

UNIVERSITY OF DHAKA



Syllabus of the Faculty of Pharmacy

for

B. Pharm. Course (five years)

for the

Sessions: 2010-2011 and onwards

Faculty of Pharmacy
University of Dhaka
Syllabus of B. Pharm.

From session 2010-2011 (Grading system)

The courses of study for the degree of Bachelor of Pharmacy under the Faculty of Pharmacy shall extend over five academic years. The examination shall be taken in 5 parts under the following heads:

B. Pharm. Professional Year I Examination

Total Credit hours 41.

Examination to be held at the end of the first year of study

B. Pharm. Professional Year II Examination

Total Credit hours 40.

Examination to be held at the end of the second year of study

B. Pharm. Professional Year III Examination

Total Credit hours 40.

Examination to be held at the end of the third year of study

B. Pharm. Professional Year IV Examination

Total Credit hours 44.

Examination to be held at the end of the fourth year of study

B. Pharm. Professional Year V Examination

Total Credit hours 34.

Examination to be held at the end of the fifth year of study

Theory Class

For 4 credit courses- 60 hours

For 2 credit courses- 30 hours

Practical Class

30 hours for 1 credit laboratory courses

Duration of Theory Examination

For 4 credit courses - 4 hours

For 2 credit courses - 2 hours

Duration of Practical Examination

6 hours for 1 credit courses.

Assignment of Marks

4 credit theory course 100

2 credit theory course 50

1 credit practical course 25

1 & 2 credit viva voce 25 & 50

Industrial Training: Students are required to complete at least 4 weeks of in-plant training in reputed pharmaceutical industries at the end of B. Pharm. Part IV examination.

Hospital Training: Students are required to complete at least 3 months training in reputed hospitals and clinics at the end of B. Pharm. Part V examination.

**Listing of Pharmacy Courses
and Credit Hours**

B. Pharm. Professional Year I

PHR 101	Introduction to Pharmacy	Credit Hr: 2
PHR 102	Inorganic Pharmaceutical Chemistry-I	Credit Hr: 4
PHR 102L	Inorganic Pharmaceutical Chemistry-I -Lab	Credit Hr: 1
PHR 103	Organic Pharmaceutical Chemistry-I	Credit Hr: 4
PHR 103L	Organic Pharmaceutical Chemistry-I-Lab	Credit Hr: 1
PHR 104	Physical Pharmacy-I	Credit Hr: 4
PHR 104L	Physical Pharmacy-I-Lab	Credit Hr: 1
PHR 105	Pharmacognosy-I	Credit Hr: 4
PHR 105L	Pharmacognosy-I-Lab	Credit Hr: 1
PHR 106	Physiology-I	Credit Hr: 4
PHR 106L	Physiology-I-Lab	Credit Hr: 1
PHR 107	Pharmaceutical Microbiology	Credit Hr: 4
PHR 107L	Pharmaceutical Microbiology-Lab	Credit Hr: 1
PHR 108	Basic Anatomy	Credit Hr: 2
PHR 109	Computer Applications in Pharmacy	Credit Hr: 2
MAT 110	Mathematics & Fundamentals of Statistics	Credit Hr: 4
PHR 111	Viva voce	Credit Hr: 1
Total Credit Hours		41

B. Pharm. Professional Year II

PHR 201	Inorganic Pharmaceutical Chemistry-II	Credit Hr: 4
PHR 201L	Inorganic Pharmaceutical Chemistry-II-Lab	Credit Hr: 1
PHR 202	Organic Pharmaceutical Chemistry-II	Credit Hr: 4
PHR 203	Physical Pharmacy-II	Credit Hr: 4
PHR 203L	Physical Pharmacy-II-Lab	Credit Hr: 1
PHR 204	Pharmacognosy-II	Credit Hr: 4
PHR 204L	Pharmacognosy-II-Lab	Credit Hr: 1
PHR 205	Physiology-II	Credit Hr: 4
PHR 205L	Physiology-II-Lab	Credit Hr: 1
PHR 206	Biochemistry & Molecular Biology	Credit Hr: 4
PHR 206L	Biochemistry & Molecular Biology-Lab	Credit Hr: 1
PHR 207	Pharmaceutical Technology-I	Credit Hr: 4
PHR 207L	Pharmaceutical Technology-I-Lab	Credit Hr: 1
PHR 208	Pharmacology-I	Credit Hr: 4
PHR 208L	Pharmacology-I-Lab	Credit Hr: 1
PHR 209	Viva voce	Credit Hr: 1
Total Credit Hours		40

B. Pharm. Professional Year III

PHR 301	Pharmaceutical Analysis-I	Credit Hr: 4
PHR 301L	Pharmaceutical Analysis-I-Lab	Credit Hr: 1
PHR 302	Medicinal Chemistry-I	Credit Hr: 4
PHR 302L	Medicinal Chemistry-I-Lab	Credit Hr: 1
PHR 303	Pharmacology-II	Credit Hr: 4
PHR 303L	Pharmacology-II-Lab	Credit Hr: 1
PHR 304	Clinical Pathology	Credit Hr: 2
PHR 305	Pharmaceutical Technology-II	Credit Hr: 4
PHR 305L	Pharmaceutical Technology-II-Lab	Credit Hr: 1
PHR 306	Pharmaceutical Engineering	Credit Hr: 4
PHR 307	Biopharmaceutics-I	Credit Hr: 4
PHR 307L	Biopharmaceutics-I-Lab	Credit Hr: 1
PHR 308	Applied Microbiology	Credit Hr: 2
PHR 309	Pharmaceutical Biotechnology	Credit Hr: 2
PHR 310	Pharmaceutical Marketing & Management	Credit Hr: 4
PHR 311	Viva voce	Credit Hr: 1
Total Credit Hours		40

B. Pharm. Professional Year IV

PHR 401	Pharmaceutical Analysis-II	Credit Hr: 4
PHR 401L	Pharmaceutical Analysis-II-Lab	Credit Hr: 1
PHR 402	Medicinal Chemistry-II	Credit Hr: 4
PHR 402L	Medicinal Chemistry-II-Lab	Credit Hr: 1
PHR 403	Pharmacology-III	Credit Hr: 4
PHR 403L	Pharmacology-III-Lab	Credit Hr: 1
PHR 404	Disease Management-I	Credit Hr: 4
PHR 405	Clinical Pharmacy	Credit Hr: 4
PHR 406	Pharmaceutical Technology-III	Credit Hr: 4
PHR 406L	Pharmaceutical Technology-III-Lab	Credit Hr: 1
PHR 407	Biopharmaceutics -II	Credit Hr: 4
PHR 407L	Biopharmaceutics-II-Lab	Credit Hr: 1
PHR 408	Cosmetology	Credit Hr: 2
PHR 408L	Cosmetology-Lab	Credit Hr: 1
PHR 409	Pharmacy Practice-I	Credit Hr: 4
PHR 410	Industrial Training	Credit Hr: 2
PHR 411	Viva voce	Credit Hr: 2
Total Credit Hours		44

B. Pharm. Professional Year V

PHR 501	Quality Control & Analytical Method Validation	Credit Hr: 4
PHR 501L	Quality Control & Analytical Method Validation- Lab	Credit Hr: 1
PHR 502	Functional Foods, Nutraceuticals and Herbal Medicine	Credit Hr: 2
PHR 503	Biostatistics and Bioinformatics	Credit Hr: 4
PHR 504	Disease Management-II	Credit Hr: 4
PHR 505	Clinical Research and Clinical Pharmacokinetics	Credit Hr: 4
PHR 505L	Clinical Research and Clinical Pharmacokinetics-Lab	Credit Hr: 1
PHR 506	Pharmacy Practice-II	Credit Hr: 4
PHR 507	Pharmaceutical Regulatory Affairs	Credit Hr: 2
PHR 508	Hospital Training	Credit Hr: 4
PHR 509	Project and Dissertation	Credit Hr: 2
PHR 510	Viva voce	Credit Hr: 2
Total Credit Hours		34

Detailed description and course contents of Five year Bachelor of Pharmacy Program

B. Pharm. Professional Year I

PHR 101 Introduction to Pharmacy

Credit Hr: 2

1. **History and evaluation of Pharmacy:** Ancient ages, middle ages, modern ages, development of pharmacy in Bangladesh, important pharmacy dates.
2. **Pharmacy education and its specialty:** Brief introduction of the courses taught in a pharmacy program, pharmacy education in Bangladesh, pharmacy education in other countries.
3. **Differences between occupation and profession:** Pharmacy as a profession, definition and characteristics of pharmacy profession, social recognition and status of pharmacy profession, scopes and opportunities for pharmacists, career development in pharmacy – international and Bangladesh perspective.
4. **Different systems of medicine:** Allopathic, ayurvedic, unani and homeopathic systems of medicine, other systems of medicine, recent interests in herbal medicines.
5. **Pharmacists' code of ethics:** Oath of a pharmacist, professional pharmacy organizations in Bangladesh and abroad, local and foreign drug regulatory bodies.
6. **Definition of drugs and medicines:** Sources of drugs, classification of drugs on the basis of actions, target organs and uses, chemical, generic and brand names, different types of dosage forms.
7. **Drug standards:** Pharmacopoeias and formularies (USP, BP, NF, BNF, BDNF etc.), monographs of drugs, drug regulation and control.
8. **Pharmacy information resources:** Books, reference and test books, journals, software etc. pharmacy information in the internet, pharmacy journals – home and abroad, study of scientific papers.
9. **Some common terms and abbreviations used in pharmaceutical sciences.**

Recommended books

1. Introduction to Pharmacy, Dr. Md. Shah Amran, 1st edition, 2010, Krishnachura Prokashoni, Dhanmondhi, Dhaka, Bangladesh.
2. Pharmacy, Pharmaceutical sector and Healthcare, Dr. Md. Shah Amran, 1st edition, 2009, Shova Prokashoni, Bangla Bazar, Dhaka, Bangladesh.

PHR 102 Inorganic Pharmaceutical Chemistry-I

Credit Hr: 4

1. **Review of atomic structures and chemical bonds:** An elementary treatment of theories of atomic structures, quantum numbers, Pauli's exclusion principle, origin of spectral lines. Electronic concept of valency, different types of chemical bonds e.g. ionic, covalent, coordinate covalent, metallic, dipole, hydrogen bond etc., theories of covalent bonding and hybridization.
2. **Classification of elements:** Modern periodic table and periodic law, variation of properties within periods and groups, usefulness and limitations of periodic table.
3. **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.

4. **Chemistry of co-ordination compounds:** Ligands or co-ordinating 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.
5. **Medicinal gases:** Medicinal gases (oxygen, nitrogen, carbon dioxide, helium, nitrous oxide, mixtures), components, containers and closures, production and process control, packaging and labelling, holding and distribution, laboratory controls, return and salvage of drug products.
6. **Inert or noble gases:** Sources, electronic configuration and inertness, isolation of inert gases from dry air (chemical method) and liquid air (physical method), physical & chemical properties and uses of noble gases, conditions and types of compounds formed by inert gases.

PHR 102L Inorganic Pharmaceutical Chemistry-I-Lab
Credit Hr: 1

Qualitative analysis of inorganic ions and radicals:

Na^+ , K^+ , Ca^{+2} , Al^{+3} , Mg^{+2} , Fe^{+2} , Mn^+ , Ag^+ , Cu^+ , Cu^{+2} , Cl^- , Br^- , I^- and CO_3^- , SO_4^{-2} , NO_3^- , PO_4^{-3} etc.

PHR 103 Organic Pharmaceutical Chemistry-I
Credit Hr: 4

1. **Introduction:** History of organic chemistry, classification of organic compounds, systematic naming of organic compounds, electronegativity, polarity of molecules, structure and physical properties, intermolecular forces, inductive effects, bond length, bond angles and bond strength, carbonium ions, carbanions, electrophiles, nucleophiles, free radicals, hydrogen bonding, m.p., b.p., solubility of organic compounds etc. Aromaticity, benzene and substituted benzenes, electrophilic aromatic substitution 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:**
 - a. Simple aromatic compounds
 - b. Aromatic halogen compounds
 - c. Aromatic nitro compounds
 - d. Aromatic amino compounds
 - e. Diazonium salts and related compounds
 - f. Sulphonic acids

- g. Phenols
- h. Alcohols, aldehydes, ketones
- i. Aromatic acids

**PHR 103L Organic Pharmaceutical Chemistry-I-Lab
Credit Hr: 4**

Identification of simple organic compounds through physical and chemical analyses.
Synthesis of simple compounds using name reactions.

**PHR 104 Physical Pharmaceutical Chemistry-I
Credit Hr: 4**

1. **Chemical equilibrium:** Law of mass action, determination of equilibrium constant, heterogeneous equilibrium and homogeneous equilibrium, the Le Chatelier principle, Van't Hoff equation.
2. **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.
Thermochemistry and thermochemical 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.
3. **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).
4. **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.
5. **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.
6. **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.
7. **Buffer and isotonic solutions:** Buffer equations, buffer capacity, buffer in pharmaceutical and biologic systems, buffered isotonic solutions, methods of adjusting tonicity and pH.

**PHR 104L Physical Pharmaceutical Chemistry-I-Lab
Credit Hr: 1**

1. Standardization of acids and bases.
2. Determination of pK_a and pK_b values.
3. Preparation of solution of different pH & buffer capacity.
4. Determination of phase diagram of binary systems.

5. Determination of distribution coefficients.
6. Determination of mol. Wt. by Victor Meyer's method.
7. Determination of heat of solution by measuring solubility as a function of temperature.

PHR 105 Pharmacognosy-I

Credit Hr: 4

1. **Definition and scope of pharmacognosy:** Its historical development.
2. **Official, nonofficial and unofficial drugs:** Definition, differences, examples etc.
3. **Structures of the cell as a unit:** Its function and form, introduction to the general structure of the morphological parts of the plants.
4. **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, drug adulteration, evaluation of crude drugs.
5. **Plant analysis:** Extraction, separation, chromatography; types of plant constituents, comparative phytochemistry and chemotaxonomy.
6. **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 Bees wax.
 - (b) **Carbohydrate and related compounds:** Sugars and sugar containing drugs- dextrose, liquid glucose, fructose, sucrose, lactose etc. Polysaccharide containing drugs- starches, dextrans etc. Gums and mucilages- tragacanth, acacia, sterculia, sodium alginate, agar, cellulose.
 - (c) **Alkaloid:** Distribution, properties, tests, extraction, structure types and classification.
7. **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, Black Cumin, Jam and Madar.
8. **Vitamins and vitamin containing few selected animal drugs:** Definition of vitamins, general uses, classification, structures of vitamins, vitamin containing animal drugs- Cod liver oil, Shark liver oil, Hilsha fish/liver oil etc.
9. **Surgical dressings and fibres:** Classification, importance and brief study of different types of surgical dressings and fibres.

PHR 105L Pharmacognosy-I-Lab

Credit Hr: 1

1. The cell, cell contents and cell types.
The cell - (a) some cellular organism, chalk & diatomite. (b) Fungi- Mucor or rhizopus, aspergillus, penicillium, ergot and yeast.
Cell contents – Starches and derivatives, calcium carbonate, silica.
Cell types – Parenchyma and modifications – colocynth, nux-vomica, endosperm, cinnamon powder, tea, labiate stem, parenchyma-pericyclic fibres jute, xylem fibres and vessels-liquorice, tracheids-pinus wood.
2. Epidetamal cells and associated structures (trichomes stomata etc.), leaves of belladonna, mentha, rosemary, senna, Indian hemp, digitalis etc. Seed trichomes- cotton and nux-vomica seeds, cork cells- cascara sagrada.
3. Study of some groups of unorganized white and off-white powder and whole drugs:
 - (a) General tests for carbohydrates.
 - (b) Preparation and examination of starches and related products.

- (c) Examination of gums: Acacia, tragacanth, sterculia agar and alginates.
4. Study of some medical plants of Bangladesh.
 5. Extraction and tests of alkaloids, lipids etc.

PHR 106 Physiology-I
Credit Hr: 4

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, haemostasis.
2. **Tissue:** Definition, classification, characteristics, distribution, minute structures and functions of different tissue, bone and cartilage.
3. **Blood system:** Composition and functions of blood, plasma and its components, plasma proteins and their functions, blood coagulation, blood transfusion and blood groups, haemolysis, ESR, blood forming cells- characteristics, functions, their formation and destruction; haemoglobin- its structure, properties, function and haemoglobin derivatives; anemia- definition and classification, causes and clinical features of various anemia.
4. **Cardiovascular system:** Heart- structure and blood circulation, cardiac muscles, 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.
5. **Digestive system:** Structure of different parts of alimentary system, gastrointestinal motility and its control, swallowing and defaecation; secretion of digestive juices from saliva, stomach, pancreas; functions of digestive juices and their mechanism and regulation of secretions; digestion and absorption of various food stuffs; liver- its function, formation of bile and its circulation.
6. **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.

PHR 106L Physiology-I-Lab
Credit Hr: 1

1. Study of compound microscope.
2. Microscopical study of blood cells: R.B.C., W.B.C., and platelets.
3. Estimation of hemoglobin.
4. Total count of R.B.C.
5. Total count of W.B.C.
6. Differential count of W.B.C.
7. Determination of clotting and bleeding time.
8. Examination of clot under the microscope.
9. Effect of chemical agents on R.B.C.
10. Fragility test of R.B.C.
11. Determination of Erythrocyte sedimentation rate (ESR).
12. Examination of Haemin crystals.

PHR 107 Pharmaceutical Microbiology

Credit Hr: 4

1. **Introduction to microbiology:** Microbiology as a field of biology, place of microbiology in the living field, prokaryotic and eucaryotic organisms, group of microorganisms, areas of microbiology, applications of microbiology.
2. **History and evolution of microbiology:** Spontaneous generation and biogenesis, germ 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 for 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 viral infections, bacterial virus or bacteriophages, morphology and composition, cultivation of bacterial viruses, reproduction of bacterial viruses.
6. **Basic concepts of immunology:** Introduction, types of immune systems, non specific and specific components of the immune system, immune regulation and diversity, types of immunity, Infections, pathogenicity and virulence immunity, hypersensitivity, Inflammation, autoimmunity, cancer immunotherapy, immunodiagnostics and immunological products (vaccines, toxoids, sera).

**PHR 107L Pharmaceutical Microbiology-Lab
Credit Hr: 1**

1. Identification and characterization of bacteria.
2. Staining of bacterial cells and spores.
3. Preparation of pure bacterial cultures.
4. Preparation of pure culture and its identification.
5. Bacterial counts.

**PHR 108 Basic Anatomy
Credit Hr: 2**

1. **Alimentary system:** Oral cavity, pharynx, esophagus, stomach, small intestine, caecum, appendix, colon, sigmoid, rectum, anal canal.
2. **Cardiovascular system:** Heart, ascending aorta, arch of the aorta, descending thoracic aorta, abdominal aorta.
3. **Respiratory system:** Nose, pharynx, larynx, trachea, bronchus, lung.
4. **Urinary system:** Kidney, ureter, urinary bladder, urethra
5. **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, Labia minora, clitoris vaginal orifice.

6. **Nervous system:** CNS: Brain & spinal cord; PNS: spinal nerve & autonomic nervous system (sympathetic & parasympathetic).
7. **Endocrine gland:** Pituitary gland, thyroid & parathyroid gland, pancreas, adrenal gland, ovary, testis.
8. **Exocrine gland:** Parotid gland, submandibular gland, pancreas.
9. **Metabolic organ:** Liver with gall bladder.
10. **Reticulo endothelial system:** Spleen, thymus, tonsil, lymph node, bone marrow.

PHR 109 Computer Applications in Pharmacy Credit Hr: 2

(The course will be conducted by both theoretical and practical classes.)

1. **Historical development of computers:** Classification of computers, organization and functional parts of central processing unit, memory and memory organizations, input / output media and devices, storage devices, hardware and software.
2. **Operating system, windows, office applications:** Word processing (MS Word), data management and database analysis (MS Excel), presentation tools (MS power point), graphics management (Adobe Photoshop), specialized applications – chemdraw, reference citation manager, SPSS etc.
3. **Computer and communication:** Networking, internet - scopes and applications, pharmacy resources in the world wide web.
4. **Computer applications in pharmacy:** Drug discovery and development, formulation and dosage form research and development, hospital management, prescription and patient management, preclinical and clinical trials, biopharmaceutical data analysis, industry management, quality control and analysis, chemo-informatics and bioinformatics, drug information system etc.

MAT 110 Mathematics & Fundamentals of Statistics Credit Hr: 4

Section A: Mathematics

1. **Graphs and gradients:** (a) Rectangular co-ordinates, curve fitting using 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.
 X^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 2^n factorial, scope of more advanced designs.
11. **Random samples and random numbers:** The need and use, representative samples.

B. Pharm. Professional Year II

PHR 201 Inorganic Pharmaceutical Chemistry-II

Credit Hr: 4

1. **Essential electrolytes:** Intra and extra cellular electrolytes (Na, K, Ca and Cl ions.); Electrolytes in acid base therapy; electrolytes in replacement therapy, electrolyte combination therapy.
2. **Essential trace elements:** Essential trace elements and their preparations (Cu, Zn, Mn, S, I, Cr, Se, Co, Ni, etc.), applications of essential trace elements in pharmaceutical sciences.
3. **Antioxidants, solvents, pharmaceutically acceptable glass and glass wires.**
4. **Hematinic preparations:** Various types of iron and iron compounds.
5. **Gastrointestinal agents:** Classification of inorganic gastrointestinal agents, systemic and non-systemic antacids, preparation and application of antacids, preparation and application of adsorbents and saline cathartics or laxatives.
6. **Dental preparations:** Dental plaque and antiplaque agents, dental caries, fluorides and other anticaries agents (preparation and application), dentifrices, mouthwash.
7. **Topical agents:** Classification of topical agents, preparations and applications of different antimicrobial, astringent and protective agents.
8. **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.
9. **Environmental chemistry and environmental sciences:**
 - A. Definition, causes of environmental pollution, types of pollutions (gases like SO₂, SO₃, CO₂, CO, NO, HCl, NO₂ etc., hydrocarbons, cigarettes, smokes, suspended particulate, pesticides, gasoline and industrial waste, pharmaceutical food additives), deleterious effects of pollutants on life cycle, applications and importance of environmental sciences.
 - B. Heavy metal toxicity: Poisoning caused by mercury, arsenic, lead, iron and copper, their adverse effects on human life cycle and study of antidotes used in these poisoning cases.

PHR 201L Inorganic Pharmaceutical Chemistry-II-Lab

Credit Hr: 1

1. **Identification of inorganic ions from pharmaceutical formulations:**
Ca⁺², Fe⁺², Al⁺³, Mg⁺², K⁺ and Na⁺ ions from supplied preparations.
2. **Conversion of different water insoluble or sparingly soluble drugs into water soluble form:**
 - a. Na/K-salicylate from salicylic acid.
 - b. Na/K-benzoate from benzoic acid.
 - c. Na/K-citrate from citric acid.
3. **Preparation of inorganic drugs:**
 - a. Preparation of aluminium hydroxide gel.
 - b. Preparation of magnesium hydroxide.
 - c. Preparation of haematinics- ferrous chloride, ferrous gluconate and ferrous fumarate.

PHR 202 Organic Pharmaceuticals Chemistry-II

Credit Hr: 4

- 1. Reaction mechanisms:**
 - (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.
 - (c) Elimination reaction:** Unimolecular (E1) and bimolecular (E2), stereochemistry of elimination reaction.
 - (d) Rearrangement reaction:** Hofmann, Claisen, Sigmatropic and Fries rearrangement.
- 2. Name reactions:** Arndt- Eistertd, Baklelite, Baeyer-Villiger, Birch reduction, Clemmensen reduction, Darzens condensation, Diels Alder, Eschweiler-Clarke, Friedel- Crafts, Gabriel synthesis, Gettermann- Koch and Sandmeyer, Grignard, Hofman, Mannich, Michael, Meerwin- Pondorf- Verley, Oppenauer oxidation, Perkin, Reformatsky, Reimer- Tiemann, Vilsmeier- Haack, Witting and Wolf-Kishner reduction.
- 3. A general introduction of heterocyclic compounds:** Characteristic properties and pharmaceutical importance of such compounds.
- 4. Carbohydrates:** General considerations, chemistry, stereochemistry, classification, aldoses, ketoses, oxidation, effect of alkali, Kiliani- Fisher synthesis of aldoses, Ruff degradation, optical family, D-L, R-S cyclic structures of D (+) glucose, mutarotation, hemiacetal, acetal form of glucose, ring size determination, disaccharide, structure determination of polysaccharides, starch cellulose, glycogen, chemical and pharmaceutical importance of carbohydrate, blood sugar, glycogenesis, glycolysis, TCA cycle, metabolism of carbohydrates etc.
- 5. Lipids:** General consideration, chemistry, biosynthesis of fats and fatty acids, catabolism of fat, fatty acid cycle, β - oxidation, catabolism of unsaturated fatty acids, ketone bodies, ketosis, ketouria, ketoacidosis, diabetic coma and its treatment, lactic acid and acidosis, phosphoglycerides, steroids, bile salts etc.
- 6. Amino acids and proteins:** General considerations, structure of amino acids, acidity and basicity of amino acids, isoelectric point, preparations and reactions of amino acids, essential amino acids, metabolism of amino acids-deamination, transamination, racimization etc.

PHR 203 Physical Pharmacy-II Credit Hr: 4

- 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, emulgents, 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 pH, potentiometric titrations and oxidation- reduction systems, concentration cells.
7. **Micrometrics :** 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.

**PHR 203L Physical Pharmacy-II-Lab
Credit Hr: 1**

1. Viscosity determinations:
 - (a) Determination of viscosity of pure liquids such as glycerin, alcohol etc.
 - (b) Determination of viscosity of liquid pharmaceutical preparation- syrup, emulsion, suspension etc.
 - (c) Study of variation of viscosity of liquid with temperature using Ostwald of Engleris viscometer.
2. Determination of velocity constant of the hydrolysis of methyl/ ethyl acetate catalyzed by HCl/ NaOH.
3. Determination of adsorption isotherm of oxalic (or acetic) acid from aqueous solution by charcoal and calculation of the constant in Freundlich's equation.
4. Determination of the equilibrium constant of the reaction $KI + I = KI_3$.
5. Determination of solubility of a sparingly soluble salt in water by conductance measurement.
6. Determination of velocity constant for the hydrolysis of an ester in the basic medium by conductance measurements.
7. Determination of the molecular weight of an organic solid.

**PHR 204 Pharmacognosy-II
Credit Hr: 4**

1. **Phytochemistry and pharmaceutical uses of the following plant constituents along with consideration of some important local and foreign drugs of each groups:**
 - A. **Glycosides and glycoside containing drugs**, biosynthesis of glycosides. The details of the following:
 - i) Cyanogenic: Wild cherry.
 - ii) Isothiocyanate: Mustard (Black mustard and white mustard).
 - iii) Cardiac: Digitalis, Strophanthus, Squill.
 - iv) Saponins: Sarsaparilla, Glycyrrhiza, Dioscorea.
 - v) Anthraquinone glycosides: Cascara sagrada, Aloe, Senna, Rhubarb.
 - vi) Other glycosides (alcohol, aldehyde, lactone, phenol, flavonoid) and neutral principles: Willow bark, Vanilla, Cantharide, Uva ursi, Gentian, Quassia, Saffron etc.
 - B. **Alkaloids:** Biosynthesis of tropane, quinoline, iso-quinoline and indole alkaloids. The details of the followings –
 - i) Pyridine-piperidine: Areca
 - ii) Tropane: Belladonna, Stramonium, Hyoscyamus and coca
 - iii) Quinoline: Cinchona, Cuprea bark
 - iv) Isoquinoline: Ipecac, Opium, Sanguinaria, Curare

- v) Indole: Rauwolfia, Nux vomica, Ergot, Catharanthus
 - vi) Imidazole: Pilocarpine
 - vii) Steroidal: Veratrum viride, Aconite
 - viii) Purine base: Coffee, tea, Cocoa
- C. **Volatile oils and related terpenoids:** Methods of obtaining volatile oils, chemistry, medicinal and commercial uses, biosynthesis of some important volatile oil used as drugs.
- Details of different types of volatile oils containing drugs:
- i) Terpenes or sesquiterpenes: Turpentine, Juniper
 - ii) Alcohols: Coriander, Sandalwood
 - iii) Ester: Peppermint, Lavender, Rosemary
 - iv) Aldehydes: Cinnamon, Lemon
 - v) Ketones: Spearmint, Caraway, Camphor
 - vi) Phenols: Clove, Thyme, Cinnamon leaf
 - vii) Ethers: Fennel, Nutmeg, Eucalyptus, Anise
 - viii) Peroxides: Chenopodium
 - ix) Others: Mustard, Wintergreen, Bitter almond
- D. **Phenolic compounds and tannins:** Chemical nature and test for tannins, medicinal and commercial uses, some tannin containing drugs such as Nutgall and Catechu.
- E. **Resin and resin combinations** (e.g. resin, oleoresin, oleo gum resin, balsam): Definition, chemistry, uses in pharmacy; brief study of Podophyllum, Jalap, Cannabis, Capsicum, Ginger, Myrrh, Tolu Balsam, and Benzoin.
2. **Herbs as health foods:** Definition, chemistry, uses in pharmacy; brief study of Alfa alfa, Apricot pits, Arnica, Garlic, Onion, Ginseng, Ginko biloba, Spiriluna Fenugreek, Sassafras, Honey etc.
3. **Poisonous plants and natural pesticides:** Datura, Poison hemlock, Water Hemlock, Foxglove (Digitalis), Ipomoea, Tobbaco, Poppy, Pyrethrum flower, Derris and Lanchoarpus, Red squill etc.

PHR **Pharmacognosy-II-Lab**
204L **Credit Hr: 1**

1. Pharmacognostic study of a few selected powdered drugs.
2. Chromatographic techniques: analysis of plant extracts by thin layer chromatography.
3. Study of volatile oils and some volatile oil containing drugs: Caraway, Clove, Cinnamon, Peppermint etc.
4. Detection of adulterants, (i.e. cotton seed, sesame and arachis oils) in olive oil.
5. Examination of Cod liver oil and detection of vitamin A in Cod liver oil.
6. Extraction and isolation of anthraquinone glycosides from Cascara sagrada, Aloe, Senna and Rhubarb.
7. Isolation of lycopene from tomato.
8. Isolation of β -Carotene from carrot.
9. Examination of some saponin containing drugs: Sarsaparilla, Dioscorea etc.
10. Study of few important cardioactive drugs: Digitalis, Strophanthus and Squill.
11. Study of alkaloids and some alkaloid containing drugs: Belladonna, Strammonium, Cinchona, Rauwolfia, Tea, Coffee, Tobacco, Ergot, Ephedra, Nux vomica and Areca.
12. Isolation of lactose from Cow's milk.
13. Physical and chemical tests for honey.

14. Study of some important medicinal and poisonous plants of Bangladesh.

PHR 205 Physiology-II
Credit Hr: 4

1. **Nervous system:** Neuron- properties, classification and functions; neuroglial cells and their functions; nerve fibres-definition, types, properties of nerve fibres, origin and propagation of nerve impulses across nerve fibres, action potential; synapse- classification, structure, properties and functions; neurotransmitters- classifications and functions, nerve 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, disorders of abnormal hormone secretions.
3. **Metabolism:** Fat, carbohydrate, protein and nucleoprotein metabolism; metabolic pathways of fats, carbohydrates and proteins; enzymes, vitamins and hormones regulating various metabolic steps; vitamins and minerals: their physiological properties and functions.
4. **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.
5. **Reproductive system:** Testis & accessory reproductive systems & their functions, male hormones and their functions, spermatogenesis and its hormonal regulation. Organs of female reproductive 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.
6. **Regulation of body temperature:** Heat production & heat dissipation, role of hypothalamus & other nerve factors in body temperature regulation, abnormalities in body temperature regulation.

PHR 205L Physiology-II-Lab
Credit Hr: 1

1. Recording of normal heart beat in toad.
2. Demonstration of the effects of temperature variation on toad heart.
3. Demonstration of the effects of stannous ligatures on toad heart.
4. Demonstration of the effects of drugs on toad heart.
5. Demonstration of the effect of Electrolytes (Na^+ , K^+ , Ca^+) on toad heart.
6. Recording of respiration with stethograph.
7. Measurement of B.P. with sphygmomanometer: effects of physical exercise on B.P. and heart rate.
8. Biochemical tests on saliva: effect of ptyalin on starch.

9. Collection of gastric juice; test for gastric acidity.
10. Estimation of blood sugar in normal person.

PHR 206 Biochemistry & Molecular Biology
Credit Hr: 4

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:** Different amino acids structures and functions, importance of amino acid sequence in protein structure, important bonds in protein, functions of proteins in biological system; peptide bond, disulfide bridge in protein structure; α helix, β sheet, hairpin turn, denaturation and renaturation of protein, 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, polarity of DNA chain, 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, 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 enzymes, regulation of enzyme activity, enzymes and reaction equilibria, enzyme kinetics, enzyme inhibition, common features of enzymes, enzyme cofactor/coenzyme; Vit B₁, Vit B₂ etc as coenzymes.

PHR 206L Biochemistry & Molecular Biology-Lab
Credit Hr: 1

1. Determination of protein content by spectrophotometric method.
2. Determination of extinction coefficient of protein.
3. Identification and molecular weight determination of protein by SDS-PAGE.
4. Identification of DNA by agarose gel electrophoresis.
5. Synthesis of DNA by PCR method.
6. Determination of lipid profiles.
7. Determination of serum creatinine level.
8. Determination of blood urea level.
9. Determination of SGPT, SGOT levels in blood.

PHR 207 Pharmaceutical Technology-I
Credit Hr: 4

- 1, **Pre-formulation:** Preliminary evaluation and molecular optimization, bulk characterization of the material crystallinity and polymorphism, thermal properties, hygroscopicity, particle characterization, bulk density, powder flow properties, solubility analysis, pK_a determination, pH solubility profile, effect of temperature, solubilization, partition coefficient, dissolution, stability analysis, solution stability, solid state stability.
- 2, **Chemical and physical incompatibility.**
- 3, **Pharmaceutical excipients:** Chemistry, physical properties and uses of the following excipients- acidifying agents, air displacement agents, alkalizing agents, antifoaming agents, antimicrobial preservatives, antioxidants, buffering agents, chelating agents, colors, complexing agents, emulsifying agents, flavoring agents and perfumes, humectant, ointment bases, solvents, stiffening agents, wetting and solubilizing agents.
- 4, **Basic principles of compounding and dispensing:** Weight, measures and units used in calculation for compounding and dispensing, fundamental operation in compounding, good pharmaceutical practices in compounding and dispensing, containers and closures for dispensed products, prescription and handling of prescription, responding to the prescription, labelling of dispensed medications.
- 5, **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.
- 6, **Dispersed system:**
 - (a) **Properties of dispersed systems:** Theoretical aspects of suspension, emulsion and colloids, surface charge activities and zeta potential, Inter- particle force, crystal growth, wetting, adsorption at solid-liquid interface, surface and interfacial tension, flocculation and coalescence.
 - (b) **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.
 - (c) **Emulsion:** Definition and applications, advantages and disadvantages, theory of emulsion formation, 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.
- 7, **Semisolids (Ointments, paste, gels):** Structure of skin, percutaneous absorption of drugs, definition and classification of semisolids, classification of ointment bases; formulation of ointments, pastes and gels; manufacturing of ointments, pastes and gels; rheological consideration, evaluation and quality analysis of ointment.
- 8, **Suppositories:** Drug absorption from colon, classification of suppositories, suppository bases, formulation of suppositories, manufacturing of suppositories, testing of suppositories.

PHR
207L

Pharmaceutical Technology-I-Lab
Credit Hr: 1

1. Preparation of percentage solution.
2. Preparation of aromatic water.
3. Preparation of syrup:
 - (a) Phenobarbitone-Na syrup
 - (b) Chlorpheniramine maleate syrup
 - (c) Promethazine HCl syrup
 - (d) Iron syrup
4. Preparation of suspension:
 - (a) Paracetamol suspension
 - (b) Antacid suspension

- (c) Chalk powder suspension
- 5. Preparation of emulsion and determination of type of emulsion
 - (a) Primary emulsion by dry gum method and wet gum method.
 - (b) Castor oil emulsion.

PHR 208 Pharmacology-I
Credit Hr: 4

1. **Introduction to Pharmacology:** Definition of pharmacology, drug, medicine and pro drug; pharmacokinetics, pharmacodynamics, agonist, synergism, side effect, toxicity, 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:** Receptors, nature of receptors, drug antagonism, relation between drug dose & clinical response.
3. **Signalling mechanism and drug action:** Legend gated channels, G-proteins and second messengers.
4. **Drugs for peptic ulcer:** Antacids, H₂ - receptor blockers, proton pump inhibitors, PG analogues, mucosal-protective agents, Helicobacter pylori infections.
5. **Anticoagulants:** Heparin, calcium complexing agents, oral anticoagulants.
6. **Autacoids:** Amine, lipid & peptide autacoids.
7. **Haematinic drugs:** Iron, vit B₁₂, folic acid, erythropoietin
8. **Sedative & hypnotics:** Benzodiazepine & barbiturates.
9. **CNS stimulant drugs:** Strychnine, xanthine & methylxanthine, amphetamine, nicotine.
10. **Chemotherapy of parasites:** Drugs used in helminthiasis, malaria, amebiasis, giardiasis, leishmaniasis & trichomoniasis.

PHR 208L Pharmacology-I-Lab`
Credit Hr: 1

1. Study of drugs acting on CNS
 - (a) CNS stimulant drugs (strychnine, ephedrine, amphetamine).
 - (b) CNS depressant drugs (barbiturates induced sleeping time).
2. Effect of pilocarpine on saliva secretion of rat.
3. Effect of digitalis, adrenaline, noradrenaline, isoprenaline on toads heart.
4. Effect of local anesthetics on rats tail.
5. Study of mydriatic and myotic effect on rabbit eye (e.g. pilocarpine, atropine, physostigmine etc.).

B. Pharm. Professional Year III

PHR 301 Pharmaceutical Analysis-I Credit Hr: 4

- 1. Introduction and techniques of pharmaceutical analysis:**
 - (A) Introduction- selection of samples, selection of chemicals.
 - (B) The art and science of pharmaceutical analysis- choosing the tools, identification of containers, filtration, ignition of precipitates, drying of samples, recording units.
- 2. Aqueous acid-base titration:** Definition, distribution of acid-base species with pH of the medium, acid-base titrimetry for determination of weakly acidic and basic pharmaceuticals, indicators and theories of indicators, selection of indicators, applications of acid base titrations.
- 3. 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.
- 4. Oxidation-reduction titration:** Principles and concepts; determination involving potassium permanganate, potassium dichromate, potassium bromate, Iodometric and miscellaneous oxidation and reduction titration; indicators, applications of oxidation- reduction titration.
- 5. Complexometric titration:** Introduction to complexometric titration, complexes and chelates, stability of complex ions, titration based on complex formation, types of complexometric titrations, techniques employed in chelometric titration, methods of end point detection, titration selectivity and masking agents.
- 5. 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.
- 7. Chromatographic methods:** Introduction, principles and theories, preparation, procedure, method of detection, applications of column chromatography, gel filtration techniques, thin layer chromatography, ion exchange chromatography.
- 8. High performance liquid chromatography:** Introduction and theoretical considerations, instrumentation, characteristics of stationary and mobile phases, reversed phase high performance liquid chromatography, latest development -UPLC & UFLC, applications.
- 9. 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 auxochromes, analysis of mixtures, absorption and intensity shifts, applications of ultraviolet and visible spectroscopy in quantitative analysis of drugs.
- 10. Fluorometry:** Introduction, principle, fluorescence and chemical structure, instrumentation, factors influencing intensity of fluorescence, comparison of fluorometry and uv-visible spectrophotometry, applications of fluorometry in pharmaceutical analysis.
- 11. Polarimetry:** Introduction, instrumentation and application, optical isomerism, origin of optical rotation, molecular requirements for optical rotatory power, specific rotation, calculation of specific rotation, circular dichroism (CD), optical rotatory dispersion (ORD).

PHR 301L Pharmaceutical Analysis-I-Lab Credit Hr: 1

1. Assay of acetyl salicylic acid in aspirin tablets.
2. Assay of phenobarbitone tablets by non-aqueous titration.
3. Determination of potency of penicillin tablets.
4. Determination of calcium in solid and liquid dosage form by complexometric

titration.

5. Assay of promethazine hydrochloride.
6. Assay of aluminium hydroxide gel.
7. Assay of magnesium and aluminium from antacid preparation.
8. Determination of iodine value and saponification value of fats and oils.

PHR 302 Medicinal Chemistry-I

Credit Hr: 4

1. Stereochemistry:

- (a) General treatment of different types of isomerisms.
- (b) Geometric isomerism of alkenes and cyclic compounds, cis, trans and (E), (Z) systems of nomenclature.
- (c) 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 stereochemistry.

2. Heterocyclic chemistry:

- a. 5-membered heterocyclic compounds: Pyrrole, furan, thiophene, pyrazole, imidazole, oxazole, isoxazole, thiazole and Isithiazole- their preparations, reactions and pharmaceutical applications.
- b. 6-membered heterocyclic compounds: Pyridine, piperidine, pyrimidine, pyradazine, pyrazine and triazine: their preparation- reaction and pharmaceutical applications.
- c. Benzofused 5-membered heteroatomic compounds: Indole, benzofuran, benzothiaphene and carbazole- their chemistry, synthesis and pharmaceutical applications.
- d. Benzofused 6-membered heteroatomic compounds: Quinoline and isoquinoline- their chemistry, synthesis and pharmaceutical applications.

3. Chemistry, SAR, mode of action and synthesis of the following groups of drugs:

- a. Hypnotics and sedatives
- b. Antihistamines
- c. Analgesics and anti-inflammatory agents
- d. Cardiovascular agents
- e. Diuretics

4. Natural products and other secondary metabolites:

- a. Vitamins: The clinical aspects of vitamins and their effects on free radicals; synthesis of vitamins such as Vit-B₁, Vit-C, nicotinamide, pyridoxine; mechanisms of the action of vitamins.
- b. Alkaloids: Alkaloids as pharmaceutical raw materials, opium and analogues, synthesis of papaverine and ephedrine, clinical comparison of ephedrine and ephinephrine.
- c. Glycosides: Clinical and chemical aspects of digoxin and other digitalis glycosides.

PHR 302L Medicinal Chemistry-I-Lab Credit Hr: 1

Laboratory synthesis, physical, chemical and spectral characterization of the following compounds:

1. Paracetamol
2. Benzocaine
3. Aspirin
4. Phenacetin
5. PABA (para amino benzoic acid)
6. Meta nitro benzaldehyde
7. Ethyl para hydroxy benzoate
8. Para amino phenol
9. Methyl salicylate

PHR 303 Pharmacology-II
Credit Hr: 4

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 & opioid analgesics, propofol, ketamine.
3. **Analgesic, antipyretic and antiinflammatory drugs:** Non-narcotic analgesic- salicylates, pyrazolone derivatives, para-aminophenol derivatives, propionic acid derivatives, indomethacin, sulindac, tolmetin, diclofenac; Narcotic analgesics - opium alkaloids, morphine antagonists, synthetic & semisynthetic opiates.
4. **Cardiovascular drugs:** Introduction, classification, mechanism of action, SAR studies of
 - a. Antihypertensive drugs
 - b. Antiarrhythmic drugs
 - c. Diuretics
 - d. Drugs used in heart failure
 - e. Drugs used in angina and myocardial infarction
5. **Antibacterial agents: Brief study of the following class of drugs**
 - a. Drugs affecting folate synthesis- sulfonamide, trimethoprim
 - b. β -lactam antibiotics-penicillin, cephalosporin.
 - c. Drugs affecting protein synthesis- tetracycline, chloramphenicol, macrolides, aminoglycosides.
 - d. Drugs affecting Topoisomerase-I enzyme- fluoroquinolones.
 - e. Glycopeptide, polymyxin, bacitracin & nitrofurantoin antibiotics.
 - f. Antitubercular agents- INH, rifampicin, ethambutol, pyrazinamide, PAS, capreomycin, cycloserine, ethionamide.
 - g. Antileprotic drugs- dapson, rifampicin, clofazimine.
6. **Vitamins:** Detailed study of water 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 antihyperglycemic agents with structures, mechanisms, uses, toxicity; Insulin resistance, management of diabetes. glucagon structure, mechanism, uses.

PHR 303L Pharmacology-II-Lab
Credit Hr: 1

1. Estimation of blood glucose by enzymatic method.
2. Estimation of blood glucose by chemical method.

3. Estimation of aspirin in blood after oral administration by UV spectrophotometric method.
4. Estimation of aspirin in blood after oral administration by colorimetric method.
5. Estimation of plasma protein by enzymatic method.
6. Estimation of plasma protein by Biuret method.
7. Estimation of blood uric acid level by enzymatic method.
8. Estimation of paracetamol in blood after oral administration by UV/Visible spectrophotometric method.
9. Handling of experimental animals: mice and rat.
10. Different routes of administration of drugs in experimental animals.

PHR 304 Clinical Pathology

Credit Hr: 2

1. **Definition and scope of pathology:** Concept of diseases.
2. **General adaptation, cell injury & cell death:** Hyperplasia, hypertrophy, atrophy, metaplasia, necrosis, apoptosis, intracellular accumulation, pathological calcification.
3. **Acute & chronic inflammation:** Vascular changes, leukocyte extravasation & phagocytosis, chemical mediators, causes of chronic inflammation.
4. **Hemodynamic disorders:** Edema, hyperemia, congestion, hemorrhage, hemostasis, thrombosis, embolism, shock.
5. **Infectious diseases:** Diphtheria, whooping cough, tuberculosis, syphilis, clostridial infections, pneumonia.
6. **Nutritional disease:** Marasmus, kwashiorkor, deficiency states of minerals & vitamins.
7. **Diseases of the blood vessel:** Varicose vein, arteriosclerosis, stroke.
8. **Heart disease:** Ischemia, carditis, congestive cardiac failure, angina pectoris, myocardial infarction, congenital heart disease, rheumatic heart disease, rheumatic fever.

PHR 305 Pharmaceutical Technology-II

Credit Hr: 4

1. **Powders and granules:** Definitions and properties of powders and granules.
2. **Formulation and manufacturing of tablets:** Formulation and granulation of powders for tableting, manufacturing of tablets by wet granulation, dry granulation and by direct compression, advantages and disadvantages of different process, processing machineries used in tablet manufacturing.
3. **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 and their solution.
4. **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- theory of film coating, film formers, plasticizer, solvents, other excipients; Enteric coating- enteric coating polymers, formulations of enteric coating, dry coating (compression coating), 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; Coating machines: conventional coating machines, perforated coating machines, fluidized coating machines.

5. **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.
6. **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.
7. **Microencapsulation technology:** Purpose, methods of preparation, evaluation, pharmaceutical and biological applications of microencapsulation process.

**PHR 305L Pharmaceutical Technology-II-Lab
Credit Hr: 1**

1. Formulation and compounding of different syrups.
2. Formulation and compounding of different suspensions.
3. Formulation and compounding of different emulsions.
4. Formulation and compounding of ointments.
5. Study of different components of a 16-station rotary table press.
6. Formulation and manufacturing of antihistamine tablets.
7. Formulation and manufacturing of dispersible aspirin tablet.
8. Formulation and manufacturing of some capsule dosage form.

**PHR 306 Pharmaceutical Engineering
Credit Hr: 4**

1. **The fundamentals of unit operations**
 - (a) Fluid flow
 - (b) Heat transfer and
 - (c) 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. **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.
4. **Centrifugation:** 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.

5. **Mixing:**
 - (a) **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.
 - (b) **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.
 - (c) **Liquid mixing-** Definition, importance, mixing equipment, axial and radial flow, 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.
6. **Refrigeration and air conditioning:**
 - Refrigeration-** Theory of refrigeration, refrigeration current cycle and equipments employed for large scale refrigeration.
 - Air conditioning:** Theory of air conditioning, application and types, humidification and dehumidification, cooling towers.
 - Humidity-** Determination methods, methods of increasing and decreasing humidity, application of humidity control in pharmaceutical industries.
7. **Lay out plan of pharmaceutical manufacturing plant-** Guidelines for selecting new plant sites, pharmaceutical lay out plan and design, criteria for production facilities.
8. **Fundamentals of pharmaceutical HVAC systems.**

PHR 307 Biopharmaceutics-I
Credit Hr: 4

1. **Introduction of pharmacokinetics and biopharmaceutics**
2. **Gastrointestinal absorption of drugs:**
 - (a) **Biological consideration-** Membrane physiology, gastrointestinal physiology, mechanism of absorption etc.
 - (b) **Physicochemical consideration-** p^k_a and gastrointestinal absorption, pH partition theory and other physicochemical factors.
 - (c) **Dosage form consideration-** Role of different dosage forms 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, 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 determining bioavailability, criteria for bioequivalence studies.
6. **Drug product selection on the basis of bioavailability testing.**

PHR 307L Biopharmaceutics-I-Lab
Credit Hr: 1

1. Tablet weight variation test.
2. Tablet hardness test.
3. Tablet friability test.
4. Tablet disintegration test.
5. Tablet dissolution test.
6. Leakage test of packaging of tablets/ capsules.
7. Capsule weight variation test.
8. Determination of binding sites and association constant.

PHR 308 Applied Microbiology
Credit Hr: 2

1. **Microbial assay of antibiotics:** Antimicrobial activity. factors affecting the measurement of antimicrobial activity, antibiotic assays. biological and non biological assays, determinations of MICs (Minimum Inhibitory Concentrations), challenge tests, Microbiological quality of pharmaceutical materials with special reference to non-sterile and sterile products, t- test.
2. **Sterilization**
 - (a) **Sterilization by dry heat-** principle, hot air oven, applications, advantages and disadvantages of sterilization by moist heat, factors affecting sterilization by moist heat, principle of sterilization by steam under pressure, autoclave- applications, testing the efficiency of autoclaves, sterilization by heating with bactericides, validation of sterilizers.
 - (b) **Sterilization by filtration**
 - (c) **Sterilization by radiation**
 - (d) **Sterilization by gas**
3. **Sterility testing:** Sampling techniques, types of media used in sterility testing, positive and negative controls, pyrogen tests. Testing procedure for aqueous solutions, aqueous suspensions, powders, semi solid preparations, oils and ointments, ligatures and sutures, surgical dressings, equipments; Miscellaneous tests- immunological preparations and viral products.
4. **Disinfection and antiseptis:** Introduction to disinfection. factors influencing disinfection, chemical disinfectants, and their modes of action, disinfectant evaluation.
5. **Industrial microbiology:** Ecology of microorganisms as it affects the pharmaceutical plant, good manufacturing practice microbial spoilage and preservation the role of recombinant DNA technology in the pharmaceutical industry. Pharmaceutical products made by genetic engineering, miscellaneous pharmaceutical products of microbial origin (vitamins, amino acids, dextran, etc.), streptokinase.
6. **Immunological products:** Active antigenic products, attenuated, inactivated and extract, viral and bacterial products, passive products, gamma globulin.
7. **Bacterial resistance**

PHR 309 Pharmaceutical Biotechnology

Credit Hr: 2

1. **Introduction of biotechnology and its application in medicine, foods, forensic science, microbial and plant genetics:** Different dimension of biotechnology and pharmaceutical biotechnology.
2. **Biophysical and biochemical analysis of recombinant proteins:** Protein structure, protein folding, analytical techniques.
3. **Recombinant DNA technology and production of biotech compounds:** Basic principle, genetic recombination- cloning, gene expression, restriction endonuclease, ligase and other enzymes used in gene cloning, cloning vectors, transfection method, knock out and transgenic animals, cultivation and downstream processing, issues to consider in production and purification of proteins.
4. **Formulation of biotech products:** Microbiological considerations, excipients used in parenteral formulations of biotech products, delivery of proteins, routes of administration and absorption enhancement.
5. **Delivery of proteinous drugs:** Approaches for rate controlled and target site specific delivery.
6. **Immunology:** Monoclonal antibody, hybridoma technology, basic principles of immunology, antigen and haptens, vaccines.
7. **Gene therapy:** Ex vivo versus in vivo gene therapy, potential target diseases for gene therapy, gene transfer methods, non-viral gene transfer.
8. **Pharmaceutical production:** Short study of current biotech products- Interleukins and interferons, insulin, vaccines, monoclonal antibody-based pharmaceuticals, follicle stimulating hormone (FSH), trastuzumab; dispensing of biotechnology products- storage temperature requirements, storage in dosing and administration devices, light protection, handling, mixing and shaking, shipment requirements, preparation and administration.

PHR 310 Pharmaceutical Marketing & Management

Credit Hr: 4

Part A: Pharmaceutical Marketing

1. **Principles of marketing:** Definition and concepts of marketing, steps in the marketing process, role of marketing & environmental forces in our society, marketing mix and exchange relationships, marketing management process, the selling concept, marketing concept and the societal concept, customer relationship management, demarketing.
2. **Strategic marketing planning:** Strategic planning process, resources and opportunities affecting the planning process, corporate, business-unit, and marketing strategies, the marketing plan and implementation process and the major approaches to marketing implementation
3. **Consumer markets and buying behavior:** Consumer market & business market, elements of a consumer behavior model & organisational buyer behavior, consumer buying process, factors affecting consumer behavior, types of buyer behavior, buying decision process, consumer decision process for new products or adoption process.
4. **Market segmentation, target marketing and marketing positioning strategies:** Identifying market segments, factors for segmenting market, choosing a target marketing strategy, market positioning for maximum competitive advantages.
5. **Product promotion:** Elements in the communication process, promotions mix (advertising, personal selling, sales promotion, public relation, direct marketing)and their roles in Integrated Marketing Communication (IMC), the promotions message and executions style,

media choice, promotional objectives, representatives, physical distribution, inventory and cost control, returns and claims

6. **Advertising:** Importance of advertising, classification of advertising, advertising strategy: appraising the opportunity, media planning and selection, creating advertising messages, measuring advertisement effectiveness, advantages and the disadvantages of the primary media, international advertising decision.
7. **Product management:** Concept of a product, classification of products, product line, and product mix, products planning and development, PLC, marketing strategies along the product life cycle, brand building and brand management.
8. **Pricing:** Definition of pricing, basic factors influencing pricing decision, pricing methods and strategies.

Part B. Pharmaceutical Management

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. **Personnel management:** Importance, principles, methods, motivation, staff requirements theory.
4. **Inventory control:** Methods-intuitive, systematic wantbook, perpetual inventory, open-to-buy, stock, record card, economic order quantity, selection of optimum methods, effect of inventory control.
5. **Purchasing:** Formulating effective buying policies, needs and desires, selecting the sources of supply, determining terms of purchase, receiving, marking and stocking of goods.

B. Pharm. Professional Year IV

PHR 401 Pharmaceutical Analysis-II Credit Hr: 4

1. **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.
3. **¹³C NMR spectroscopy:** Introduction, principle, chemical shift, spin-spin coupling, applications.
4. **Mass spectrometry:** Introduction, theory, the mass spectrum, recognition of molecular ion, isotopic peaks, ionization techniques- electron impact, chemical ionization, fast atom bombardment etc.; fragmentation pattern; aliphatic and aromatic hydrocarbons, alcohols, ethers, aldehydes, ketones, acids, esters, amides etc.; analyzing techniques-magnetic sector, quadrupole; determination of molecular formula, applications of mass spectrometry.
5. **Atomic absorption spectroscopy:** Theory, instrumentation and application in quantitative analysis.
6. **Potentiometric titration:** Introduction, theory and principles, electrochemical cells and half-cells, electrodes, measurement of potential, application of potentiometric titration.
7. **Polarography and amperometric titration:** Introduction, theoretical considerations, instrumentation, general polarographic analysis, amperometric titration using one and two electrodes.

8. **Gas chromatography:** Introduction and principles, theoretical consideration, column technology, detectors, analytical application of gas chromatography.
9. **Microbiological assay of antibiotics:** Introduction, reference standard and units of activity, agar diffusion assay, theory of zone formation, factors affecting agar diffusion assay, dose response curve, large plate assay using Latin square design, statistical interpretation of microbiological assay results.
10. **A brief study about electron microscopy and scanning electron microscopy (SEM).**

**PHR 401L Pharmaceutical Analysis-II-Lab
Credit Hr: 1**

1. Estimation of ampicillin by UV spectrophotometric method.
2. Estimation of aspirin by UV spectrophotometric method.
3. Determination of protein concentration in tissue preparation by UV-Vis spectrometry.
4. Estimation of ferrous fumarate from iron capsule.
5. Determination of ampicillin by iodometric titration.
6. Determination of potency of atenolol in the tablet by volumetric and conductometric method.
7. Determination of captopril potency in the tablet by volumetric and conductometric method.
8. Compare the titration curves using conductometric method when (a) 0.05 M solution of HCl (b) 0.05M solution of oxalic acid (c) 0.05M solution of acetic acid and (d) 0.05 M solution of acetyl salicylic acid are conductometrically determined with a standard solution of sodium hydroxide.
9. Potentiometric determination of the concentrations of an iodide and a chloride sample in a mixture.

**PHR 402 Medicinal Chemistry-II
Credit Hr: 4**

1. **Drug discovery and design**
 - (a) Source of drugs
 - (b) Cost and place of development of drugs
 - (c) Search for new drugs
 - (d) 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, removal, introduction or replacement of bulky groups, isosteric substitution, change of position or certain groups, introduction of alkylating 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 the following groups of drugs:**
 - (a) Antihypertensive agents (β -blockers)
 - (b) H₂-blockers

- (c) Antidiabetic drugs
 - (d) Psychotropic drugs and antidepressants
 - (e) Semisynthetic penicillins, cephalosporins, and quinolone derivatives
 - (f) Oral contraceptives and steroidal hormones.
3. **Drugs metabolism:** Pathways of drugs metabolism, metabolism of various groups of drugs, factors affecting drugs metabolism, methods of studying drug metabolism, new aspect of drug metabolism, metabolic products of common drugs.
 4. **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 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) Combinatorial chemistry- applications and impact on drug discovery.

**PHR-402L Medicinal Chemistry-II-Lab
Credit Hr: 1**

Laboratory synthesis, physical, chemical and spectral characterization of the following compounds:

1. Para amino benzoic acid (PABA)
2. Phenacetin
3. Benzocaine (Ethyl para aminobenzoate)
4. Aspirin (Acetylsalicylic acid)
5. Preparation of nitro, amino, methyl, acetyl derivatives of different drugs or lead compounds.

**PHR 403 Pharmacology-III
Credit Hr: 4**

1. **Antiepileptic drugs:** Phenytoin, primidone, phenobarbitone, mephobarbitone, carbamazepine, valproic acid, lamotrigine, vegabatratin, benzodiazepines, trimethadone, gabapentin, types of seizures.
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 antiviral drugs.
4. **Antineoplastic drugs:** Alkylating agents, antimetabolites, vinca alkaloids, Taxanes antibiotics, cisplatin, carboplatin, etoposide.
5. **Psychotropic and antidepressant drugs:** Amphetamine, LSD etc
6. **Drugs affecting uterine contraction:** Oxytocin, prostaglandin, ergot alkaloid, tocolytics.
7. **Antifungal drugs:** Amphotericin B, Flucytosine, Itracouzole, Ketoconazole, Fluconazole, Nystatin, griseofulvin
8. **Cholinergic and anticholinergic drugs.**
9. **Adrenergic and antiadrenergic drugs.**
10. **Hormone therapy:** Adenohypophyseal and adrenocorticosteroid hormone.
11. **Ophthalmology:** Anatomical consideration, corneal grafting, cataract formation, contact lens, drugs used in the treatment of eye disorders.

PHR 403L Pharmacology-III-Lab
Credit Hr: 1

1. Determination of plasma proteins by the Biuret Method (Method of Reinhold).
2. Determination of paracetamol in blood by colorometric method.
3. Estimation of cholesterol in human blood by enzymatic method.
4. Estimation of cholesterol in human blood by chemical method.
5. Estimation of Aspirin in human blood.

PHR 404 Disease Management-I
Credit Hr: 4

1. **Calculation of creatinine clearance for a patient and classification of their degree of renal impairment:** Identification of two drugs which have active metabolites that are renally eliminated, identification of six drugs for which the dose should be reduced in renal impairment and study about the clinical consequences of not reducing the dose, hepatic disease that may affect the disposition and pharmacokinetics of drugs, identification of the most useful indicators to monitor hepatic function, recommendations on how to choose drugs and/or adjust doses in patients with hepatic disease.
2. **The role and limitations of therapeutic drug monitoring (TDM) in individualizing drug therapy:** Identification of five drugs for which TDM may contribute to optimization of therapy, identification of three parameters which need to be identified in order to ensure appropriate use of TDM.
3. **Drug delivery & administration for each of the following routes of administration:** The drug formulations commonly given by that route, the key biopharmaceutical and therapeutic considerations integral to the route of administration, a clinical condition or situation in which this may be the preferred route; oral, sublingual, buccal, parenteral; including intravenous, intra-articular, intradermal, intramuscular, subcutaneous, topical, transdermal, inhalation, intracular, intranasal, inhalation.
4. **Adverse drug reactions:** Definition of an adverse drug reaction (ADR), three key difference between type A and type B ADRs, six factors which may contribute to the development of an ADR, the six most common clinical manifestations of ADRs, for each of the following; two clinical syndromes and two common causative agents.
 - * drug-induced hepatic disease
 - * drug-induced renal disease
 - * drug-induced skin disorder
 - * drug-induced hematological disorder
5. **Drug-Interactions:** Six pharmacokinetic mechanisms by which interactions may occur, giving a clinical example of each; three pharmacodynamic mechanisms by which interactions may occur, giving a clinical example of each two examples of a drug-food interaction; two examples of a drug alcohol interaction, one example of a drug-tobacco interaction.
6. **Asthma:** Aetiology and pathogenesis of asthma, treatments for acute and chronic asthma, factors influencing the choice of drug, dose, formulation and route of administration; monitoring the beneficial and adverse outcomes of drug therapy asthma.
7. **COPD:** Aetiology and pathogenesis of COPD; treatment of COPD; complications of COPD and their management; factors influencing the choice of drug, dose, formulation and route of administration; monitoring the beneficial and adverse outcomes of drug therapy for COPD.
8. **Pharmaceutical care in respiratory disease:** How pharmacists identify patients with undiagnosed asthma or COPD (chronic obstructive pulmonary disease); the role of the pharmacists in smoking cessation; choices of device available to deliver treatments; methods by which patients with asthma or COPD should be monitored; pharmacists' role in the provision of oxygen therapy for COPD; problems which may lead to treatment failure.

- 9 **Management and treatment of different psychiatric disorders** including depression, anxiety, manic disorder, panic disorder, OCD, schizophrenia and others, management and treatment of drug abusive patients.

PHR 405 Clinical Pharmacy

Credit Hr: 4

1. **General consideration:** Scope, importance and application of clinical pharmacy, clinical hematology, blood bank techniques etc., organ function tests, clinical pathology, manifestation of diseases, drug or hospital acquired diseases, cautionary and advisory notes for drug therapy.
2. **Guidance for special clinical practices:** Neonates, children, elderly, terminal care, liver disease, renal impairment, pregnancy and lactating mothers.
3. **Clinical pharmacy for OTC preparation:** Antacids and anti-flatulence, antidiarrhoeals, laxatives, emetics and antiemetics, antihistamines and anti-allergen, analgesics, contraceptives, ear-nose-throat preparations, dermatological preparations.
4. **Blood and related products:** Whole blood and blood components, plasma expanders and intravenous fluids, antibodies and isoagglutinins, agents affecting blood coagulation, anticoagulants, electrolytes and systemic buffers, drugs affecting blood production.
5. **Clinical toxicology:** Role of poison centers, adverse reactions and poisoning incidences, analysis of poisoning situations, poison information sources, assessment of poison exposure.
6. **Clinical signs, symptoms and management of poisoning:** Case with pesticides, fumigants, solvents, vapors, gases, food toxins, cyanides poison, cosmetics, toxins of animal origin, over-doses of drugs, drug interactions etc.

PHR 406 Pharmaceutical Technology-III

Credit Hr: 4

1. **Compaction and compression of powder:** Physics of tablet compression, mechanism of tablet formation, bonding to tablets, the effect of compressional force on tablet properties, effect of lubricants on tablet compression and binding, instrumented tablet machines and tooling, problems associated with large scale manufacturing of tablets.
2. **Sustained release drug delivery systems:** Principle of SR dosage forms, advantages and disadvantages 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.
3. **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.
4. **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.
5. **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.

6. **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.
7. **Packaging technology:** Purpose of packaging, properties of packaging materials, factors influencing choice of package, advantages and disadvantages of different packaging materials, glass and glass containers, metal and metal containers, plastic and plastic containers, films, foils and laminates, rubber based materials, closures, tamper resistant packaging, testing and quality assurance of packaging materials, different packaging machines and accessories, organization of packaging line, labeling.

**PHR 406L Pharmaceutical Technology-III-Lab
Credit Hr: 1**

1. Preparation of paraffin ointment B.P. (50 gm).
2. Formulation and preparation of paracetamol suspension (50 ml).
3. Formulation and preparation of chlorpheniramine maleate solution (100 ml).
4. Formulation and preparation of paracetamol tablet.
5. Formulation and preparation of cotrimoxazole suspension.
6. Formulation and preparation of iron syrup (100 ml).
7. Formulation and preparation of Whit-field's ointment.

**PHR 407 Biopharmaceutics-II
Credit Hr: 4**

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 disease:**
 - (a) Pharmacokinetic considerations, general approaches for those adjustment in renal diseases, 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.**

PHR 407L Biopharmaceutics-II-Lab
Credit Hr: 1

1. Determination of the dissolution time and dissolution rate of the enteric coated diclofenac sodium tablet.
2. In vitro dissolution study of theophylline tablet.
3. In vitro dissolution study of SRDF theophylline capsule.
4. Preparation of castor oil emulsion and determination of its pH and viscosity.

PHR 408 Cosmetology
Credit Hr: 2

1. **The skin:** Introduction, epidermis and keratinizing system, pigment system, langerhans cell, 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.

PHR 408L Cosmetology-Lab
Credit Hr: 1

1. Formulation and preparation of cold cream.
2. Formulation and preparation of vanishing cream.
3. Formulation and preparation of transparent shampoo.
4. Formulation and preparation of egg shampoo.
5. Formulation and preparation of talcum powder.
6. Formulation and preparation of tooth powder.
7. Formulation and preparation of after shave lotion.
8. Formulation and preparation of shaving cream.

PHR 409 Pharmacy Practice-I
Credit Hr: 4

A. Hospital Pharmacy

1. **Introduction:** Goals, minimum standards, abilities required for a hospital pharmacist, hospital as an organization, classification, organizational patterns, management and administration, different departments and services, role of a pharmacist in the hospital, hospital pharmacy, organizational and personnel, supportive personnel, pharmacy education, job description.
 2. **Pharmacy and therapeutics committee:** Description and purpose, membership and functions, hospital formulary, guiding principles, legal basis, principles for admission or deletion of drugs, selection of text, investigational use of drugs, description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee.
 3. **Purchasing and inventory control:** Purchasing agent, purchasing procedure, control on purchase, storage, perishable inventory, physical inventory, perpetual inventory.
 4. **Control of special classes of drugs:** Use of samples, in-patient drug orders, out-patient prescriptions, ward stock drugs, label symbols, narcotics and their control, classes, procurement and execution of order forms, dispensing, hospital narcotic regulations, new systems, floor stock drugs, selection, charge and non-charge, labeling, regulations concerning narcotics, inspection of nursing drug cabinets.
 5. **Dispensing to in- and out-patients:** Drug distribution systems, dispensing of charge, non-floor stock drugs, mobile dispensing unit, unit dose dispensing, new concepts, dispensing to out-patients, locality of out-patient dispensing area, dispensing routine, record keeping, dispensing during off-hours, use of nursing supervisors, emergency boxes and night drug cabinets, pharmacist-on-call, drug charges in hospitals, pricing, break-even point pricing.
 6. **Manufacturing—bulk and sterile:** Control and budget, manufacturing facility and capacity, operating costs, quality control.
 7. **Drug information center and library**
- B. Community pharmacy:** Concept of community health care, health needs of the community, different level of health care, elements of primary health care, principles of primary health care: equitable distribution, community participation, intersectoral coordination, appropriate technology, health manpower, health care delivery at different levels, community pharmacy in dealing with communicable diseases problem, nutritional problems, environmental sanitation problems and indigenous systems of medicine, development of community pharmacy infrastructure, participation of non-governmental voluntary health agencies.
- C. Rational use of drugs:** Background of rational use of drugs, definition, factors underlying irrational use of drugs: patients, prescribers, drug supply system; drug regulation and drug promotion, impact of irrational use of drugs with examples, disease-specific indicators, drug use patterns in developing countries, changing drug use patterns, factors effecting drug use, strategies to improve prescribing, experiences with interventions to change drug use in developing countries, strengths and weaknesses of different interventions to change drug use patterns, international network for rational use of drugs.
- D. Forensic pharmacy:** Definition, epidemiology of poisoning, influential factors, substances most frequently involved in accidental ingestions among children, first-aid treatment for poisoning, treatment, antidotes: locally acting and systemic, prevention of poisoning, poison control, poison control act, schedules, poison treatment centers, poison prevention packaging, national and community awareness, centralization of poison information, role of pharmacist at different levels.

B. Pharm. Professional Year V

1. **Quality control overview:** Introduction, general information & significance of quantitative and qualitative analyses in quality control, sampling techniques. Pharmacopoeial tests and specifications, standardization of pharmaceuticals and formulated products, quality control systems for drugs and pharmaceuticals, causes of poor quality, theory and basic concepts of GLP, ISO 9000, ISO 9001, ISO 17025, TQM and ICH.
2. **Terminology and validation overview:** Introduction, terminology used in the validation of analytical procedures, regulatory basis for process validation.
3. **Validation of analytical methods:** Strategy and parameters for the validation of methods, verification of standard methods, validation of non-routine methods, analytical validation within the pharmaceutical environment, validation of standard operating procedures (SOP).
4. **Overview of pharmaceutical product development and its associated quality system:** Discovery research, preclinical phase, clinical phases, regulatory submission, quality system for the analytical development laboratory.
5. **Potency method validation:** Validation practices, strategies and validation parameters, potency method revalidation, common problems and solutions.
6. **Method validation for HPLC analysis:** Introduction, background information, method validation experiments, common problems and solutions.
7. **Performance verification**
 - (a) **Performance verification of HPLC:** Introduction, performance verification practices, operation tips for HPLC performance verification.
 - (b) **Performance verification of UV-Vis and IR spectrophotometers:** Introduction, performance attributes, practical tips in UV-Vis and IR spectroscopic performance verification
 - (c) **Performance verification of NMR and MS:** Introduction, calibration of spectra, internal standards, common problems and solutions.
 - (d) **Karl fisher apparatus and its performance verification:** Introduction, instrumentation, performance verification, common problems and solutions.
8. **Bioanalytical method validation:** Definition of bioanalytical method validation, regulatory guidance on bioanalytical method validation, current validation practices, common problems and solutions.
9. **Quality control of herbal drugs:** Introduction, detection of adulterants including the presence of API, determination of foreign matters, development of standardization parameters, phytoconstituents and their analysis, analytical procedures for some bioactive materials, screenings of herbal drugs for pesticide residues and other potential contaminants.
10. **Statistical methods in data analysis.**

PHR
501L

Quality Control & Analytical Method Validation-Lab
Credit Hr: 1

1. Calibration of UV spectrophotometer through absorbance and wavelength checks.
2. Determination of the effects of slit width and scanning speed on the UV absorption spectrum of a given drug.
3. Determination of the E-Z isomer ratio in clomiphene citrate mixture.
4. Assessment of the precision of quantitative measurements using HPLC.
5. Separation and identification of the xanthene derivatives in tea or coffee by HPLC.
6. Gas chromatographic determination of the composition of fatty acids in fixed oils.
7. Testing of containers, closures, liners, glasses and plastics used for packing

pharmaceutical products

8. Test of packaging materials, cartons, aluminum foils, films used for blister packing, ampoules, vials, etc.

PHR 502 Functional Foods, Nutraceuticals and Herbal Medicine

Credit Hr: 2

- 1 **Introduction:** Definition of functional foods, nutraceutical and herbal medicine, their role in health care management
- 2 **Food Science and nutrition:** Overview on medical foods, nutraceuticals, functional foods and dietary supplements.
- 3 **Food components and nutrition:** Food composition, macronutrients, micronutrients, protein, carbohydrates, fats and oils vitamins, minerals, dietary fibers and fiber-like ingredients, trans fatty acids and omega 3,6,9 fatty acids, sugar and fat substitutes.
- 4 **Food, nutrition, health and diseases:** Relationship of nutrition and health, dietary guidelines/food pyramid, food habit and obesity, effects of trans and omega 3,6,9 fatty acids on health and diseases.
- 5 **Nutraceuticals in herbal products, fruits, vegetables and grains with health benefits:** Effects of nutraceutical on cancer, immune system; phytochemicals and their roles in prevention of specific diseases; antioxidant, antidiabetic, anti-inflammatory a hypolipidemic herbs and nutraceuticals.
- 6 **Food processing and food products developments:** Food preservation, food irradiation, fermentation, processing of dairy foods, confectionary foods, cereals and grains, beverages, special infant foods and formulas, microorganisms in food, food packaging.
- 7 **Food Biotechnology:** Genetic engineering in improving plant and animal products and improving food processing.
- 8 **Quality assurance of nutraceuticals, dietary supplements & herbal products:** GMPs, hazard and risk analysis, quality factors, toxicity analysis, shelf life of nutraceuticals, functional foods and dietary supplements, bioavailability and safety issues of functional foods and nutraceuticals.

PHR 503 Biostatistics & Bioinformatics

Credit Hr: 4

Section A: Biostatistics

1. **Definition of biostatistics and its application in pharmaceutical sciences.**
2. **Sources and presentation of data:** Definition of data, types of data, collection of data, presentation of data, frequency distribution, cross tabulation, graphical/diagrammatic presentation of data, variables, population, sample.
3. **Statistical inference:** Introduction, standard error, p value, test of significance /hypothesis, types of hypothesis, one-tailed & two-tailed tests, type I & type II errors, degrees of freedom, confidence interval.
4. **Hypothesis testing- parametric tests:** Introduction, z test, t test, analysis of variance (anova), repeated measures split-plot design, pearson's correlation co-efficient, simple linear regression, multiple linear regression, logistic regression.
5. **Hypothesis testing:**
 - a) **Multiple comparison tests:** Introduction, Bonferroni test, Dunnett's test, Isd test, Tukey's test, Scheffe test.
 - b) **Nonparametric tests:** Introduction, ranking, Mann-Whitney U test, Wilcoxon test, Kruskal-Wallis test, Friedman's test, Chi square test, relative risk & odds ratio, sensitivity

and specificity, the Spearman's rank correlation.

6. **Choosing an appropriate statistical test:** Introduction, rationale for using statistical tests, parametric versus nonparametric tests, which test to apply in which situation? choosing an appropriate post hoc test.
7. **Study design & types of study:** Defining objectives & proposal formulation, types of study, descriptive case studies, cross sectional studies, case control studies, cohort studies, parallel designs, cross-over designs, pre-test/post test studies, quasi-experimental designs.
8. **Sampling & sample size determination:** Introduction, sampling, steps in sampling design, sampling methods, simple random sampling, stratified sampling, systematic sampling, cluster sampling, multistage sampling, purposive sampling, convenience sampling, quota sampling, determination of sample size.
9. **Statistical test for bioequivalence:** Introduction, bioequivalence, experimental designs, statistical analysis for bioequivalence, dissolution testing.

Section B: Bioinformatics

1. **Introduction:** Definition of bioinformatics, basic concepts of protein and nucleic acid, sequence, structure and function.
2. **Bioinformatics databases:** Introduction, nucleotide sequence databases, primary nucleotide sequence databases, secondary nucleotide sequence databases, protein sequence databases, sequence motif databases, protein structure databases.
3. **Sequence alignment and database searching :** Single sequence alignments, biological motivation, pairwise alignments, database searching including BLAST, multiple sequence alignments.
4. **Protein structure alignments:** Definition of structure superposition, structure alignment, different alignment algorithms, number of protein folds in PDB.
5. **Phylogenetics:** Sequence-based taxonomy, from multiple alignment to phylogeny, computer tools for phylogenetic analysis.
6. **Metabolism and networks.**

PHR 504 Disease Management-II Credit Hr: 4

1. **Contraception:** Advantage and disadvantages of combined oral contraception (COC); symptoms including the need to stop taking COC immediately; advice when stopping or changing the COC; advice given to a patient who forgets to take a progestogen only pill (POP) or the COC pill; other forms of contraception available to women where COC and POP are unsuitable or are not their first choice; the role of the pharmacist in the supply of emergency hormonal contraception.
2. **Women's health:** Common symptoms associated with cystitis, thrush, dysmenorrhoea and pre-menstrual tension (PMT); suitable OTC treatments, advice pharmacists should give about these conditions; patients needing referral to other health care professionals.
3. **Osteoporosis:** Etiology and pathology of osteoporosis; risk factors for the development of osteoporosis; lifestyle advice for prevention and treatment of osteoporosis; hormone replacement (HRT) regimens; risks and benefits of HRT; advantages and disadvantages of selective oestrogen receptor modulators (SERMS) and bisphosphonates.
4. **Urinary tract infections:** Clinical features of urinary tract infections and population groups at risk; natural history and current treatment options in relation to UTIs; therapeutic options for resistant UTI.
5. **Sexually transmitted infections:** Signs and symptoms of, and causative organisms and treatment options for gonococcal and non-gonococcal urethritis, candidiasis, bacterial

- vaginosis, trichomoniasis, genital herpes, syphilis, genital warts, cervical infections.
- 6 **Diabetes:** Etiology and pathogenesis of type 1 and type 2 diabetes; aims of diabetes management; dietary and lifestyle advice for diabetes, The pharmacists role in the prevention and identification of undiagnosed diabetes; core elements education programmes; prevention and management of hypoglycaemia; advice that should be given during intercurrent illness; the pharmacists role in risk modification to prevent long-term complications.
 - 7 **Rheumatoid arthritis and osteoarthritis:** The drug and non-drug measures used to manage osteoarthritis and the modern therapeutic approach used in the treatment of rheumatoid arthritis, pharmaceutical care in bone and joint disease-how pharmacists can contribute to the prevention of falls and care of patients with osteoporosis, arthritis or taking long term corticosteroids.
 - 8 **Oral hygiene:** The impact of fluoride in preventing gum disease, how a patient should choose and use a suitable toothbrush and the treatment of mouth ulcer, candidosis and angular cheilitis, wound care, the different stages in the healing process, the factors that can affect wound healing, the different wound types, the characteristics of an ideal dressing and the properties and actions of available dressings.
 - 9 **Acute poisoning:** The different types of poisoning, the general principles of management of acute poisoning and the management of poisoning with aspirin, paracetamol and drugs of misuse.
 - 10 **Childhood conditions:** The symptoms, treatment and advice for common childhood conditions and childhood immunisation schedule. pharmaceutical care in children-why drug handling varies for different age ranges, dosing conventions used to calculate drug doses in children, unlicensed and off-label drug used in children, medicines taking and concordance issues in children.
 - 11 **Management and treatment of different cardiovascular diseases.**

PHR 505 Clinical Research and Clinical Pharmacokinetics
Credit Hr: 4

- 1 **Basic concept and general discussion on clinical research:** Pre clinical, toxicity studies, evolution of drugs and regulatory framework. drugs discovery and development, clinical data management. ICH GCP introduction.
- 2 **Definition of clinical research:** Guidelines for undertaking clinical trails, data to be submitted for clinical trails. Structure, content & format for clinical study report, approval for clinical trials, responsibility of sponsor, investigator & ethical committee.
- 3 **Animal toxicology:** (non-clinical toxicity study), Animal pharmacology, human pharmacology (phase I), therapeutic exploratory trail (phase II), therapeutic confirmatory trails (phase III), post marketing trails (phase IV), studies in special population, special studies: bioavailability /bioequivalence, pharmacovigilance.
- 4 **Introduction and review of pharmacokinetic processes:** Kinetics following IV bolus, define clearance, volume of distribution and elimination half-life, concentration-time profile following IV bolus, estimation of pharmacokinetic parameters from IV data.
- 5 **Kinetics following IV infusion:** Define steady state and describe the concentration-time profile following IV infusion, estimation of pharmacokinetic parameters following IV infusion and cessation of infusion.
- 6 **Kinetics following extravascular administration:** Describe concentration: time profile of first order absorption, define absorption rate constant and bioavailability, estimation of pharmacokinetic parameters following extravascular administration.
- 7 **Kinetics following multiple dosing.**
- 8 **Pharmacokinetics of drug molecules in different disease conditions:** In-vivo in-vitro relationship study, detail pharmacokinetics for bioequivalence study of different formulations,

drug-drug interaction study, pharmacokinetics of drug molecules in different populations.

PHR 505L Clinical Research and Clinical Pharmacokinetics-Lab
Credits Hr: 1

The practical course will be conducted as designed by the course teacher.

PHR 506 Pharmacy Practice-II
Credits Hr: 4

- 1 **Therapeutic drug monitoring of aminoglycosides and vancomycin in hospitalized patient:** Assessment of peak and trough concentration of the antibiotics during treatment to avoid toxicities.
- 2 **Empirical uses of antibiotics in different infections:** Choice of antibiotics on the basis of culture sensitivity report, antibiotics in clean cut surgery, antibiotics uses in intra-operative surgery.
- 3 **Antibiotic policy in a hospital:** Role of physicians and pharmacist in implementing the antibiotic policy in a hospital setting.
- 4 **Assessment of medication to the patients undergoing cardiac surgery:** Coronary artery stenting, closing of atrial septal defect (ASD) through surgery, closing of patent ductus arteriosus in neonates through surgery and medicines used for treatment of patent ductus arteriosus, patient management in coronary care unit (CCU), drug use management in cardiac patient
- 5 **Drug uses and management during pregnancy:** Relatively safe drugs, drug associated with some risk, drugs contraindicated during pregnancy.
- 6 **Total parenteral nutrition (TPN):** Requirements of TPN in a hospital setting, types of patients need TPN, calculation and preparation of TPN by the pharmacist in a hospital following good professional practice, TPN required in pre-term baby, TPN required by a cancer patient unable to take food orally, TPN to patient in long term unconsciousness etc
- 7 **Extemporaneous preparation:** Professional justification, legal justification, compounding accuracy and medication potency, sources of medicinal ingredients, examples of some oral preparations, dermatological preparations, ophthalmic preparations, parenteral admixtures.
- 8 **Therapeutic management of patient in intensive care unit (ICU) with case studies.**
- 9 **Dispensing of anticancer drug by the pharmacist and its rationale:** Pre- and post medication of the patient during chemotherapy, side effects and risk of anticancer drugs
- 10 **Dosage adjustment of medicines in patients with hepatic and renal failure.**
- 11 **Adverse drug reaction reporting and role of pharmacist in prevention ADR event.**
- 12 **Prescription error:** Types and assessment, role of pharmacist in prevention.

PHR 507 Pharmaceutical Regulatory Affairs
Credit Hr: 2

1. Regulations and laws governing the practices of pharmacy in Bangladesh (The Pharmacy Ordinance 1976), role of Pharmacy Community of Bangladesh
2. Policies, sales, regulation and laws concerning to the manufacture, possession, distribution, sale of drugs and poisons:

- The Drug Act 1940 (XXIII of 1940)
The Drug Ordinance 1982
The Drug Policy 1982
The Drug (Control) Ordinance 1982 (Ordinance No. VIII of 1982), its amendments
The Narcotics (control) Act 1990
The National drug policy 2005 for regulation of process of registration, manufacture, distribution, sale, import, and export of drug in Bangladesh.
The Poisons Act 1919 and related amendments
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. The Pharmacist's code of ethics

PHR 508 Hospital Training
Credits Hr: 4

Students must go through rigorous hospital training for a period of three months. Hospital authority will arrange their visit in each unit of the hospital; will give training about how to manage patients in different critical conditions, prevention of diseases, use of drugs etc. After completion of training, students will produce their work through multimedia presentation in the faculty

PHR 509 Project and Dissertation
Credits Hr: 2

Project titles will be provided by the supervisor of the student. The supervisor will be in overall charge of the management of the project and will also ensure that the student adheres to the project regulations and requirements. At the end of the project each student will submit a dissertation and give an oral presentation of his or her findings.