

ANNEXURE-I

Summary of B. Pharm Syllabus

THEORY COURSES	
Inorganic Pharmacy-I	Credit 2
Organic Pharmacy	Credit 3
Pharmacognosy-I	Credit 3
Physical Pharmacy-I	Credit 3
Inorganic Pharmacy-II	Credit 2
Pharmaceutical Microbiology-I	Credit 3
Basic Anatomy	Credit 3
Physiology-I	Credit 3
Basic Mathematics & Statistics	Credit 3
Physical Pharmacy – II	Credit 3
Biochemistry and cellular biology	Credit 3
Pharmaceutical Microbiology -II	Credit 3
Physiology– II	Credit 3
Pharmacognosy- II	Credit 3
Pharmaceutical Technology-I	Credit 3
Pharmaceutical Analysis– I	Credit 3
Basic Pharmaceutics	Credit 3
Pharmacology-I	Credit 3
Pathology	Credit 2
Medicinal Chemistry-I	Credit 3
Pharmaceutical Technology-II	Credit 3
Biopharmaceutics & Pharmacokinetics-I	Credit 3
Pharmacology-II	Credit 3
Pharmaceutical Marketing	Credit 3
Pharmaceutical Management	Credit 2
Medicinal Chemistry – II	Credit 3
Pharmaceutical Analysis-II	Credit 3
Pharmaceutical Engineering- I	Credit 3
Biopharmaceutics & Pharmacokinetics-II	Credit 3
Medicinal Chemistry-III	Credit 3
Pharmaceutical Technology-III	Credit 3
Cosmetology	Credit 3
Pharmacology-III	Credit 3
Quality Assurance and Quality Control systems	Credit 3
Pharmaceutical Packaging Technology	Credit 3

Pharmaceutical engineering-II	Credit 3
Clinical, Hospital and community pharmacy.	Credit 3
Pharmaceutical Regulatory Affairs	Credit 3
LABORATORY COURSES	
Inorganic Pharmacy-I: Lab	Credit 1
Inorganic Pharmacy-II: Lab	Credit 1
Organic Pharmacy Lab	Credit 1
Pharmacognosy-I Lab	Credit 1
Pharmacognosy – II Lab	Credit 1
Physical Pharmacy-I Lab	Credit 1
Physical Pharmacy - II Lab:	Credit 1
Pharmaceutical Microbiology-I Lab	Credit 1
Pharmaceutical Microbiology –II Lab	Credit 1
Physiology-I Lab	Credit 1
Physiology-II Lab	Credit 1
Pharmaceutical Technology-I: Lab	Credit 1
Pharmaceutical Technology-II Lab	Credit 1
Pharmaceutical Technology- III Lab	Credit 1
Pharmaceutical Analysis-I- Lab	Credit 1
Pharmaceutical Analysis-II Lab	Credit 1
Pharmacology-I Lab	Credit 1
Pharmacology-II Lab	Credit 1
Pharmacology-III Lab	Credit 1
Medicinal Chemistry – I Lab	Credit 1
Medicinal Chemistry – II Lab	Credit 1
Medicinal Chemistry – III Lab	Credit 1
Biopharmaceutics & Pharmacokinetics-I Lab	Credit 1
Biopharmaceutics & Pharmacokinetic Lab-II	Credit 1
Cosmetology-Lab	Credit 1
Other courses	
Thesis or Project	Credit 3
Industrial Training	Credit 1
Total Credit for completion of B.Pharm. Course	140

Detail descriptions and course contents of
B.Pharm Syllabus

FIRST YEAR, FIRST SEMESTER

Inorganic Pharmacy-I	Credit 2
-----------------------------	-----------------

1. **Structure of atoms:** An elementary treatment of theories of atomic structure, quantum numbers, Pauli's exclusion principle, origin of spectral lines.
2. **Chemical bonds:** Electronic concept of valence, different types of chemical bond e.g. ionic, covalent, co-ordinate covalent, metallic, dipole, hydrogen bond etc., theories of covalent bonding and hybridization.
3. **Classification of elements:** Modern periodic table and periodic law, variation of properties within periods and groups, usefulness and limitations of periodic table.
4. **Chemistry of alkali and alkaline earth metals:** General characteristics of alkali and alkaline earth metals, chemistry of group IA & II elements and their compounds, comparison of alkaline earth metals with alkali metals, physiological importance and pharmaceutical applications of alkali and alkaline earth metals.
5. **Chemistry of co-ordination compounds:** Ligands or coordinating groups, monodentate or unidentate ligands, polydentate ligands, co-ordination number, co-ordination sphere, chelation, factors affecting the stability of metal complexes, application of chelate formation, isomerism of co-ordination compounds, Warner's co-ordination theory, Sidgwick's electronic concept of co-ordinate bond in co-ordination compounds, valence bond theory, pharmaceutical importance of chelation.
6. **Chemical Impurities:** The occurrence of impurities in medicinal chemicals and substances used in pharmaceuticals.

Organic Pharmacy	Credit 3
-------------------------	-----------------

1. **Introduction:** History of organic chemistry, classification of organic compounds, systematic naming of organic compounds, electro negativity, polarity of bonds, polarity of molecules, structures and physical properties, intermolecular forces, carbonium ions, carbanion ions, electrophiles, nucleophiles, free radicals, hydrogen bonding, melting point, boiling point, solubility etc.
2. **Chemistry of aliphatic compounds**
 - (a) **Alkanes, alkenes and alkynes:** Properties, nomenclature, preparations, identifications, reactions and pharmaceutical applications of alkanes, alkenes and alkynes.
 - (b) **Aldehydes and ketones:** Properties, nomenclature, preparations, identifications, reactions and pharmaceutical applications.
 - (c) **Alcohols, ethers and epoxides:** Properties, nomenclature, preparations, identifications, reactions and pharmaceutical applications.
 - (d) **Carboxylic acids:** Properties, nomenclature, preparations, identifications, reactions and pharmaceutical applications.
 - (e) **Amines:** Properties, nomenclature, preparations, identifications, reactions and pharmaceutical applications.
3. **Chemistry of aromatic compounds:** Aromaticity, general chemistry of aromatic compounds, with special reference to biological and pharmaceutical importance.
 - a) Simple aromatic compounds
 - b) Aromatic halogen compounds
 - c) Aromatic nitro compounds
 - d) Aromatic amino compounds
 - e) Diazonium salts and their related compounds
 - f) Sulphonic acids
 - g) Phenols
 - h) Alcohols, aldehydes, ketones and quinines
 - i) Aromatic acids

Pharmacognosy-I	Credit 3
<ol style="list-style-type: none"> Definition and scope of Pharmacognosy, its historical development. Structures of the plant cell as a unit, its function and form; Introduction to the general structure of the morphological parts of the plants. Crude drugs: A general view of their origin, distribution, cultivation, collection, drying and storage, commerce and quality control.; Classification of drugs; Preparation of drugs for commercial market; Evaluation of crude drugs; Drug adulteration. Plant analysis: Extraction, separation, chromatography; types of plant constituents, comparative phytochemistry and chemotoxicity. Phytochemistry and pharmaceutical uses of the following plant constituents along with consideration of some important drugs of each group: (A). Lipids: Castor oil, Linseed oil, Coconut oil, Olive oil, Peanut oil, Chaulmoogra oil and beeswax. (B). Carbohydrate and related compounds: Sugars and sugar containing drugs- sucrose, dextrose, glucose, fructose etc. (C). Polysaccharide containing drugs- starches, dextrans etc. (D). Gums and mucilages- tragacanth, acacia, sterculia, sodium alginate, agar cellulose. Plants in complimentary and traditional systems of medicine: Introduction, different types of alternative systems of treatments (eg. Ayurvedic, Unani, Homeopathic medicine.), contribution of traditional drugs to modern medicines. Details of some common indigenous traditional drugs: Punarnava, Vashaka, Anantamul, Arjuna, Chirata, Picrorhiza, Kalomegh, Amla, Asoka, Bahera, Haritaki, Tulsi, Neem, Betel nut, Joan, Karela, Shajna, Carrot, Bael, Garlic, Jam and Madar. Vitamins and vitamin containing few selected animal drugs: Cod liver oil, Shark liver oil, Hilsha fish/liver oil etc. 	

FIRST YEAR, SECOND SEMESTER

Physical Pharmacy-I	Credit 3
<ol style="list-style-type: none"> Chemical equilibrium: Law of mass action, determination of equilibrium constant, heterogeneous equilibrium and homogeneous equilibrium, the Le Chatelier principle, Van't Hoff equation. Chemical thermodynamics: Introduction, the first law of thermodynamics, work, energy and heat, work of expansion, internal energy, determination of internal energy, heat change at constant volume and constant pressure, thermodynamic reversibility, work of isothermal reversible expansion of gases, the maximum work under the isothermal expansion of a gas, heat capacities, difference between molar heats, Adiabatic processes, Joule- Thomson experiment. Thermo chemistry and thermo chemical law: Second law of thermodynamics, Carnot's cycle and efficiency of a perfect engine, the concept of entropy and entropy changes for an ideal gas expansion, entropy changes of materials under various conditions, free energy and work functions, Gibbs Helmholtz equation, free energy changes under equilibrium, the Clausius-Clapeyron equation. Phase Equilibria: Phase, components and degree of freedom, the phase rules and its thermodynamic deviation, the phase diagrams of water and sulphur systems, partially miscible liquid pairs: the phenol and water, nicotine water system; Completely miscible liquid pairs and their separation by fractional distillation; freeze drying (lyophilization). Solution: Types and properties of solution; units of concentration; ideal and real solution; Henry's law; distribution of solids between two immiscible liquids; distribution law; partition coefficient; solvent extraction. Solution of Electrolytes: Concentration expressions, equivalent weights, Colligative properties of dilute solution, Osmotic pressure, measurement of osmotic pressure, Van't Hoff and Morse equations for osmotic pressure, Coefficients for expressing Colligative properties. Ionic Equilibria: Modern theories of acids, bases and salts, acid-base Equilibria, Sorensen's pH scale, Species concentration as a function of pH, calculation of pH, acidity constants, Buffer and Isotonic Solutions : Buffer equations, Buffer capacity, Buffer in Pharmaceutic and Biologic systems, Buffered isotonic solutions, methods of adjusting tonicity and pH. 	

Inorganic Pharmacy-II	Credit 2
<ol style="list-style-type: none"> Inorganic Medicinal Agents: Gastrointestinal Agents: Antacids (Al, Mg preparations with application) & adsorbents, saline cathartics, their preparations with applications. 	

Agents for bone and bone growth: Calcium preparations.

Haematinic Agents: Iron and iron preparations.

Dental Preparations: Fluorides and other anti-carries agents,

Topical Agents: Zinc oxide, Iodine preparations, and other Anti-microbial, Astringents & Protective.

2. **Major Intra & Extra-cellular Electrolytes:**

Major Physiological Ions, Electrolytes used for replacement therapy, Electrolytes used in acid-base therapy, Electrolytes combination therapy etc.

3. **Essential trace elements** for nutrition and growth and their functions: Copper, cadmium, zinc, molybdenum, selenium, silicone etc. and their preparations.

4. **Radioactivity and radiopharmaceuticals:** Introduction, types of radiation and their properties, radioactive decay, half-life, average life, modes of radioactive decay, interaction of radiation with matter, measurement of radioactivity, radiation hazard and radiological safety, biological effects of radiation, control of radiation exposure, storage of radioactive materials, medical applications of radionuclides, official radioactive compounds and their importance, toxicity of radioactive isotopes.

Pharmaceutical Microbiology-I

Credit 3

1. **Introduction to Microbiology:** Microbiology as a field of biology, place of microbiology in the living field, prokaryotic and eucaryotic protests, group of microorganisms, areas of microbiology, application of microbiology.
2. **History and Evolution of microbiology:** Spontaneous generation and biogenesis; germs theory of diseases; pure culture concept; immunization; widening horizons.
3. **Microscopic observations of microorganisms:** Bright field, dark field, fluorescence and phase contrast microscopy, electronic microscopy, preparations of microscopic examinations, wet mount and hanging drop techniques, fixed and stained smears, microbiological stains: simple and differential staining methods.
4. **Bacteria:** Nomenclature of bacteria, morphology and fine structures, nutritional requirements, bacteriological media, growth and reproduction, quantitative measurements of bacterial growth, maintenance and preservation of pure culture of bacteria.
5. **Microorganisms other than bacteria (brief study):**
 - a) **Yeasts** –Types, morphology, reproduction and physiology, pathogenic yeasts.
 - b) **Rickettsiae** – Introduction, characteristics of rickettsiae, pathogenic rickettsiae, laboratory diagnosis of rickettsial diseases.
 - c) **Viruses** – History of viruses, classification of viruses, characteristics of viruses, reproduction and cultivation of viruses, virus inhibition, control of virus infections, bacterial virus or bacteriophages, morphology and composition, cultivation of bacterial viruses, reproduction of bacterial viruses.

Basic Anatomy

Credit 3

1. **Tissue:** Definition and classification of tissue. Definition, classification, characteristics, distribution, minute structures and functions of different tissue. Bone and cartilage.
2. **Alimentary system-**oral cavity, pharynx, esophagus , stomach, small intestine, caecum, appendix, colon, sigmoid, rectum, anal canal.
3. **Cardiovascular system-** Heart, ascending aorta, arch of the aorta, descending thoracic aorta, abdominal aorta.
4. **Respiratory system-**nose, pharynx, larynx, trachea, bronchus, lung.
5. **Urinary system-**kidney, ureter, urinary bladder, urethra
6. **Reproductive system:** Female-ovary, uterus with fallopian tube, cervix, vagina; Male- Testis, ductus deferens, seminal vesicle, prostate, urethra. External genitalia: male- scrotum, penis. female- Labium majora, L.minora, clitories vaginal orifice.
7. **Nervous system-** CNS: Brain & spinal cord; PNS: spinal nerve & autonomic nervous system (sympathetic & parasympathetic)
8. **Endocrine gland** - Pituitary gland, thyroid & parathyroid gland, pancreas, adrenal gland, ovary, testis.
9. **Exocrine gland** - Parotid gland, submandibular gland, pancreas.
10. **Metabolic organ** - Liver with gall bladder.

11. **Reticulo endothelial system** - spleen, thymus, tonsil, lymph node, bone marrow.

Physiology-I	Credit 3
---------------------	-----------------

- 1. General Physiology**
Physiology and its scope in pharmacy. Structure of cell, its various organelles and functions, cell division, body fluid compartments and its composition, transport across cell membrane and membrane potentials, homeostasis.
- 2. Blood system**
Composition and functions of blood. Plasma and its components, plasma proteins and their functions. Blood coagulation, blood transfusion and blood groups, hemolysis, ESR. Blood forming cells- characteristics, functions, their formation and destruction. Hemoglobin- its structure, properties, function and hemoglobin derivatives. Anemia- definition and classification, causes and clinical features of various anemia.
- 3. Cardiovascular system**
Heart- Structure and blood circulation. Cardiac muscle, their properties, origin of heart beat and action potential. Cardiac cycle, Heart sounds, cardiac output, ECG, Regulation of cardiac function. Blood pressure- types, significance, measurement and regulation. Hypertension-types and causes.
- 4. Digestive system**
Structure of different parts of alimentary system, gastrointestinal motility and its control, swallowing and defecation. Secretion of digestive juices from saliva, gastric, pancreatic, intestinal glands and bile. Functions of digestive juices and their mechanism and regulation of secretions. Digestion and absorption of various foodstuffs. Liver- it's function, formation of bile and its circulation.
- 5. Respiratory system**
Organs of respiratory system and its structure. inspiration and expiration, mechanism of respiration, pulmonary ventilation, ventilation volumes. Gaseous exchange through lungs, carriage of O₂ and CO₂. Hypoxia- causes and classification.

SECOND YEAR, FIRST SEMESTER

Basic Mathematics & Statistics	Credit 3
---	-----------------

- 1. Graphs and gradients:** (a) Rectangular co-ordinates, curve fitting gusting first degree equation in both variables, determination of slope, intercept and points of intersection, equation of first degree in both x and y (circle), ellipse, rectangular hyperbola etc. (b) Exponential and logarithmic curves, graphical solution equation, graphical solution of simultaneous equation. (c) Arithmetic progression, geometric progression, permutation, combination, the binomial theorem and exponential theorem.
- 2. Calculus:** (a) Rate of process, rules of differentiation, successive and partial differentiation, differentiation of a function of a function relation between the derivatives of inverse function. (b) Rules of integration- integration as a summation, area under a curve, integration by partial fraction, graphical integration.
- 3. Matrices:** Addition, subtraction and multiplication of matrices, unit matrix, row transformation, determinants, inverse of a matrix, solution of equation by matrix.

Section B: Statistics:

- 1. Graphical and diagrammatic representation-** Graphs and diagrams.
- 2. Measurement of central tendency** – Arithmetic mean, geometric mean, harmonic mean, median and mode.
- 3. Measures of dispersion** – Range of mean deviation, variance, coefficient of variance, standard deviation.
- 4. Moments, Skewness and kurtosis.**
- 5. Probability distribution** – The normal, binominal and Poisson distribution, derivation, means and variances.
- 6. The basic ideas of significance test** – Simple significance tests based on the normal distribution, comparison with a known standard, comparison of means of two large samples.
The use of 't' test for small samples, importance of small sample comparison of sample mean with a standard, comparison of means of two small sample (unknown variances- assumed equal, not assumed equal) confidence limits.

χ^2 –tests of goodness of fit and homogeneity introduction to general idea, testing the fit of a whole frequency distribution to data, tests of homogeneity, variance ratio test.

7. **The correlation of measurement** – General notion of correlation, calculation of correlation coefficient.
8. **Regression analysis** – Basic idea of regression, calculation of regression coefficient, standard error and significance test. Partial correlation and multiple regression with two and more than two independent variables.
9. **Simple experimental design and the analysis of variances** – Introduction, completely randomized design, randomized block design, testing the homogeneity of variances.
10. **Introduction to factorial experiments** – Principle basic ideas, notation in 2n factorial, scope of more advanced designs.
11. **Random samples and random numbers**- the need and use, representative samples.

Physical Pharmacy – II

Credit 3

1. **Kinetics:**
 - (A) **Physical degradation of Pharmaceutical products:** loss of water, absorption of water, loss of volatile constituents, polymorphism, color change.
 - (B) **Chemical degradation:** hydrolysis, oxidation, isomerization, polymerization, Decarboxylation, factors affecting chemical degradation etc.
 - (C) **Chemical kinetics:** Definitions, rates and orders of reactions, methods for determination of orders of reactions, influence of temperature on rate of reactions, theories of reaction rates, decomposition of pharmaceutical products, accelerated test for physical, chemical and photochemical stability, stability aspects of formulations, marketed products and clinical supplies, shelf life determination.
2. **Interfacial phenomena:** Adsorption and Interface, Freundlich and Langmuir isotherm, BET equation, Electrical properties of interfaces, electrical double layer, Nernst and zeta potential, Gibbs equation, spreading, surface active agents, Emulsifiers, detergents and antifoaming agents, surfactants and drug activity, surfactants and pharmaceutical products.
3. **Rheology and rheology of dispersed system:** Newtonian liquids, Non-Newtonian materials, yield value, plastic & pseudo plastic flow, dilatant and thixotropic flow, viscosity of suspending agents.
4. **Colloids:** Classification, preparation, electrical and optical properties, sedimentation, Stoke's law, stability of colloidal dispersion, protective colloid, sensitization, dialysis, donnan membrane equilibrium, application and uses of colloidal preparation in pharmacy.
5. **Electrochemistry:** Electrical units and their interrelation, Faradays laws of electrolysis and electrochemical equivalents, electrolytic conduction, equivalent conductance and the related facts, conductometric titrations, transference numbers and their determination.
6. **Electrochemical cells:** Electrode and cell potentials, energies involved in electrode processes, reference electrodes, buffer solutions and measurement of P^H ; Potentiometric titrations and oxidation- reduction systems, concentration cells.
7. **Micromeritics:** Importance of particle size determination, Different means of expressing particle size, Methods of particle size determination, optical and electron microscope studies, coulter counter methods, Laser beam technique, Sieve analysis, sedimentation methods, particle shape and surface area, Measurement of particle surface area.

Biochemistry and cellular biology

Credit 3

1. **Introduction to cell:** Differences between prokaryotic cells and eukaryotic cells, structure and functions of mitochondria and chloroplasts, cytoskeleton, cell development and differentiation.
2. **Plasma membrane, cell walls and cell surface:** Principle of semi-permeability, active transport, endocytosis, exocytosis, bacterial, fungal and plant cell walls.
3. **Nuclear structure and function:** Cell division and cell cycle, mitosis and meiosis, structure and function of chromosomes.
4. **Proteins:** Important bonds in protein, important functions of protein in biological system, importance of amino acid sequence in protein structure, different amino acids structures and functions, peptide bond, disulfide bridge in protein structure, peptide bond is rigid and planner, a helix, b sheet, hairpin turn, denaturation and renaturation of protein, proteins are rich in hydrogen-bonding potentiality, different structures of protein, conformational change of protein, gel electrophoresis, 2-D gel electrophoresis, purification of protein, synthesis of protein, protein sequencing, recombinant DNA technology for protein sequencing.

5. **Nucleic acids:** Importance of nucleic acid study, different bases of DNA/RNA, nucleotide, nucleoside, structures of DNA, DNA chain has polarity, AT/GC structure, melting point of DNA, physical states of DNA, Replication, discovery of DNA polymerase I and III, mRNA, hybridization studies of mRNA, synthesis of mRNA, recombinant DNA technology, restriction enzymes, promoter region of DNA, RNA synthesis termination, tRNA, role of tRNA in protein synthesis, codons, DNA sequencing.
6. **Enzymes:** Definition, activation energy and enzymes, specificity of enzyme, regulation of enzymes activity, enzymes and reaction equilibria, enzyme kinetics, enzyme inhibition, common features of enzymes, enzyme cofactors & coenzymes.

Pharmaceutical Microbiology -II	Credit 3
--	-----------------

1. **Infectious diseases and causative organisms.**
2. **Basic concepts of Immunology:** Infection Pathogenicity, virulence immunity.
3. **Immunological Products:** Active antigenic products, attenuated, inactivated and extract, viral and bacterial. Passive products, gamma globulin.
4. **Sterilization:** (a) Sterilization by dry heat: principle, hot air oven, method of use, applications, advantages and disadvantages of sterilization by moist heat, factors affecting sterilization by moist heat, principle of sterilization by steam under pressure, (b) Sterilization by filtration; (c) Sterilization by radiation; (d) Sterilization by gas.
5. **Sterility testing and LAL testing methods of pharmaceutical products**
6. **Microbiological assay of antibiotics:** Introduction, reference standard and units of activity, agar diffusion assay, theory of zone formation, factors affecting diffusion assay, Dose response curve, large plate assay using Latin square design, statistical interpretation of microbiological assay methods.
7. **Microbiological monitoring methods for pharmaceutical industry:** Different methods of microbial monitoring systems for environment in pharmaceutical industry.
8. **Disinfectants and Antiseptics.**

Physiology– II	Credit 3
-----------------------	-----------------

1. **Nervous system**
Neuron- properties, classification and functions. Neuroglial cells and their functions. Nerve fibers- Definition, types, properties of nerve fibers, origin and propagation of nerve impulses across nerve fibers, action potential. Synapse- classification, structure, properties and functions. Neurotransmitters- classifications and functions, never endings.
Different types of sensations- Mechanism and properties of sensations, Receptors- definition, classifications, properties and functions.
Reflex and reflex arc , their classifications, properties and components of reflex arc. Principal division of nervous system – CNS and PNS. Functions of different parts of CNS. Ascending and descending tracts of spinal cord. Differences between – somatic & autonomic, and sympathetic & parasympathetic nervous system. Cranial and spinal nerves & their functions. Regulation of autonomic nervous system. Muscle tone- definition & regulation. CSF- definition , composition and function.
2. **Endocrine System**
Different endocrine glands & their structure & functions of pituitary, thyroid, parathyroid, adrenal & pancreatic glands. Functions & regulation of secretion of hormones. Abnormal hormone secretions.
3. **Excretory System**
Structure of kidney, nephron & its different parts. Renal circulation- its regulation & measurements. Renal clearance & its importance. Urine- its composition & properties. Counter current mechanism. Role of kidney in acid-base balance of blood & in maintenance of plasma volume.
4. **Reproductive System**
Testis & accessory reproductive systems & their functions. Male hormones and their functions. Spermatogenesis and its hormonal regulation.
Organs of female reproduction system and their functions. Menstruation cycle, different phases & its regulation. Oogenesis & ovulation and its control. Female sex hormones & their functions, Pregnancy and lactation & their hormonal control.
5. **Regulation of body temperature**

Heat production & heat dissipation. Role of hypothalamus & other nerve factors in body temperature regulation. Abnormalities in body temperature regulation.

Pharmacognosy- II	Credit 3
--------------------------	-----------------

- Glycosides and glycoside containing drugs.** Classifications, source and use of different types of glycosides.
 - Isothiocyanate: Mustard.
 - Cyanogenetic: Wild Cherry.
 - Anthraquinone glycosides: Cascara sagrada, aloe, senna, rhubarb.
 - Saponins: Sarsaparilla, glycyrrhiza, dioscorea.
 - Cardiac: Digitalis, strophanthus, squill.
- Alkaloids:** Distribution, properties, tests, extraction, structure types and classification. The details of the following:
 - Pyridine, piperidine: Areca, conium
 - Tropane: Belladonna, Stramonium, hyoscyamus and coca.
 - Quinoline: Cinchona.
 - Isoquinoline: Ipecac, opium.
 - Indole: Rauwolfia, nux-vomica, ergot.
 - Imidazole: Pilocarpus.
 - Steroidal: Veratrum viride, aconite.
 - Purine bases: Coffee, tea.
 - Lupinane: Lupinus
- Volatile oils and related terpenoids:** Methods of obtaining volatile oils; Chemistry of the volatile oils and their medicinal and commercial uses.
- Phenolic compounds and tannins:** Chemical nature and test for tannins, some tannin containing drugs such as Nutgall and Catechu.
- Resin and resin combinations** (resin, oleoresin, oleo gum resin, balsam): Jalap, Cannabis, Capsicum, Ginger, Myrrh, Tolu Balsam, and Benzoin.
- Herbs as health foods:** Alfa alfa, Apricot pits, Arnica, garlic, onion, Ginseng, Spirulina Fenugreek, Sassafras and Honey.
- Poisonous plants and natural pesticides:** Datura, Poison Hemlock, Water Hemlock, Foxglove (Digitalis), Ipomoea, Tobacco, Poppy, Pyrethrum flower, Derris and Lanchocarpus, Red Squill, Strychnine etc.

SECOND YEAR, SECOND SEMESTER

Pharmaceutical Technology-I	Credit 3
------------------------------------	-----------------

- Liquid dosage forms:** Solution and Elixirs, theory of solution, different factors affecting solution process, advantages and disadvantages, formulation consideration, manufacturing considerations, packaging of liquids, preservation and stability aspects, Quality control of liquids.
- Dispersed system:**
 - Properties of dispersed systems:** Theoretical aspects of suspension, emulsion and colloids, surface char and zeta potential, Inter- particle force, crystal growth, wetting, adsorption at solid-liquid interface, surface and interfacial tension, flocculation and coalescence.
 - Suspension:** Advantages and disadvantages, aggregated and dispersed system, formulation of suspension, Manufacturing of suspension, stability of suspension, Evaluation and quality analysis of suspension, Rheological consideration, illustrative examples.
 - Emulsion:** Definition and applications, advantages and disadvantages, theory of emulsion, formation of emulsion, Classification of emulsifying agents, HLB values of surface active agents, formulation of emulsion, manufacturing of emulsion, stability of emulsion, Evaluation and quality analysis of emulsion, Rheological considerations, illustrative examples.
- Semisolids (Ointments, paste, gels):** Structure of skin, percutaneous absorption of drugs, definition and classification of semisolid preparations, classification of bases, formulation, manufacturing, consideration, evaluation and quality analysis of semisolid preparations.

4. **Suppositories:** Drug absorption from colon, classification of suppositories, merits and demerits of suppository, suppository bases, formulation, manufacturing and testing of suppositories.

Pharmaceutical Analysis– I	Credit 3
<p>1. Aqueous Acid-Base Titration: Definition, distribution of acid-base species with P^H of the medium, acid-base titrimetry for determination of weekly acidic and basic pharmaceuticals, Indicators (theories) and their selection, applications.</p> <p>2. Oxidation-Reduction Titration: Principles and concepts, determination involving potassium permanganate, potassium dichromate, potassium bromate, Iodimetric and iodimetric determination, miscellaneous oxidation and reduction titration, indicators, applications.</p> <p>3. Complexometric Titration: Introduction to complexometric titration, complexes and chelates, stability of complex ions, titration based on complex formation, types of complexometric titration, techniques employed in chelometric titration, methods of end point detection, titration selectivity and masking reagents.</p> <p>4. Non aqueous Acid-Base Titration: Theoretical considerations and principles, Bronsted-Lowry theory of acids and bases, non aqueous solvents, titration of weak acids and weak bases, application and scope of non aqueous titration.</p> <p>5. Potentiometric titration: Introduction, theory and principles, electrochemical cells and half-cells, electrodes, measurement of potential, application of potentiometric titration.</p> <p>6. Amperometric titration: Introduction, theoretical considerations, instrumentation, general polarographic analysis, amperometric titration using one and two electrodes.</p> <p>7. Aquametry: Principle and scope, Physical methods of water determination, chemical method of water determination, Karl-Fischer procedure –principle, chemistry, methodology, equipment, end point detection and limitation.</p> <p>8. Testing of Pharmaceutical and potable waters: Test for waters according to BP and USP, Total Organic Carbon (TOC) equipment and methods, Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD).</p> <p>9. Short study of (I) Refractometry (II) Polarimetry (III) Nephelometry.(IV) Particle analysis methods, such as, coulter counter and laser beam particle analyzers.</p>	

Basic Pharmaceutics	Credit 3
<p>1. Pre-formulation: Preliminary evaluation and molecular optimization, bulk characterization of the material and polymorphism, thermal properties, particle characterization, bulk density, powder flow properties, solubility analysis, Pk_a determination, P^H solubility profile, effect of temperature, solubilization, partition coefficient, dissolution, stability analysis, solution stability, solid state stability.</p> <p>2. Chemical and Physical incompatibility.</p> <p>3. Pharmaceutical excipients: Chemistry, Physical properties and uses of following excipients, acidifying agents, air displacement agents, alkalizing agent, antifoaming agents, antimicrobial preservatives, antioxidants, buffering agents, chelating agent, colors, complexing agents, emulsifying agents, flavoring agents and perfumes, Humectant, ointment bases, solvents, Stiffening agents, Wetting and solubilizing agent.</p> <p>4. Basic principles of compounding and Dispensing: Weight, measures and units calculation for compounding and dispensing, fundamental operation in compounding, good pharmaceutical practices in compounding and dispensing, containers and closures for dispensed products, responding to the prescription, Labelling of dispensed medications.</p> <p>5. Pharmaceutical Calculations: Mathematical principles, common and decimal fractions, exponents and power and root, logarithmic calculations, reducing and enlarging formulas, ratio and proportions, percentage calculations, ratio strength, stock solution, parts per million, dilution and concentration, temperatures, dosage calculations.</p> <p>6. Polymer Science for pharmaceuticals Pharmaceutical applications, physical, chemical and mechanical properties, molecular weight and distribution, polymer solution properties, plasticization and elastomers.</p>	

Pharmacology-I	Credit 3
<ol style="list-style-type: none"> 1. Definition of Pharmacology, drug, medicine, pro-drug, pharmacokinetics, pharmacodynamics, agonist, synergism, side effect, toxicity, teratogenicity, drug interaction, drug tolerance, drug dependence, drug abuse, idiosyncrasy, dose, dosage form, absorption, distribution, bioavailability, distribution, protein binding, metabolism & excretion, Routes of drug administration. 2. Basic concept of drug action: receptor, nature of receptor, drug antagonism, Relation between drug dose & clinical response. 3. Signalling mechanism and drug action, ligand gated channels, G-proteins and second messengers. 4. Drugs for peptic ulcer: antacid, H₂-receptor, proton pump inhibitors, PG analogues, mucosal-protective agent, Anti Helicobacter pylori agents. 5. Anticoagulant: Heparin, calcium complexing agents, Heparin, oral anticoagulants 6. Autacoids: Amine, lipid & peptide autacoids. 7. Haematinic drugs: Iron, vit B₁₂, folic acid erythropoietin 8. Sedative & hypnotic drugs: Benzodiazepine & Barbiturates. 9. CNS stimulant drugs: Strychnine, xanthine & methylxanthine, amphetamine, nicotine. 10. Chemotherapy of parasites: Drugs used in helminthiasis, malaria, leishmaniasis & trichomoniasis. 	

Pathology	Credit 2
<ol style="list-style-type: none"> 1. Definition and scope of pathology 2. General concept of disease 3. Cellular injury and adaptation 4. Inflammation 5. Pathological calcification 6. Body defense mechanisms 7. Nutritional diseases 8. Neoplasia 9. Thrombosis and other disorders of circulation 10. Infectious disease 11. Immunological disease. 12. Name, Definition and examination of all common pathological tests and the standard values. 	

THIRD YEAR, FIRST SEMESTER

Medicinal Chemistry-I	Credit 3
<ol style="list-style-type: none"> 1. Reaction mechanisms: 2. (a) Addition reaction: electrophilic; nucleophilic and free-radical; 1,2- and 1,4- addition. (b) Substitution reaction: Unimolecular (S_N1) and bimolecular (S_N2), stereochemistry of S_N1 and S_N2 reaction, free-radical and intermolecular nucleophilic substitution. © Elimination reaction: Unimolecular (E1) and bimolecular (E2), stereochemistry of elimination reaction. (d) Rearrangement reaction: Hofmann, Claisen, Sigmatropic and Fries rearrangement. 3. Name reactions: Arndt- Eistert, Baeyer-Villiger, Birch reduction, Clemmensen reduction, Darzens condensation, Diels Alder, Escheiwer-Clarke, Friedel- Crafts, Gabriel synthesis, Gettermann- Koch and Sandmeyer, Grignard, Hofman, Mannich, Michael, Meerwin- Ponderf-Verley, Oppenauer oxidation, Perkin, Reformatsky, Reimer- Tiemann, Vilsmeier- Haack, Witting and Wolf-Kishner reduction. 4. Carbohydrates: General considerations, chemistry, stereochemistry, classification, aldoses, ketones, oxidation, effect of alkali, Kiliani- Fisher synthesis of aldoses, Ruff degradation, optical family, D-L, R-S cyclic structures of D (+) glucose, topoisomers, hemiacetal, acetal form of glucose. Disaccharides and polysaccharides. 5. Lipids: General consideration, chemistry, fatty acid cycle, β- oxidation, catabolism of unsaturated fatty acids, ketone bodies, ketosis, ketouria, ketoacidosis. 	

6. **Amino acids and Proteins:** General considerations, structure of amino acids, acidity and basicity of amino acids, topoisomer point, reactions of amino acids, essential amino acids. Reactions of proteins.

Pharmaceutical Technology-II		Credit 3
1.	Formulation and manufacturing of tablets: Manufacturing of tablets by wet granulation, dry granulation and by direct compression. Granulation of powders for tableting, advantages and disadvantages of different process, Processing machineries used in tablet manufacturing.	
2.	Common tableting problems and evaluation of tablets: Hardness measurement, weight variation tests, thickness and diameter, friability, disintegration time, dissolution time, mechanism of tablet disintegration and dissolution, In process quality control methods in tablet manufacturing, Study of common tableting problems.	
3.	Tablet coating: Definitions and classification of coating methods, advantages and disadvantages of coated tablets, different methods of coating: sugar coating, different stages of sugar coating, problems of sugar coating; film coating, film formers, plasticizer, solvents, other excipients; comparison between sugar coating and film coating, aqueous film coating techniques, modern film coating materials and coating formulations, problems of organic and aqueous film coating; Film coating problems; Coating machines.	
4.	Hard gelatin capsules: Definition and classification, advantages and limitations of capsule dosage form, Gelatin and its manufacture, manufacture of hard capsule shells, properties of capsules, formulation of capsules, capsule filling machines, tooling and accessories, problems in capsule manufacturing, quality control methods of capsules, packaging of capsules.	
5.	Soft gelatin capsules: Definitions and classifications, advantages and limitations, properties of soft capsules, formulation of soft capsules, manufacturing of soft capsules, problems in soft capsule manufacturing, quality control methods of soft capsules, packaging of soft capsules.	
6.	Microencapsulation Technology: Purpose, methods of preparation, evaluation, pharmaceutical and biological applications of microencapsulation process.	

Biopharmaceutics & Pharmacokinetics-I		Credit 3
1.	Introduction of Pharmaceutics and Biopharmaceutics	
2.	Gastrointestinal absorption of drugs: (a) Biological Consideration: Membrane physiology, gastrointestinal physiology, mechanism of absorption etc. (b) Physicochemical consideration: Pk_a and gastrointestinal absorption, Ph-partition theory and other physicochemical factors. © Dosage form consideration: Role of different dosage form like solution, suspension, tablet, capsule, emulsion etc. on gastrointestinal absorption. (d) Disintegration and dissolution of drugs.	
3.	Distribution of drugs: (a) Important Pharmacokinetic parameters such as biological half-life, apparent volume of distribution, area under the curve, elimination rate constant etc. (b) Interpretation of Drug-plasma level curve. (c) Drug-protein Interaction: Theoretical aspect of protein-drug interaction, methods used for protein binding, identification of drug binding sites, kinetics of protein binding, determination of binding sites and association constant, factors affecting protein binding, effects of protein binding on drug distribution, elimination and pharmacological effects of drugs.	
4.	Drug Clearance: (a) Theoretic aspects of drug elimination, excretion and biotransformation. (b) Renal elimination: Glomerular filtration, Active tubular secretion, Tubular reabsorption, determination of renal clearance. (c) Hepatic elimination: Biotransformation of drugs in the liver, drug biotransformation reactions, pharmacokinetics of drugs and metabolites (Michelis Menten Equation), First pass effect, Liver excretion ratio, Relation between absolute bioavailability and liver excretion, hepatic clearance-relationship between blood flow, intrinsic clearance and hepatic clearance, Hepatic clearance of a protein bound drug (effect of protein binding on hepatic clearance). (d) Biliary excretion of drugs.	

5. **Bioavailability and Bioequivalence:** Definitions of different parameters relative to bioavailability; purpose of bioavailability, relative and absolute bioavailability, methods of assaying bioavailability, criteria for bioequivalence studies.
6. **Drug product selection on the basis of bioavailability testing.**

Pharmacology-II	Credit 3
------------------------	-----------------

1. **Local anesthetic:** History, mechanism of action, properties, SAR, Pharmacological action, fate, ester and amide type local anesthetics.
2. **General anesthetic:** Inhaled anesthetics, nitrous oxide, halothane, enflurane, isoflurane & sevoflurane. Intravenous anesthetics – Barbiturates, benzodiazepines & opiod analgesics, **toposid, toposid.**
3. **Analgesic, antipyretic and antiinflammatory drugs:** Non-narcotic analgesic- salicylates, pyrazolone derivatives, para-aminophenole derivatives, propionic acid derivatives, indomethacin, **toposid, toposid, toposide** ; **Narcotic analgesic** –opium alkaloids, morphine antagonist, synthetic & semisynthetic opiate.
4. **Cardiovascular drugs:**
 - a. Antihypertensive drugs
 - b. Antiarrhythmic drugs.
 - c. Diuretics
 - d. Drugs used in heart failure
 - e. Drugs used in angina and myocardial infraction
5. **Antibacterial agents:**
 - a. Drugs affecting folate synthesis: Sulfonamides and toposide n .
 - b. β -lactam antibiotics-Penicillin,cephalosporin.
 - c. Drugs affecting protein synthesis- Tetracycline, chloramphenicol, macrolides, aminoglycosides.
 - d. Drugs affecting Topoisomerase-I enzyme-Fluoroquinolones.
 - e. Glycopeptide, bacitracin & toposidene.
 - f. Antitubercular agents-Isoniazide, toposid, toposide, toposide n , PAS, toposide n, toposide n, toposide n.
 - g. Antileprotic drugs-Dapson, toposid, toposide n.
6. **Vitamin:** Water soluble and fat soluble vitamins.
7. **Antidiabetic agents:** Introduction to diabetes, classification, causes, complications and treatment of diabetes. Hypoglycemia, causes and treatment, Relationship between stroke and diabetes, Causes of stroke. Different types of anti-hyperglycemic agents with structures, mechanisms, uses, toxicity. Insulin resistance, management of diabetes. Glucagon structure, mechanism and uses.

THIRD YEAR, SECOND SEMESTER

Pharmaceutical Marketing	Credit 3
---------------------------------	-----------------

1. Principles of marketing
2. Strategic Marketing Planning
3. Consumer Markets and Buying Behavior
4. Market Segmentation and Target Market Strategies
5. Product Promotion
6. Advertising
7. Products: Planning and Development
8. Positioning and Product Life cycle
9. Branding
10. Pricing

Pharmaceutical Management	Credit 2
----------------------------------	-----------------

1. **Nature and Principles of Management:** Style of management, The MBO system and improving decision-making.

2. **Organization Structures:** Social organization and legal organization, the sole proprietorship, the general partnership, private and public limited companies, their relative advantages and disadvantages.
3. **Personal management:** Importance, principles, methods, motivation, staff requirements theory.
4. **Planning, organizing, staffing, landing & controlling**
5. Managerial role of pharmacists, Pharmacists in different services of health and pharmaceutical industry, marketing & sales, regulatory affair research & development, hospital pharmacy, community pharmacy etc.
6. **Inventory Control:** Methods: Intuitive, systematic wantbook, perpetual inventory, open-to-buy, stock, record card, economic order quality, selection of optimum methods, effect of inventory control.
7. **Purchasing:** Formulating effective buying policies, needs and desires, selecting the sources of supply, determining terms of purchase, receiving, marking and stocking of goods.

Medicinal Chemistry – II

Credit 3

1. **Stereochemistry:**
 - (a) General treatment of different types of isomerism.
 - (b) Geometric isomerism of alkenes and cyclic compounds, Cis, trans and (E), (Z) systems of nomenclature.
 - © Conformational isomers: conformation of open chain and cyclic compounds.
 - (d) Chirality of molecules: enantiomer, diastereomer, racemic modification, meso compound, R- and S-configuration, sequence rule, optical rotation.
 - (e) Asymmetric synthesis: preparation of enantiomer by asymmetric synthesis and optical resolution method.
 - (f) Stereoselective and stereospecific reaction.
 - (g) Pharmaceutical importance of studying stereochemistry.
2. **Heterocyclic chemistry:**
 - a. 5-membered heterocyclic compounds: Pyrrole, Furan, Thiophene, Pyrazole, Imidazole, Oxazole, Isoxazole, Thiazole and Isothiazole: their preparations, reactions and pharmaceutical importance.
 - b. 6-membered heterocyclic compounds: Pyridine, Piperidine, Pyrimidine, Pyradazine, Pyrazine and Triazine: their preparation, reaction and pharmaceutical importance.
 - c. Benzofused 5-membered heteroatomic compounds: Indole, Benzofuran, Benzothiaphene and Carbazole: their chemistry, synthesis and pharmaceutical importance.
 - d. Benzofused 6-membered heteroatomic compounds: Quinoline and Isoquinoline: their chemistry, synthesis and pharmaceutical importance.
3. **Chemistry, SAR, mode of action and synthesis of following groups of drugs:**
 - a. Hypnotics and sedatives.
 - b. Antihistamines
 - c. Analgesics and anti-inflammatory agents.
 - d. Cardiovascular agents
 - e. Diuretics.

Pharmaceutical Analysis-II

Credit 3

1. **Visible and ultraviolet spectrophotometry:** Introduction, electromagnetic radiation, units, electromagnetic spectra and absorption of radiation, Lambert's and Beer's law, deviations from Lambert-Beer law, instrumentation, colorimetry, chromophores and toposide, analysis of mixtures, absorption and intensity shifts, applications of Ultraviolet and visible spectroscopy in quantitative analysis of drugs. Ultra violet and infrared spectroscopy in structural analysis.

2. **Nuclear magnetic resonance spectroscopy:** ¹HNMR spectroscopy: Introduction and theory, relaxation process, instrumentation, chemical shift, spin-spin coupling, different spin systems, coupling constants, spin-spin decoupling, long range coupling; Two dimensional NMR spectroscopy, nuclear over hauser effect, 2D correlated (COSY) and 2D Nuclear over hauser enhancement spectroscopy (NOESY), HMBC, HMQC. ¹³C NMR spectroscopy: Introduction, principle, chemical shift, spin-spin coupling, applications.
3. **Chromatographic methods:** Principle and applications of different chromatographic methods. These include, Column chromatography, Thin layer chromatography, and gel filtration, High Performance Liquid chromatography and Gas Chromatography etc.
4. **HPLC:** Detail study of HPLC techniques and its applications in pharmaceutical analysis. Different detector systems and columns used in pharmaceutical analysis.
5. **Mass spectroscopy:** Introduction, theory, the mass spectrum, determination of molecular formula, ionization technique, recognition of molecular ion, fragmentation process, application.
6. **Atomic absorption spectroscopy:** Theory, instrumentation and application in quantitative analysis.
7. **Fluorometry:** Introduction, theoretical principle, fluorescence and chemical structure, instrumentation, factors influencing intensity of fluorescence, comparison of fluorometry and spectrophotometry, applications of fluorometry in pharmaceutical analysis.
8. **Other Analytical tools:** Short study of differential Scanning Calorimetry (DSC) and Differential Thermal Analysis (DTA), Near Infrared detectors (NIR) and their applications in different areas.

Pharmaceutical Engineering- I

Credit 3

1. **The fundamentals of unit operations:** Fluid flow, Heat transfer and Mass transfer.
2. **Drying:** Definition, importance of drying, terminology, theory and fundamental concepts, periods of drying, constant rate period, falling rate period, critical moisture content, equilibrium moisture content, classification, direct, indirect, radiation, batch and continuous, dielectric, types of beds static, moving, fluidized, pneumatic bed systems, different drying equipments, construction, operation, merits, demerits, tray dryer, through-circulation dryer, pneumatic conveying, rotary dryer, spray dryer, tunnel dryer, steam tube rotary dryer, agitated pan dryer, vacuum rotary dryer, selection of drying equipment, preliminary dryer selection, drying tests, final selection. **Freeze drying:** Definition, application, basic principles, basic elements.
3. **Size reduction and classification.**
4. **Filtration:** Definition, importance of filtration, difference with expression, sedimentation and drying, classification of filters, theory of filtration, filter media, filter aids, filter thickeners, different filtration equipment, construction, operation, merits, demerits, the gravity nutsche, delpark industrial filter, bag filters, sand filters, plate and frame press, recessed plate filter press, eimco-burwell plates and frames, readco short cycle filter, vertical pressure leaf filter, horizontal plate filter, industrial tubular filter, Rodney hunt pressure filter, moore filter, vacu-flow suction leaf filter, string discharge filter, clarifying filters, selection of filtration equipments.
5. **Centrifuges:** General principles, Magnitude of centrifugal force, materials of construction, critical speed, sedimentation centrifuges, filtering centrifugals, centrifuge auxiliaries, drive mechanisms, feed and discharge lines, feed treatment, costs, selection of centrifugal separators.
6. **Solid-solid mixing:** Importance, fundamentals, batch homogeneity, types of solids-mixing machines, mixing mechanisms and operations, double cone, twin shell, horizontal drum, double-cone revolving around long axis, ribbon, vertical screw, batch muller, continuous muller, twin rotor, performance characteristics, selection of machines.
7. **Paste mixing:** Definition, importance, simple blending, dispersion operations, general equipment design, standard types of equipment and operations, change-can mixer, change-can mixer with planetary motion, change-can mixer with rotating turntable, troy angular mixer, duplex mixer, stationary-tank mixer, kneader, mullers, three-roll mill, selections of process and mixer.
8. **Liquid mixing:** Definition, importance, mixing equipment, axial and radial flow, Impellers, mechanisms, flow patterns, impellers, flat-blade and curves-blade turbines, spiral turbines, paddles, gate impellers, anchor impellers, different fixed-mounted and portable positions, shaft lengths, baffled and unbaffled tanks, vortex formation and its control, costs, selection of impeller.

Biopharmaceutics & Pharmacokinetics-II

Credit 3

1. **Introduction to compartment.**

- (a) **One-compartment open model**, determination of plasma concentration from one compartment open model, elimination rate constant, apparent volume of distribution, calculation of K from urinary data.
- (b) **Multiple compartment models**: (i) Two-compartment open model, method of residuals, apparent volumes of distributions, drug in tissue compartment, elimination rate constant (ii) Three compartment open model, method of residuals, determination of area under curve, apparent volumes of distribution, elimination rate constant.
2. **Pharmacokinetics of Drug absorption**: Zero-order absorption model, first- order absorption model, determination of absorption rates constant from oral absorption data.
3. **Multiple Dosage Regimen(MDR)**: Drug accumulation, repetitive intravenous injection, multiple oral dosage regimens, loading dose and determination of bioavailability and bioequivalence from MDR.
4. **Intravenous infusion**: One-compartment model drugs, two-compartment model drugs, infusion plus loading dose.
5. **Dosage adjustment in renal and hepatic disease**:
(a) Pharmacokinetic considerations, general approaches for dose adjustment in renal disease, dose adjustment based on drug clearance, dose adjustment based on the elimination rate constant, measurement of glomerular filtration rate (GFR), calculation of creatinine, clearance from serum creatinine concentration, dose adjustment based on nomogram, Giusti-Hayton method, Wagner method.
(b) Extracorporeal removal of drugs.
6. **Non-compartmental analysis**: Physiologic-pharmacokinetic model, statistical moment, mean residence time etc.
7. **Relationship between pharmacokinetic and pharmacologic responses.**

FOURTH YEAR, FIRST SEMESTER

Medicinal Chemistry-III		Credit 3
1.	Drug discovery and Drug design : Source of drugs, Cost and place of development of drugs, Search for new drugs, Genesis of drugs i) Serendipity ii) Random Screening iii) Extraction from natural sources iv) molecular modification (general process ,special process-ring closure or opening, formation of lower or higher homologues, toposide n , removal or replacement of bulky groups, isosteric substitution, change of position or certain groups, introduction of toposide moieties, modification towards inhibition or promotion of various electronic states). Methods of lead optimization (Topliss sequential method), Fibonacci Search, sequential complex optimization (v) Selection or synthesis of soft drugs, soft analogues, activated soft compounds, natural soft drugs, soft drugs based on the active metabolite approach, soft drug based on inactive metabolite approach (vi) Prodrugs (vii) Rational drugs design, antimetabolites, enzyme inhibitors.	
2.	Chemistry, mode of action, SAR and synthesis of : (a) Antihypertensive agents (β -blockers), (b) H ₂ -blockers, (c) Psychotropic drugs and antidepressants, (d) Antidiabetic drugs, (e) Semisynthetic Penicillin's (f) Cephalosporins, (g) Quinolone derivatives, (h) oral contraceptives and steroidal hormones. (i) Anticancer drugs.	
3.	Combinatorial chemistry : (a) Combinatorial synthesis: Introduction to drug discovery process (b) Library synthesis on resin beads – solid phase chemistry, resin beads, speeding up of peptide synthesis, mix and split library synthesis (c) Solution phase, indexed combinatorial libraries, template-based libraries, liquid phase combinatorial synthesis, d) Encoded combinatorial synthesis-encoded requirements. Examples of tagged libraries e) Solid phase library, chemistry of linkers, carboxylic acid linkers, carboxamide linkers, alcohol linkers, amine linkers, traceless linkers, light cleavable linkers, selected solid phase chemistry, f) Analysis of products with different analytical techniques used, IR, solid phase NMR g) Combinatorial chemistry: applications and impact on drug discovery.	

Pharmaceutical Technology-III	Credit 3
--------------------------------------	-----------------

1. **Sustained release drug delivery systems:** Principle of SR dosage forms, advantages and limitations of SR dosage forms, classification and types of SR dosage forms, methods of obtaining SR effects of drugs, drug release mechanisms from SR dosage forms, formulation and manufacturing of SR matrix tablets, dose calculation for SR dosage forms, evaluation of sustained release dosage forms.
2. **Aerosol science and technology:** Definition and classification of aerosols, propellants for aerosol manufacturing, components of aerosol formulations, containers and valves for aerosols, metered dose delivery of aerosols, manufacturing of aerosols, testing and quality assurance of aerosols.
3. **Design and operation of clean rooms:** Source of contamination, classification of clean rooms, airflow systems- conventional flow, unidirectional flow, laminar airflow units; air filtration mechanisms, fibrous filters and HEPA filters, temperature and humidity control, building design, construction and use, personnel, protective clothing, cleaning and disinfection, commissioning tests of clean and aseptic rooms, routine monitoring tests, the operation of clean and aseptic rooms, Key factors in clean room operations.
4. **Parenteral products:** Definition and classification of parenteral products, formulation considerations, vehicles and additives, containers, manufacturing techniques, raw materials and machines, quality control of parenteral products.
5. **Ophthalmic products:** Anatomy of eye and adrena, absorption of drugs in the eye, classification of ophthalmic products, safety considerations of ophthalmic products, formulation, vehicles and additives, manufacturing considerations, environment, manufacturing techniques, quality control of ophthalmic products, packaging of ophthalmic products.

Cosmetology	Credit 3
--------------------	-----------------

1. **The Skin:** Introduction, epidermis and keratinizing system, pigment system, dermis, nerves and sense organs, blood vessels, exocrine sweat glands, hair follicles, sebaceous glands, apocrine glands, common disorders of the skin.
2. **Product ingredients:** Commonly used surface-active agents, humectants, antiseptics, preservatives, antioxidants.
3. **The manufacture of cosmetics:** Introduction, mixing and the manufacture of bulk cosmetic products, solid-solid mixing, manufacture of pigmented powder products, mixing processes involving fluids, general principles of fluid mixing, mixing equipments for fluids, solid-liquid mixing, suspension of solids in agitated tanks, liquid-liquid mixing- miscible liquid, immiscible liquid.
4. **Skin Creams:** Introduction, Classification of skin creams, cold creams, cleansing creams, night and massage creams, moisturizing, vanishing and foundation creams, pigmented foundation creams, hand creams and hand-and-body creams, all purpose creams.
5. **Shaving preparations:** Introduction, Lather shaving cream, brush less or non-lathering cream, aerosol shaving foams, after-shave preparations.
6. **Dental products:** Introduction, formulation and manufacturing of toothpastes and tooth powders, mouth wash.
7. **Hair products:** Introduction, shampoos, hair setting lotions, hair tonics and conditioners.

Pharmacology-III	Credit 3
-------------------------	-----------------

1. **Antiepileptic drugs-** Phenytoin, toposide, toposidene, mephobarbitone, toposidene, valproic acid, toposiden, vegabatratin, benzodiazepines, trimathadone, toposide.
2. **Immunosuppressive agent and gene therapy-**Cytotoxic drugs, glucocorticoids, antibodies, specific T-cell inhibitors, gene modification, gene transfer, application.
3. **Antiviral drugs-**Anti-herpes virus, antiretro virus, anti-influenza virus, nonselective.
4. **Antineoplastic drugs:** Alkylating agents, antimetabolites, topo alkaloids, Taxanes antibiotics, toposide, toposiden, toposide.
5. **Psychotropic and antidepressant drugs**
6. **Drugs affecting uterine contraction-**Oxytocin, prostaglandin, ergot alkaloid.
7. **Antifungal drugs:** Amphotercin B, Flucytosine, Itracouzale, Keloconzole, Fluconazole, Nystatin, griseofulvin
8. **Cholinergic and anticholinergic drugs.**
9. **Adrenergic and antiadrenergic drugs.**
10. **Hormone therapy-** adenyhypophyseal and adrenocorticosteroid hormone.

11. **Ophthalmology**- Anatomical consideration, corneal grafting, cataract formation, contact lens, drugs used in the treatment of eye disorders.

FOURTH YEAR, SECOND SEMESTER

Quality Assurance and Quality Control systems	Credit 3
--	-----------------

1. Detail study of WHO cGMP guide line
2. Good Laboratory Practice
3. Sampling and sampling plan
4. Control charts.
5. Concept of Quality control and quality assurance
6. Hazards associated with chemicals and Laboratory safety
7. Importance of calibration.
8. Analytical methods validation.

Pharmaceutical Packaging Technology	Credit 3
--	-----------------

1. **Packaging Materials for pharmaceutical products:** Properties of packaging materials, Glass and glass containers, (vials, ampoules, glass bottles for non-sterile products) metal and metal containers, plastic and plastic containers, films, foils and laminates, rubber-based materials, aluminium tubes for ointments. Advantages and disadvantages of different packaging materials.
2. **Closures for pharmaceutical packaging:**
3. Tamper resistant packaging and Child resistant packaging.
4. Desiccants used in pharmaceutical packaging
5. Different packaging machines and accessories: Blister packing machine, sachet packing machine, strip packaging machine,
6. Testing and quality assurance of packaging materials.

Pharmaceutical engineering-II	Credit 3
--------------------------------------	-----------------

1. **Cooling and Refrigeration.**
2. **Air conditioning, humidification and dehumidification.**
3. **Evaporation and distillation.**
4. **Water Purification Engineering:** Types of water, Impurities in water, water softening and purification for potable water, Production and generation of Purified water (PW), Production of Water for injection (WFI), Techniques used in water purification, such as, deionization, electro deionization (EDI), distillation, reverse osmosis. Water storage and distribution systems for pharmaceutical plant, loop system. Piping components and types.
5. **Sterilization:**
 - A. Efficiency of sterilization.
Designing the sterilization process
Rate of biocidal action.
Initial contamination level
Sterility assurance
Determination of sterilizing conditions
Testing the sterilization process
 - B. Important engineering features of heat sterilizers,
Testing and validation of different sterilization process, including dry heat sterilizers, autoclaves, sterilization by filtration and gas sterilization.

Clinical, Hospital and community pharmacy.	Credit 3
---	-----------------

- A. Clinical Pharmacy:**
1. Introduction to clinical pharmacy
 2. Basic concepts of pharmacotherapy:

- a) Clinical pharmacokinetics and individualization of dosage regimen
- b) Drug induced diseases
- c) Adverse drug interaction
- d) Clinical toxicology
3. Interpretation of common clinical laboratory tests
4. Pathophysiology & Therapeutics:
 - i) Fluid and electrolyte disorders and shock
 - ii) Infectious diseases
 - iii) Cardio-vascular diseases
 - iv) Kidney and urinary tract disorders
 - v) Nervous system disorders
 - vi) Endocrine and reproductive disorders
5. Drug information

B. Hospital pharmacy:

A comprehensive knowledge of hospital pharmacy, control of special classes of drugs, floor stock drug, hospital pharmacist in educational and training programs, health education and public health

C. Community Pharmacy:

1. Definition and scope of community pharmacy
2. Organization inventory control and management of retail pharmacy business
3. Communication, counseling for patient compliance
4. Role of pharmacist in community health care and education

Pharmaceutical Regulatory Affairs

Credit 2

1. Regulations and laws governing the practices of pharmacy in Bangladesh (The Pharmacy Ordinance 1976).
2. Policies, sales, regulation and laws concerning to the manufacture, possession, distribution, sale of drugs and poisons:
The Drug Act 1940, The Poisons Act 1919 and related amendments, The drug ordinance 1982, The Drug Policy 1982, The Drug (control) ordinance 1982, The Narcotics (control) Act 1990, The drug policy 2006
3. Approval process, format and registration of pharmaceuticals in Bangladesh.
4. Rules and regulations for controlling poisons and narcotic materials in Bangladesh.
5. Control of Drug Advertisements and prices, patented and trade marked medicine, proprietary medicine, regulation of cosmetics and poison control.
6. Schedules of drugs and poisons.
7. Drug authority of Bangladesh: Functions and activities of Directorate of Drug registration methods in Bangladesh, Technical committee and Drug Control committee (DCC).