nail lacquers, kohl, mascara, eye liner, eye shadow, toothpowder, toothpaste, lipstick, lip balm.

**Shaving preparations:** Skin conditioners, beard softeners, lather preparations, aerosol foams, after shave lotions, balms and creams.

Unit IV
Safety evaluation of finished cosmetic product: Stability, physical and chemical characteristics, microbial quality.

**Anti perspirants and deodorants:** Introduction and types.

Unit V
**Herbal cosmetics:** Brief study of natural depigmentation agents and antioxidants. Formulations of herbal creams, powders, gel, shampoo, hair color, conditioners, face pack, face wash, lip balm, hair oils, soaps for cosmetic use.
Suggested Practicals

To prepare and evaluate the following cosmetics-

1. Cold cream   2. Vanishing cream
7. Tooth powder 8. Tooth paste
9. Shaving cream 10. After shave lotion
11. Nail lacquers 12. Lipstick

Preparation of the following herbal products-

1. Shampoo
2. Cream
3. Face pack
4. Lip balm
5. Soap

BOOKS RECOMMENDED

5. Sharma P.P., Cosmetics Formulation, Manufacturing and Quality control, Vandana Publication Pvt. Ltd. Delhi
9. Indian Pharmacopoeia 2014(7th edition), Ministry of Health and Family Welfare, Published by Govt. of India.
Theoretical considerations and application in drug analysis and quality control by the following analytical techniques (assays included in the Indian Pharmacopoeia)-

Unit I

**Non-aqueous titrations:** Basic concepts, types of solvents, leveling and differentiating solvents, titrations of weakly acidic and weakly basic compounds (assay of drugs like nitrazepam, chlorpromazine and ethosuccimide).

**Complexometric titrations:** Principle, complexing agents, indicators, masking and demasking, types of complexometric titrations, assay of some drugs like alum, calcium gluconate injection and determination of hardness of water.

Unit II

Introduction, dielectric cell, electrode potential, Nernst equation, salt bridge, standard potential, reference and indicator electrodes.

Potentiometry: General principles, instrumentation, types of potentiometric titrations, advantages and applications.

Conductometry: General principles, effect of dilution, conductance measurement, types of conductometric titrations, merits, demerits, instrumentation and applications.

Unit III

General principles (adsorption and partition), classification and theories (plate and rate) of chromatography. Retardation factor, selection of stationary and mobile phase, development of chromatogram and its visualization.

**Paper chromatography:** Introduction, types (ascending, descending, ascending-descending, radial and two dimensional), applications.

**Thin layer chromatography (TLC):** Introduction, types and techniques of TLC, applications. Introduction to high performance thin layer chromatography (HPTLC).

Unit IV

**Column chromatography:** Introduction, selection and preparation of column, flash chromatography, applications.
**High performance thin layer chromatography (HPLC):** Introduction, instrumentation (sample injection system, pumps, columns and guard columns, detectors) and applications. Reverse Phase-High Performance Liquid Chromatography (RP-HPLC). Introduction to gas liquid chromatography (GLC).

**Unit V**

Suggested Practicals

1. Preparation and standardization of perchloric acid by non-aqueous titration.
5. Determination of hardness of water by complexometric titration.
6. Preparation and standardization of sodium nitrite by diazotization titration method.
7. Assay of sulfa drugs by diazotization titration method.
8. To determine moisture content in drug by Karl Fischer method.
9. Determination of end point in acid base titration and oxidation reduction titration by potentiometric technique.
10. Determination of end point in acid base titration by conductometric methods.
11. Exercises based on paper, column and thin layer chromatography.
12. Demonstration of HPLC.

BOOKS RECOMMENDED:

2. Pharmacopoeia of India, Published by The Controller of Publications, Delhi.
BOP 245

PHARMACEUTICAL JURISPRUDENCE & INTELLECTUAL PROPERTY RIGHTS

Unit I

Unit II
An elaborate study of the following: Pharmacy Act 1948. Drugs and Cosmetics Act 1940 and Rules 1945.

Unit III

Unit IV
A brief study of the following with special reference to the main provisions.
Patents act 1970. Indian Copyright Act 1957

Unit V

Note : The teaching of all the above Acts should cover the latest amendments.
BOP 245P

PHARMACEUTICAL JURISPRUDENCE PROJECT (CASE STUDIES)

The students shall study cases based on the acts mentioned in theory syllabus. (for example—cases of revoked patents in India; cases of evergreening; patent of basmati, haldi, neem; schedule M and revised schedule M, trademark infringement and so on). Further, different cases shall be assigned to the students, based on the acts mentioned in the theory syllabus, on which the projects shall be prepared.

BOOKS RECOMMENDED

2. Relevant Acts and Rules Published by the Govt. of India.
5. Bare Acts, Published by The Government of India, New Delhi.