Four Years Degree Course of Pharmaceutical Technology

First year First Semester

Pharm/T/111 PHARMACEUTICS-I 3 pds/week

Prescription: Parts of prescription, handling of prescription, Posology.
Solution: Formulation, aqueous and non aqueous vehicles, factors affecting rate of solubilization and solubility, methods to improve aqueous solubility, formulation additives; Elixirs; Linctus; Mouthwashes and Gargles; Nasal and Ear drops; Lotions; Stability of solution; Syrups.

Powder: Classification, advantages of powder formulation, milling, mixing and dividing of powders, factors influencing blending of powders, powders containing liquids, eutexia.

Pharmaceutical calculations

Labeling of Pharmaceutical products

Galenicals: Different methods used in the preparation of the official galenicals like maceration, percolation, infusion, decoction, continuous hot extraction and digestion; Aromatic waters and Spirits; Different extractives; Resins and Gums.

Pharm/T/112: Pharmaceutical Biology 3 Pds/Week

- Plant and Animal cell – Structure and Function, Cell division including classification of plant and animal tissue.
- Classification of Plant and Animal Kingdom with cognate examples from both the groups.
- Morphology and histology of root, stem, bark, leaf, flower, fruit and seed.
- Study of Gastrointestinal, Cardiovascular and Respiratory system of guinea pig.
- Introduction to Parasitology – General concepts, Structure, life history and pathogenicity of parasites like-
  (a) Entamoeba histolytica
  (b) Plasmodium vivax, P. falciparum
  (c) Ascaris lumbricoides
  (d) Ancylostoma duodennale (hook worm)
- Preliminary Concept of Bacteria and Virus; its role in human diseases.
- Study of DNA and RNA, Chromosomal aberration, polyplody.

Pharm / ME/ T/113 Applied Mechanics 3 pds / week

I) Engg. Mechanics-- Equilibrium, concurrent forces, composition and resolution of forces , friction, sliding friction, center of gravity and applications, relative velocity of motion under gravity, motion under inclined planes, force , work, power , energy , conservation of energy, mechanical advantage of levers, balance, pulley.
II) Strength of materials-- Stress, Elasticity, problem in direct tension and compression, bending moment, shear force diagram, deflection statically determinate cases.
I) **Statistical relations in living system**

Conservation in biochemical energetics, Lose of thermodynamics in living system (irreversible and non equilibrium system), solution thermodynamics, Chemical potential, Electrolytic potential, Free energy, Thermodynamics of flexible linear polymers, Transport Phenomenon, Elements of coordination geometry.

II) **Bonds, orbitals and spectra**: 
Nature of chemical bonds, molecular orbitals, Resonance, Sigma and Pi bonds, Bonding and antibonding orbitals, hydrogen bonds, Homonuclear and heteronuclear molecules, polar molecules, Dielectric properties of Solutions, Electronegativity, Huckel's theory of orbitals, Strong and weak forces, London dispersive forces, Excited Molecular spectra.

III) **Structures of biomolecules**: 
Biological fitness of organic compounds, water, protein, nucleic acids, lipids, phase transitions, X-ray Crystallographic and spectroscopic studies, correlation between structure and function, Circular dichroism and ORD, steric effects, Muscle fiber and muscle behavior.

IV) **Cell Biology**: 
Cell structure and function (Self regulation of cell reaction, self replication, laws of genetics etc.), functions of various intracellular organelles, membrane and its conformational properties, Nature of a nerve cell electron microscopy, radiation biology, Optical interference and phase contrast microscopy, centrifugation-ultracentrifuge.

V) **Biological membranes**: 
Membrane structure, facilitated diffusion, Active membrane transport, membrane receptors, Membrane capacitance, membrane resistance, Membrane potential, Rheobase and chromaxie, cable properties and electronus; Action potential.

VI) **Radioactivity**: 
Radio active emissions, Radioactive decay, radioisotopes, Detection and measurement of radioactivity, Radiation dosimetry, Biological applications of radio isotopes.

VII **Gravity and G forces**
Effect of gravity, G forces, Effect of G forces, protection against G forces, Effect of zero gravity.


Books:
Current topics in membrane transport: Bronner, F & Kleinzeller, A
Physics for Biology and premedical students: Burns, D.M. and MacDonald, S.S.G.

College Physics: D.B. Sinha & J.N.Das Sharma

Hu / B / T / 115

Humanities---B

3 pds/ week

Syllabus for English
a) Comprehension
b) Formal letter and writing a curriculum vitae: report writing; paragraph writing (description and narration)
c) Grammar and vocabulary
d) Texts: any two of following
   "Dear as the moon"
   "Scientific Research for amateurs"
   "Governmental checks industrial growth"
   "Modern improvements"
   "English for everyone"

Pharm / Math / T / 116

Mathematics I M

3 pds/ week

CALCULUS
I) Differential calculus: Successive differentiation, Leibnitz theorem, Rolle's theorem (statement only), Mean Value Theorem, Taylor's theorem, Indeterminate forms, Functions of two variables, Partial differentiation, Maxima and Minima.
II) Integral calculus: Properties of definite integrals, Beta and Gamma functions.

Elementary matrix Algebra:

I) Introduction to matrix algebra.
II) Determinants.
III) Inverse matrix.
IV) Rank and equivalence.
V) Linear equations and linear dependence.
VI) Laplace transform (preliminary treatment)

Statistics: Overview of the following:
I) Frequency distribution.
II) Measures of central tendency.
III) Measures of dispersion.
IV) Elementary probability theory.
V) The Binomial, Normal and Poisson distribution.
VI) Elementary Sampling Theory.
VII) Statistical Estimation Theory.
VIII) Statistical Decision Theory.
IX) Small Sampling Theory - Tests of Hypothesis and Significance.
X) The Chi Square Tests.
XI) Curve Fitting: the methods of least squares.
XII) Correlation theory.
XIII) Multiple and partial correlations.
XIV) Analysis of variance.
XV) Non-parametric tests and parametric.

**Pharm/S/111**  Pharmaceutical Biology Lab  3 Pds/Week

- Identification of Invertebrate and Vertebrate species.
- Study of human Physiology by dissecting Mammalian species and demonstration by charts, models and slides.
- Study of Osteology of man and demonstration human skeleton and models.
- Microscopic study and slide preparation of Monocot and Dicot root and Stem.
- Morphological study of Phytochemically important Plants, as used in Ayurvedic and Homeopathic medicines.
- Dissection of Toad/Frog and identification of different organs.

**Pharm / Ph / S / 112**  Physics Lab  3 pds/week
(Selected Experiments will be conducted from amongst the listed terms)

1. Determination of galvanometer resistance by half-deflection method.
2. Determination of galvanometer resistance by Thomson’s method.
3. To find high resistance by galvanometer deflection method.
4. To measure J by electrical method by copper colorimeter (radiation correction to be done).
5. To compare low resistance by drop of potential method.
6. To determine resistance per unit length of a wire using Carey Foster bridge.
7. To estimate the strength of a current by using copper voltameter.

8. A) To compare the e.m.f.s of two cells by using a potentiometer.
    B) To measure the current by using a potentiometer.
9. To measure the horizontal component of Earth’s magnetic field industry by using deflection and magnetometer.
11. To determine the coefficient of viscosity of a liquid by Capillary flow method.
12. Determination of Young’s modulus by Flexure method.
13. To draw the mutual and anode characteristic of a triode and hence to find Ra, u, and gm from both sets of curves.
14. To draw the transistor characteristics (NPN/PNP) in the given configuration.

Book: A textbook of Practical Physics for B. Sc (Pass) Students by K.G. Majumder
Pharm / ME / S / 113                Engineering drawing 4 pds / week

I.S conventions of drawing- Lettering, scales, etc. orthographic projections- first and third angle concepts, isometric drawing and dimensioning.
Sections and sectional view.
Bolted and riveted joints, Welded joints , Pipe joints and fittings,
Types of flanges and working drawing of pulley , key etc. pressure vessel and auxiliaries- skirt, saddle etc.
Line drawing of agitator, ball mill, mixer , filter press, centrifuge, dryer , evaporator calandria, granulator, sieving machine, tablet machine etc.
Concept of flow diagram

Books:
Machine drawing by N.D. Bhat
Engineering drawing M. Bhattacharya.

Pharm / ME / S / 114                Work shop practice 6 pds / week

Pattern Making, Operation of lathe and operation of milling machine.

First Year, Second Semester

Pharm / T / 121                Pharmaceutics-II 4 pds/weeks

Suspension: Theoretical consideration, preparation, evaluation, stability.
Emulsions: Definition, type of emulsion, theories of emulsification, pharmaceutical applications, preparation , stability and preservation.

Ointments: Classification, ointment bases, preparation and evaluation.
Paste: Bases of paste, preparation of paste.
Jelly: Type of jelly, jelling agents and their properties, preparation of jellies.
Lozenges: Definition and preparation.
Suppositories: Bases, method of preparation, quality control.

Pharm / T / 122                Pharm. Chem – I ( Organic- 1) 4 pds/weeks

1. Mechanistic aspects of organic reactions of different categories of aliphatic and aromatic compounds:
Hydrocarbons, alcohols, alkyl and aryl halides, esters, carbonyl compounds, carboxylic acids and their derivatives, sulfonic acids, nitro compounds, amino compounds, diazonium salts, phenols.

2. Alicyclic compounds
3. Polynuclear aromatic hydrocarbons

Pharm / T / 123                  Pharm. Chem - II (Analytical I)          4pds / week

PHARMACEUTICAL ANALYSIS – I

THEORY

Significance of quantitative analysis of quality control. Different technique of analysis, significant figures. Rules of retaining significant digits, Types of errors, mean deviation, standard deviation, statistical treatment of small data sets, selection of sample, precision and accuracy. Fundamentals of volumetric analysis, methods of expressing concentration, primary and secondary standards.

ACID BASE TITRATIONS

Acid base concepts, Role of solvent, Relative strengths of acids and bases, ionisation, law of mass action, common ion effect, ionic product of water, pH, hydrolysis of salts, Henderson-Hasselbalch equation, buffer solutions, neutralisation curves, acid base indicators, theory of indicators, choice of indicators, mined indicators, polyprotic system, polyamine and amino acid system, amino acid titration, application of assay of H3PO4, NaOH, CaCO3, etc.,

OXIDATION-REDUCTION TITRATION

Concept of oxidation and reduction, redox reaction, strength and equivalent weights of oxidising and reducing agents, theory of redox titration, redox indicators, cell representations, measurement of electrode potential, oxidation reduction curves, iodimetry and iodometry, titrations involving ceric sulphate, potassium iodate, potassium bromate, potassium permanganate, titanous chloride and sodium, 2,6-dichloro phenol indophenol.

PRECIPITATION TITRATIONS

Precipitation reactions, solubility products, effect of acids, temperature and solvent upon the solubility of a precipitate, argentometric titrations and titration involving ammonium or potassium thiocyanate, mercuric nitrate and barium sulphate, indicators, Gay-Lussac method, Mohr's method, Volhard’s method and Fajan's method.

GRAVIMETRIC TITRATIONS

Precipitation techniques, solubility products, the colloidal state, super saturation co-operation, post precipitation, digestive washing of the precipitate, filtration, filter papers and crucibles, ignition, thermogravimetric curves, specific examples like barium sulphate, aluminium as aluminium oxide, calcium as calcium oxalate and magnesium as magnesium pyrophosphate, organic precipitants.

NON-AQUEOUS TITRATIONS

COMPLEXOMETRIC TITRATIONS
MISCELLANEOUS METHODS OF ANALYSIS
Diazotization titration, Kjeldahl method of nitrogen estimation, Karl-Fischer titration, oxygen flask combustion gasometry.

Quality control concept in drugs and pharmaceuticals.
Sources of impurities in Pharmaceuticals and their management. Limit tests for impurities like chloride, sulphate, iron, lead, heavy metals, arsenic in pharmaceutical substances

Pharm/T/124 Human Anatomy and Physiology I 4 Pds/Week

- Concept of health and diseases.
- Cardiovascular system, study of ECG, special nodal tissue and regional circulation – related disorders.
- Blood - composition, function, grouping and coagulation of blood– related disorders.
- Study of Lymph – related disorders.
- Urinary system – related disorders.
- Endocrine glands, function and related diseases.

Pharm / T / 125 Numerical methods and computer programming 4 pds / week
B) Basic Languages: BASIC, FORTRAN, C++, DOS, WINDOWS.

Pharm / T / 126 ENVIRONMENTAL SCIENCES AND COMTROL 4 pds / week

Water resources, Quality and control: lakes , streams, oceans and ground water , elements of fluid dynamics of surface and ground water, waste water, sources and pollution, water treatment processes, river water monitoring, control and clean up methods.

Control of Air and Noise Pollution : Classification of pollutants and sources, description of noise pollution. Control of Solid Wastes: Definition, Classification of Solid wastes, domestic, industrial and hazardous and waste disposal.
Environmental Conservation and Sustained development: Policies and strategies of sustainable development, sustainable natural resources management and biodiversity management.
Environmental Microbiology and Biotechnology: Microorganisms in nature, Microbial biodiversity and bioremediation.
Environmental Health and Toxicology: Toxicology of metal pollutants, Non metal pollutants and air pollution effects on the respiratory system.
Environmental Impact Assessment ( EIA) : Relation between development and environment, comparison between economic and ecological criteria, Relation between EIA and sustainable development.

Recommended Books:
I) Environmental Science : Prof. Subhas Santra. Dept of environmental science, Kalyani university.
II) Microbial Ecology,  Atlas & Bartha
III) Environmental toxicology, Wright & Wellbourn.

Pharm / S / 121  Pharmaceutics Lab - I  3 pds/ week
Preparation of the following will be exemplified during laboratory session: Solution, Powder, Galenical, Suspension, mouth wash, gargle, lotion, and emulsion.

Pharm / S / 122  Pharmaceutical Chemistry Lab - I (Organic)  3 pds/ week
Identification of organic compounds based on detection of elements, determination of physical constants, group solubility, functional groups and preparation of derivatives.

Pharm / S / 123  Pharmaceutical Chemistry Lab - II (Analytical)  3 pds/ week
Assay of inorganic pharmaceuticals by acidimetry, alkalimetry, permanganometry, iodometry, dichromatometry (internal and external indicators), and argentometry using Mohr’s method and adsorption indicator, gravimetry, and complexometry. Limit tests.

Pharm / S / 124  Numerical methods and computer programming  3 pds/ week
Lab problems based on theory.

Second year, First semester

Pharm / T / 211  Pharmaceutics- III  4 pds/ week

PHYSICAL PHARMACY

Surface and interfacial phenomenon, surface active agents, surfactants and drug activity, surfactants and pharmaceutical products, wetting & solubilizing agents, emulgents, detergents, and antifoaming agents; Colloids;

Kinetics: Physical degradation of pahrmaceutical products, loss of volatile constituents, loss of water, absorption of water, crystal growth, polymorphism, color change; Factors influencing chemical degradation like hydrolysis, oxidation, isomerisation, polymerisation, decarboxylation etc.; Methods of reducing physical and chemical degradations; Chemical kinetics and their application to decomposition of pharmaceutical products; Accelerated tests for physical, chemical and photochemical stability; Stability aspects of formulations.

Rheology and rheology of disperse systems: Newtonian liquids, non-newtonian materials, yield value of viscoelastic material, plastic, pseudoplastic, dilatant and thixotropic flow, viscosity of suspending agents,
effects of temperature and concentration of dispersed phase on viscosity, reological properties of suspension and emulsions, gels and paste.

Complexation: Metal complexes, organic molecular complexes, occlusion compounds; Methods of analysis; Thermodynamic treatment of stability constants; Complexation and drug action; Protein binding; physical properties of drug molecules.

Pharm / T / 212  Pharmaceutical Chemistry - III (Organic II)  4 pds/ week

a) Orientation and reactivity in electrophilic aromatic substitutions
b) Introduction to heterocyclic chemistry nomenclature with special reference to fused ring system and drugs.
c) Five membered ring containing one and two hetero atoms and related drugs.
d) Six membered ring containing one and two hetero atoms and related drugs.
e) Fused ring system:
   Indole, benzofuran, benzimidazole, quinoline, isoquinoline, pteridine, quinazolone, purine, 1,4-benzodiazepine, \( \beta \)-lactam ring, coumarins, thioxanthenes and their related compounds.

Pharm / T / 213  Pharmaceutical Chemistry - IV (Physical)  4 pds/ week

1. Properties of real gases.
2. Properties of solids
3. Thermodynamics: The first law, Thermochemistry, The second Law, Free energy functions and applications.
4. Homogenous and Heterogenous chemical equilibria.
5. Solutions of non-electrolytes
6. Solutions of electrolytes
7. Ionic equilibria.
8. Buffered and isotonic solutions.
9. Solubility and distribution phenomena
10. Reaction kinetics
11. Adsorption and surface phenomena
12. Rheology; Viscosity.
13. Colloids.

Pharm / T / 214  Pharmaceutical Chemistry - V (Inorganic)  4 pds/ week
1. Water: Chemical properties, natural water, potable water, softened water, purified water, water for parenterals, selection of suitable water
2. **Silicates in Pharmacy**: General chemistry of silica, silicic acid, amorphous silica system, kaolin, bentonite, talc, magnesium trisilicate, soluble silicates, glasses etc.

3. **Minerals I**: Fluid electrolites and trace ions, fluid electrolyte replenisher, ionic structure and physiological suitability of electrolites, calcemic and tonics. Fluorides and general health, iodine as antigoiterogenic

4. **Mineral II**: Essential trace elements, transitional elements and their compounds, iron and the hematinsics, mineral supplements

5. **Germicide and related substances**: General background, oxidising germicides, per oxides, halogen, and their oxo compounds

6. **Radio isotopes & radio-opaque**: Nuclear decomposition, uses of radio-isotopes

7. **Inorganic cathartics**

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**Pharm / T / 215**  
Introduction to Pharmaceutical Engineering  
4 pds/week

1. Different unit systems, dimensional analysis, different types of plotting methods.
4. a) Fluid statics, Measurement of pressure drop— Simple, differential, inclined etc. Fluid Dynamics in Newtonian system: Types of flow, Reynolds number, Bernoulli’s theorem, Fluid friction, pipe roughness, sudden contraction and enlargement in pipes and pipe fittings, Flow measuring devices—Orificemeter, venturimeter, rotameter, pitot tube, weirs; pumps—centrifugal, gear, reciprocating, gear peristaltic etc.
   b) Non-Newtonian Fluid flow—Theory of various types of Non-Newtonian Fluid flow, modified Reynolds number etc.

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**Pharm / T / 216**  
Human Anatomy and Physiology II  
4 pds/week

- **RESPIRATORY SYSTEM**: Anatomy of the respiratory pathway, mechanism of respiration, lung capacities and volume, carriage of the respiratory gases, control of respiration—related disorders.
- **CENTRAL NERVOUS SYSTEM** (Conduction of nerve impulse, synapse, reflex action, postural equilibrium, condition reflex, sleep, cerebrum and cerebrospinal fluid) – related disorders.
- **AUTONOMIC NERVOUS SYSTEM** (classification), general arrangement, autonomic ganglia, sympathetic and parasympathetic systems–related disorders.
- **DIGESTIVE SYSTEM**: Physiology of digestion and absorption, liver and pancreas—related disorders.
- **REPRODUCTIVE SYSTEM** – related disorders.
- **Special Senses**—in respect of Taste, Vision, Olfaction and Hearing.

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**Pharm / S / 211**  
Pharmaceutics Lab - II  
4 pds/week

1. To study on the effect of complexing agents on the solubility of sparingly water soluble drug.
2. To study on the effect of co-solvent on the solubility of sparingly water soluble drugs.
3. To study on the effect of surfactant on the solubility of sparingly water soluble drugs.
4. To determine the bulk density and void porosity of powdered drugs.
5. To study the effect of lubricants on angle of repose of granules / powdered drugs.
6. Quantitative analysis of Salicylic acid using Spectrophotometer.
7. To study particle size distribution of granules by sieve method.
8. Determination of critical micelle concentration of surfactants.
11. To study the effect of pH on the solubility of a slightly soluble weak acid.
12. Determination of dissolution of tablets.
13. Determination of rate constant and half life of pseudo first order reaction.
14. Determination of second order reaction rate constant of ethyl-acetate in sodium hydroxide.
15. Determination of shelf-life of aspirin in 0.1(N) HCl using accelerated stability study.

**Pharm / S / 212  Pharmaceutical Chemistry Lab – III (Organic)  4 pds/ week**

Preparation of simple organic compounds based on different types of reactions such as nitration, sulfonation, oxidation, reduction, diazotization, hydrolysis, acylation etc. Examples: Asprin, Acetanilide, Nitrobenzene, m-Dintrobenzene, Benzamide etc.

Estimation of functional groups like carboxyl, hydroxyl, amino, acetyl, carbonyl, unsaturation, ester group and amino nitrogen.

**Pharm / S / 213  Physiology Lab  4 pds/ week**

- Identification of different visceral organs.
- Histological studies of different visceral organs (i.e. liver, lungs, kidney, spleen, pancreas, endocrine glands, muscle- skeletal, smooth, cardiac, Spinal cord, cerebellum, cerebrum, testes, ovary etc.)
- Blood Pressure measurement.
- Human physiology: TC, DC, Hb, ESR, Clotting time, Bleeding time, ABO- Grouping, etc.
- Experimental Physiology: Handling, weighing, numbering, anaesthetizing and injection of mice/rat/rabbit.
- Canulation of trachea, artery, vein etc.
- Heart Curve: Normal curve, effect of temperature, ions and neurohurmonal substances on normal heart curve.
- Muscle curve: Normal curve, effect of temperature, ions, loads, on normal muscle curve.

To study genesis of Tetanus

**Second year, Second semester**

**Pharm / T / 221  Pharmaceutics- IV  4 pds/ week**

Micromeritics: Definition, particle size distribution, particle size measurement, particle volume measurement, derived properties of powder: porosity, density of particles, packing arrangements, flow properties etc. Particle size analysis-newer developments.

Cosmetics: Shampoo, shaving products, hair oil, lipsticks, antiperspirants, nail polish, nail polish remover, cleanser, toner, moisturizer, vanishing cream, cold cream, anti aging cream.
Surgical dressings: Features of an ideal dressing, fibres, fabrics, impregnated fabrics, bandages, self adhesive, plasters, and compound dressings.

Suture, ligature and catgut: Absorbable and non-absorbable sutures and ligatures; Preparation and sterilizations of surgical catgut; Blood and blood related products.

Incompatibility: physical, chemical and therapeutical.

Radiopharmaceuticals: Biological half life, medicinal and diagnostic uses of radio isotopes, Measurement of Radioactive molecules: Isotope dilution techniques, activation analysis.

**Pharm / T / 222 Pharmaceutical Chemistry - VI (Natural products) 4 pds/week**

Chemistry of natural products:
1) An introduction to medicine from natural resources
   Insight to alternative systems of medicine; Drug development from natural products. Role of natural product in primary health care and the aspects related to their safety and toxicity. Ethnobotany and aspects biodiversity for development of natural products.

2) Phytopharmaceuticals development and evaluation
   General technique used for extraction and isolation; Isolation and characterization of different classes of phytoceuticals- qualitative test procedures; Phytomedicines with different dosage forms, their formulation and development.

3) Standardization and quality control of natural products:

1) Drugs from natural origin with Phytochemical and therapeutic importance:
   Chemistry, test, isolation and characterization and estimation of phytopharmaceuticals belonging to the group of Carbohydrate, Glycoside, Tannin, Saponin, Flavonoids, Lipids, Volatile oil and Resin, Alkaloids, Carotenoids, Steroids and Terpenoids. Pesticides of natural origin and miscellaneous products.

5) Regulatory and legal parameters for drug development from natural resources;
   Various official monograph on natural products of therapeutic importance, regulation and guidelines on drug development from natural sources - Indian and global perspectives.

**Pharm / T / 223 Pharmaceutical Chemistry - VII (Advanced organic) 4 pds/week**

1. Stereochemistry - Geometrical and Optical Isomerism
2. Physical properties of drug molecules: Electromagnetic radiation, Atomic spectra, Molecular spectra, UV and Visible spectrophotometry, Fluorescence and Phosphorescence, Dielectric constant and induced polarization, Permanent dipole moment of polar molecules, Infrared spectroscopy -- an
elementary treatment, Electron spin resonance and NMR spectroscopy -- an elementary treatment, Refractive index and molar refraction, Optical rotation, Circular dichroism, Partition coefficient.

3. Nucleophilic aromatic substitutions
\[ \alpha, \beta \text{-unsaturated carbonyl compounds} \]
Molecular orbitals -- Orbital symmetry, Aromatic character, Electrocyclic reactions, Cycloaddition reactions, Sigmatropic shift.

4. Organic name reactions with mechanisms

**Pharm / T / 224**  
**Applied Microbiology - I**  
4 pds/ week
1) Classification and nomenclature of microorganisms.
2) Microbiology of bacteria, yeast, molds and viruses specifically their structure, shape, size, distribution and their pathogenicity. Beneficial role of microorganisms.
3) Cultivation and growth of bacteria and fungi.
4) Isolation of pure culture and identification.
5) Staining agents and staining methods of microorganisms -- e.g. - Simple staining, Differential Staining, Negative Staining and Acid Fast Staining.
6) Principles of sterilization and different methods, Sterilization of pharmaceutical products, Sterilization control and sterility testing.
8) Disease and disease producing microorganisms, Virulence factors.
9) Microbial genetics and their role in industrial and medical microbiology.
10) Microbiological assay of antibiotics, vitamins and amino acids.

**Pharm / T / 225**  
**Applied Biochemistry - I**  
4 pds/ week
Basic elementary chemistry of carbohydrates, lipids, proteins and nucleic acids.
Metabolism: basic concepts and designs
Glycolysis, Citric acid cycle, Oxidative phosphorylation, Pentose phosphate pathway and glyconeogenesis, Glycogen and disaccharide metabolism.
Fatty acid metabolism, Introduction to biological membranes.
Food and nutrition:
General considerations, Vitamins, Growth factors, Mineral proteins caloric malnutrition.

**Pharm / S / 226**  
**Industrial management**  
4 pds/ week
Industrial management and record keeping:
Principles of economics: Want, Activity, Satisfaction of wants; Distribution under Laissez Faire and under socialism; public sector and private sector of Indian economy. Types of markets and goods; factors of production, optimization of factors inputs; Demands and supply; Price determination; specialization, location of industry; concept of social cost.
Principles of management:
Planning, organizing, staffing, Leading coordination and control: marketing, advertisements; Problems of uncertainty and risks; General principles of insurance. Inland and foreign trade, outlines of Factories Act and E.S.I. Act. Industrial organization; Limited liability system

**Pharm / S / 221**  
**Pharmaceutical Chemistry Lab - IV (Physical)**  
4 pds/ week
1) Determination of viscosity of a liquid using Ostwald Viscometer
2) Determination of Surface tension of a pure liquid using different methods.
3) Determination of Interfacial tension between two liquids by the drop count method
4) Determination of transition temperature of sodium carbonate by solubility method.
5) Determination of mutual solubility curve of phenol and water.
6) Determination of variation of refractive index with the composition of liquid mixtures.
7) To test the validity of Beer-Lambert law using
   I) Duboscq colorimeter:
   II) Photoelectric colorimeter.
8) Determination of end point in a typical titration by Conductometric method.
9) Determination of the specific and molecular rotation of a compound using polarimeter.
10) Determination of velocity constant of a first order reaction.
11) Determination of coefficient of an organic compound between two solvents.
12) Determination of equilibrium constant of the equilibrium
    \[ KI + I_2 = KI_3 \] by partition method.
13) study on the absorption of acetic acid on charcoal--------- verification of Freundlich's adsorption isotherm.
14) Potentiometric titration.

**Pharm / S / 222**
**Applied Biochemistry Lab**
**4 pds/ week**

Experiments of sugar: Test of reducing sugar, Colorimetric estimation of sugar, Chromatography on sugars.
Experiments on Vitamins from sources: Assay of thiamine, riboflavin and vitamin B_{12}.
Experiments on Enzymes: Effect on pH, Effect on temperature, Use of inhibitors.
Fundamental methods of analysis: Spectrophotometric, Fluorimetric and Electrophoretic.

**THIRD YEAR FIRST SEMESTER**

**Pharm / T / 311**
**Pharmaceutics - V**
**4 pds / week**

Tablet: Definition, types, additives; Methods of preparation; Processing problems, evaluation, commercial processing equipments, other compressed tablets, flow design for tablet manufacturing.

Tablet coating: Sugar coating process, characteristics and requirements of uncoated tablet, equipments, film coating process-materials, solvents, and additives for film coating, air suspension coating and dip coating, film testings and film defects, electrostatic coating, laminated coating, physiological availability.

Capsules: Manufacturing area design, lay-out and flow diagram of capsule manufacture; hard gelatin capsule; materials for capsule; method of capsule shell production; capsule filling equipments; capsule filling operations; soft gelatin capsule; Size and shape, methods of manufacture; nature of capsule shell and capsule content, and evaluation.
Biopharmaceutical consideration of the following dosage forms such as solution, suspension, capsule, tablets, coated tablets, prolonged released products, injectables, aerosols, ophthalmic preparation, and topical dermatological preparation. Bioavailability and Bioequivalence.

**Pharm / T / 312  Pharmaceutical Chemistry - VIII (Analysis II)**  
4 pds / week

1. Extraction procedure including separation of drugs from excipients,
2. Chromatography:
   Following techniques will be discussed with relevant example of Pharmacopoeial products - TLC, HPLC, GLC, HPTLC, Paper chromatography, column chromatography.
3. Instruments Analysis:
   - Theory and application of the following instruments, Potentiometry, UV - Visible Spectrophotometry, conductimetry, NMR, Mass spectrometry, polarography, X-Ray diffraction analysis.
4. Quality assurance. GLP, ISO 9000, TQM, Quality review and Quality Documentation
5. Regulatory control, regulatory drug analysis, interpretation of analytical data.
6. Validation, Quality audit, quality of equipment, validation of equipments, validation of analytical procedures.

**Pharm / T / 313  Medicinal Chemistry - I**  
4 pds / week

THEORY AND BASIC PRINCIPLES OF MEDICINAL CHEMISTRY

Physicochemical aspects (Optical, geometric and bioisosterism) of drug molecules and biological action, drug receptor interaction including transduction mechanisms.

PRINCIPLES OF DRUG DESIGN (THEORITICAL ASPECTS)

Different aspects of structure-activity relationships in drug design (general treatment). Concept of Pharmacophore and lead optimization.

SYNTHETIC PROCEDURES OF SELECTED DRUGS, MODE OF ACTION, USES, STRUCTURE ACTIVITY RELATIONSHIP INCLUDING PHYTOCHEMICAL PROPERTIES OF THE FOLLOWING CLASSES OF DRUGS:

A) Drugs acting at synaptic and neuroeffector junction sites:
   1) Cholinergics and anticholineesterases
   2) Adrenergic drugs
   3) Antispasmodic and antiulcer drugs
   4) Neuromuscular blocking agents
B) Autocoids:
   2) Antihistamines
3) Eicosanoids
4) Analgesic, Antipyretics, Antiinflammatory (Non steroidal) agents.

C) Drugs affecting uterine motility:
   Oxytocics (including Oxytocin, ergot alkaloids and prostaglandins), Biochemical approaches in drug designing wherever applicable should be discussed.

Pharm / T / 314 Pharmacology - I 4 pds / week
- General Pharmacology: Introduction, Routes of Administration of Drugs, Mechanism of action of Drugs (Absorption, Distribution, Metabolism and Excretion of Drugs).
- Basic idea of mechanism of Drug action, Drug Toxicity.
- Pharmacology of ANS - Neurohumoral transmission, Drug acting on Sympathetic and Parasympathetic system.

Principles of Toxicology- Poisons and Antidote

Pharm / T / 315 Applied Biochemistry - II 4 pds / week
Introduction to protein structure and function:
Three dimensional structure, Stability and denaturation of proteins, Allosteric proteins, Amino acid degradation and urea cycle, Introduction to enzymes, Mechanism of enzyme action.

Enzyme & coenzymes: Classifications, Enzyme kinetics, Michaelis-Menten Equation, Modification of enzyme activity, Mechanism of enzyme action
Protein and Nucleic acid metabolism: Metabolism of important amino acids, urea cycle, creatine, creatinine, phospholipids, Metabolism of cholesterol and bile acids, Role of hormones in metabolism, ketogenesis and ketolysis
Structure and conformation of proteins, Protein ligand interaction as the basis of antibody receptor and enzyme action; Active site and allosteric site for enzymes. Feed back regulation and drug development;
Enzymes in Pharmacopoeias.
Study of metabolism in relation to drug development:
Differential centrifugation and biofunction of organelles; Glycogen metabolism and cyclic AMP as second messenger; Nucleotide sugars, amino acid transformation, histamine, and serotonin;
Purine Biosynthesis and therapy of neoplasms; Cholesterol biosynthesis and steroidogenesis;
Enzymatic basis of biotransformation of drugs, cytochrome.
Hormones: Mechanism of secretion, Mode of action of steroid hormones and protein and peptide hormones, their preparation & biochemical functions, Assay methods and role as a drug.
Vitamins: Mode of action of vitamins, Assay methods from sources.
Elements of molecular biology: DNA as hereditary material, DNA double helix, different types of functions of RNAs. Phage cycle and message transformation, Basic steps in replication, Transcription and translation, Genetic code.

Pharm / T / 316 Forensic Pharmacy 4 pds / week
A study of the dangerous drug act 1930, Opium Act, poison act, the Excise act and rule, the Drug and Magic Remedies act and such other acts as materially affect the pharmaceutical profession. Code of ethics for the
pharmacists. Study of the various enquiry commission which have been set up by the Government of India or the State Governments to enquire into affairs of Drug Industry, trade or profession.


A survey of the Pharmacy Act 1948 and its impact on the development of the pharmacy profession in India. Study of other relevant legislations affecting the profession of Pharmacy and the drug industry in India.

**Pharm / S / 311**  
**Pharmaceutics Lab - III**  
4 pds / week

Non systemic liquid antacid preparation, Application and related emulgents, Non staining iodine preparation, Syrup IP, Syrup based liquid preparation, Effervescent preparation, Tooth Powder, Liquid Disinfectant, and Ointment

**Pharm / S / 312**  
**Pharmaceutical Chemistry Lab - V (Natural products)**  
4 pds / week

1. Estimation of alkaloid content in crude drugs and pharmaceutical formulations.
2. Estimation of functional groups like hydroxyl, acetyl, methoxyl, carboxyl, esters etc.
3. Qualitative identification tests for drugs and pharmaceuticals in official formulations.
4. Assay of drugs and bioactive substances using HPLC, GLC etc
5. Chromatographic Analysis

**Pharm / S / 313**  
**Applied Microbiology Lab**  
4 pds / week

1) Different methods of sterilization: Moist heat, Dry heat, Filtration through Bacterial filter.
2) Sterility testing of injectables according to I.P.
3) Microscopic examination of microbes including bacteria, yeast and fungi. Gram staining of bacteria.
4) Evaluation of antiseptic / disinfectants: Rideal-Walker Test (Phenol Co-efficient)
5) Assay of antibiotics: Well diffusion and Disc diffusion method; MIC and MBC of antibiotics.
6) Assay of vitamins/ amino acids.

**THIRD YEAR SECOND SEMESTER**

**Pharm / T / 321**  
**Pharmaceutics - VI**  
4 pds / week

Parenteral products: Route of administration, selection of vehicles, added substances; containers; suspension and emulsion for injections; production-facilities; environmental control, personnel; cleaning of containers and closures; sterilization of equipments; compounding, filtration, filling and sealing procedures; sterilization of products; various quality control test for parenteral products.

Ophthalmic products: Eye drops, eye lotions, eye ointments, formulation, additives, preparation, sterilizing, packaging; contact lens solutions.

Aerosol: Mode of operations, propellants, containers, valves, actuators, buttons, diptubes; packing, application and testing.
Biopharmaceutics: Mechanism of drug absorption, factors affecting drug absorption (biological, physical, chemical, dosage form, excipients), distribution of drugs; excretion
Basic Concepts of sustained and controlled release dosage form:
Microcapsules, gastro retentive, mucoadhesives, buccal and sublingual preparations, transdermal patches & other topical products,
Iontophoresis & Sonophoresis: Fundamental and applications
An overview on Neutraceuticals including role of antioxidants in optimal health.

Pharm / T / 322  Medicinal Chemistry - II  4 pds / week

Synthetic procedures of selected drugs, mode of action, uses, structure activity relationship including physico-chemical properties of the following class of drugs:

STEROIDS AND RELATED COMPOUNDS
Steroidal nomenclature and stereochemistry, androgens and anabolic agents, estrogens and progestational agents, adrenocorticoids.

DRUGS ACTING ON THE CENTRAL NERVOUS SYSTEM
General anaesthetics, local anaesthetics, hypnotics and sedatives, opioid analgesics, antitussives, anticonvulsants, antiparkinsonian drugs, CNS stimulants, psycho pharmacological agents, (Neuroleptics, antidepressants, anxiolytics).

DIURETICS, ANTICOAGULANT AND ANTIPLATELET DRUGS AND CARDIOVASCULAR DRUGS
Antihypertensives, cardiotonics, antianginals, antiarrhythmics and antihyperlipidemic drugs.

Pharm / T / 323  Pharmacology - II  4 pds / week

- Drugs acting on CNS - Sedative and Hypnotic agents, Psychotropic drugs including Psychomimetics, Drugs used for Epilepsy.
- Analgesics - Anti-inflammatory drugs, anti arthritic and anti gout drugs, Narcotic analgesics.
- Drugs acting on Endocrine system –
  Drugs used in the treatment of thyroid disorders, Drugs acting on Pituitary and Adrenal Cortex, Hypoglycemic agents
- Drug Discovery – including concepts of Clinical Trials.

Pharm / T / 324  Pharmacognosy - I  4 pds / week

1. Definition, history, scope and development of Pharmacognosy
2. Classification of drugs: Alphabetical, Morphological, Taxonomical, Chemical and Pharmacological classification of Drugs.
3. Systematic pharmacognostic study of the following:
   a) Carbohydrates and derived products: Agar, guar gum, acacia, honey, Isapgul, pectin, Starch, Sterculia and Tragacanth.
   b) Lipids, Beeswax, Castor oil, Cocoa butter, Cod liver oil, Hydnocarpus oil, kokum butter, Lard, Linseed oil, Rice Bran oil, Shark liver oil and Wool fat.
5. Resins: Study of Drugs Containing Resins and resin Combination like Colophony, podophyllum, Jalap, cannabis, capsicum, myrrh, asafoetida, balasam of tolu, balasam of Peru, benzoin, turmeric, ginger.


7. Fibres: Study of Fibres used in pharmacy such as cotton, silk, wool, nylon, glasswool, polyester and asbestos.


9. Tannins: Study of tannins and tannin containing drugs like Gambier, black Catechi, gall and Myrobolan. The holistic concept of drug administration in traditional systems of medicine. Introduction to ayurvedic preparations like Arishtas, Asavas, Gutikas, Churnas, Lehyas, and Bhasmas.


Pharm / T / 325 Pharmaceuticals Engineering- I 4 pds / week
4. Separation: (a) Screening, theory of sedimentation, Stoke’s law, classification of particle size by elutriation. (b) Theory of filtration, various industrial filtering equipments. (c) Theory of centrifuging, centrifuges.
6. Crystallization: Basic concept on solubility, Meirs supersaturation theory, caking of crystals, crystallizers and related problems.

Pharm / T / 326 Applied Microbiology - II 4 pds / week
1) Chemotherapy, Chemotherapeutic agent/Antimicrobial agents, Chemoprophylaxis/Chemoprevention, Antibiotics.
2) Classification of chemotherapeutic/antimicrobial drugs and their origin.
3) Manufacture of antibiotics and mechanism of action of antibiotics.
4) Bacterial resistance to antibiotics.
5) Chemical disinfectants, antiseptics and preservatives: Evaluation and mode of action.
6) Ecology of microorganisms affecting pharmaceutical industry.
7) Microbial spoilage and preservation of pharmaceutical products.
8) Pharmaceutical products of microbial origin.
9) Production of therapeutic drugs by genetic engineering (Recombinant DNA Technology)
10) Fermentation Technology: Production of alcohol, acids, antibiotics, vitamins, etc.

Pharm / S / 321  Pharmaceutics Lab - IV  4 pds / week
Preparation of the following preparation:
Tablet, coating, Capsule, Parenterals, ophthalmic products, suppository.

Pharm / S / 322  Pharmaceutical Chemistry Lab - VI (Med Chem Lab I)  4 pds / week
A) Preparation and Purification of Drugs and their intermediates like Methyl salicylate, Benzilic acid, Antipyrine, Sulphanilamide, 4-Methylcoumarin, Nicotinic acid and Nicotinamide, Phenylbenzoate, Benzylhydrol, Iodoform, Paracetamol Phenacetin etc.
B) Preparation and purification of Inorganic pharmaceuticals like Ferrous Sulphate, Sodium chloride, Sodium benzoate, Sodium salicylate, Disodium hydrogen citrate, Calcium gluconate, Magnesium trisilicate, potassium acetate, Ferrous ammonium citrate
C) Analysis of Drugs: Inorganic and Organic

Pharm / S / 323  Pharmacognosy Lab  4 pds / week
1. Identification of crude drugs mentioned in theory
2. Microscopic studies of the crude drugs mentioned in theory
3. Preparation of herbarium sheets
4. Powder analysis of crude drugs mentioned in theory.
5. Extraction of crude drugs
6. Chemical group tests on the crude drugs.
7. Thin layer chromatographic studies of the herbal drug constituents.
8. Isolation, separation, Purification of various phytoconstituents of pharmaceutical significance.
9. Microscopic measurement of cells and cell contents: Starch grains, calcium oxalate crystals and phloem fibres, trichomes etc.
10. Determination of leaf constants such as stomatal index, stomatal number, vein islet number, vein termination number and Palisade ratio.

FOURTH YEAR FIRST SEMESTER

Pharm / T / 411  Pharmaceutics- VII  4 pds / week
Pharmaceutical biotechnology:
Concepts of Protein, peptide & gene deliveries: Their basics, success, limitation and application.
An overview on parenteral controlled release formulations including-Solution, Suspension, Mirosphere, Microcapsule, Liposome, Noisome, Herbosome, Nanoparticle, Multiple emulsions, Implants, Infusion Devises.
Prodrug and drug latentiation.
Packaging materials of pharmaceutical products; Different types of packaging techniques of various dosage forms.
1. Drug metabolism and concept of prodrugs.
2. Synthetic procedures of selected drugs, mode of action, uses, structure activity relationship (including physiochemical aspects) of the following drugs (biochemical approaches in drug designing wherever applicable should be discussed).
   i. Antibiotics: Detailed studies on penicillin, cephalosporins, macrolides, tetracyclines, chloramphenicol.
   ii. Synthetic agents: sulphonamides, quinolines, fluroquinolones.
   iii. Chemotherapeutic agents: Antiamoebic, antifungal, antimalarials, anthelmintics.
   iv. Anticancer agents
   v. Antiviral including anti HIV agents.
   vi. Diagnostic agents.
   vii. Antimycobacterial agents

3. Amino acids, peptide, nucleotide and related drugs.
   a. Thyroid and antithyroid drugs.
   b. Insulin and oral hypoglycemic agents.
   c. Peptidomimetics and nucleomimetics.

Pharm / T / 413 Pharmacology - III 4 pds / week

- Renal Pharmacology: Diuretics.
- Autocoids: 5-HT, GABA, Bradykinin and lipid derived eicosanoids.
- Anti allergic drugs.
- Respiratory pharmacology: Drugs used in the treatment of various disorders of the respiratory tract.
- Chemotherapy:
  a) Bacterial infections: Anti bacterial drugs (drugs acting on the cell wall, affecting protein synthesis, topoisomerase inhibitors, anti-tubercular drugs and miscellaneous agents).
  b) Viral diseases: Anti viral drugs.
  c) Protozoal diseases:
     (i) Malaria and anti malarial agents.
     (ii) Leishmaniasis and anti Leishmanic drugs
     (iii) Drugs with trypanocidal activity.
     (iv) Anti amoebic drugs.
     (v) Helminthic infection and anthelminthic drugs.
- Cancer chemotherapy.

Pharm / T / 414 Pharmacognosy - II 4 pds / week

1. Quality control of Crude drugs; Adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical and biological methods of evaluation.
2. Phytochemical Screening:
   a) Preparation of Extracts.
b) Screening of alkaloids, saponins, cardenolides and bufadienoildes, flavonoids and
leucoanthocyanidins, tannins and polyphenols, anthroquinones, Triterpenoids cyanogenetic
glycosides, amino acids in plant extracts.

3. Plant bitters and sweeteners.

4. Biological sources, preparation, identification tests, and uses of the following enzymes: Diastase, papain, pepsin, trypsin, pancreatin.

5. Natural allergens and photosensitizing agents and fungal toxins.

6. Systematic study of source, cultivation, collection, processing, commercial varieties, chemical
constituents, substituents, adulterants, uses, diagnostic macroscopic and microscopic features and specific
chemical tests of following alkaloid containing drugs.
   a) Pyridine-piperidine: Tobacco, areca and lobelia.
   b) Tropane: Belladona, hyoscyamus, datura, duboisia, coca and withania.
   c) Quinoline and Isoquinoline: Cinchona, ipecac, opium.
   d) Indole: ergot, raufwofia, catharanthus, nux-vomica and physostigma.
   e) Imidazole: Pilocarpine.
   f) Steroidal: Veratrum and Kurchi.
   g) Alkaloidal amine: Ephedra and Colchium.
   h) Glycoalkaloid: Solanum
   i) Purines: Coffee, tea and cola.

7. Study of the biological sources, cultivation, collection, commercial varieties, chemical
constituents, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific
chemical tests of following groups of drugs containing glycosides.
   i) Saponins: Liquorice, ginseng, dioscorea, sarsaparilla and senega.
   ii) Cardiovascular sterols: Digitalis, squill, strophanthus and thevetia.
   iii) Anthroquinone Cathartics: aloe, senna, rhubarb, and cascara.

8. Chemistry and biogenesis of medicinally important lignans and quassionoids, flavonoids.

9. Alkaloids; Chemistry, biogenesis, and pharmacological activity of Atropine and related compounds;
Quinine, Reserpine, Morphine, Papavereine, Ephedrine, Ergot and Vinca alkaloids.

10. Marine pharmacognosy, novel medicinal agents from marine sources.

11. Herbal cosmetics.

12. Introduction, classification and study of different chromatographic methods and their applications in
evaluation of herbal drugs.

Pharm / T / 415          Elective - I          4 pds / week

a) INDUSTRIAL PHARMACY I

Bioavailability: the concept of bioavailability of drugs formulated as dosage forms, Generic Equivalence and
inequivalence of oral product, Bioequivalence and therapeutic equivalence,
Bioinequivalence, and therapeutic inequivalence. Illustrative examples.
Current G.M.P and Pharmaceutical processes validation; Scope and definition, organization and personnel etc.
Instrumentation in pharmaceutical industry: Measurement of temperature, pressure, density, humidity,
viscosity, level and flow rate, and pollution control devices.
Pilot plant study and scale-up techniques: Details of Pilot Scale-up methods, scope and uses.
Manufacturing or isolation of the following groups or categories from plants and animals; Secondary
metabolites or drug constituents and secondary metabolites or Pharmaceutical Adjuvant.
Sterilization in Pharmaceutical Industry and its control

Fundamentals of immunology: toxins (bacterial, fungal etc.) preparation of antitoxins, toxoid standardization; Manufacture of immunological products
And their quality control, toxicity tests for vaccines and disinfectants.

a) Newer Drugs And Biotechnological Applications—I
Carbohydrate, lipid, protein and nucleic acid metabolism; Genetic Engineering.
Isolation, Purification and Standardization of biologically active compounds.

Pharm / S / 411  Pharmaceutics Lab - V  3 pds / week
Evaluation of dosage form as per compendium.

Pharm / S / 412  Pharmaceutical Chemistry Lab - VII (Med Chem Lab II)  3 pds / week
1. Assay of antibiotics, (like Streptomycin, Penicillin e.t.c.), Vitamins (like ascorbic acid), hormones by instrumental and other methods.
2. Assay of various classes by novel and classical methods e.g. INH, Sodium salicylate by iodimetry; Phenobarbitone, metronidazole, Ephedrine, e.t.c. by non aqueous titration; Hetrazan by extraction followed by residual alkalimetry; Paracetamol by UV spectrophotometry; Piperazine Citrate by Gravimetry; Sulpha drugs by potentiometric titrimetry etc.
3. Estimation of water content, alcohol content, ash content, fat content in medicinal and pharmaceutical agents.
4. Preparation of medicinal agents

Pharm / S / 413  Pharm. Engineering Lab  4 pds / week
Pharmaceutical Engineering Laboratory

Experiments:
1. Experiments on Reynolds Apparatus—determination of critical point.
2. Particle size measurement by Stoke’s law.
3. Experiment on filtration by laboratory apparatus- determination of specific cake and filter medium resistance.
4. Study of the effect of filter aids on rate of filtration.
5. Experiment on pot mill—determination of Rittinger’s law and Kick’s law coefficient.
6. Experiment on cabinet tray dryer.
7. Experiment on cabinet bench scale tray dryer.
8. To study the performance of laboratory fluid bed dryer.
10. Experiment on batch distillation to verify Rayleigh’s equation.
11. Determination of humidity of air by dew point method.
12. Determination of crystallization.
13. Engineering drawing on different laboratory equipments like vacuum tray dryer, pot mill, fluid bed dryer, leaf filter setup, batch crystallizer, bubble cap column and spray dryer etc.
Pharmacology Lab

- Study of different apparatus and experimental devices in pharmacology with particular reference to isolated tissue preparation.
- Drugs acting on the eyes.
- Narcotic analgesic activity.
- Non-Narcotic analgesic activity.
- Sedatives, hypnotics and muscle relaxants.
- Anti convulsive activity.
- Local Anaesthetic activity.
- Pyrogen testing
- Drugs activity on smooth muscle.
- Drug activity on Skeletal muscle.
- Drug activity on perfused heart.
- Assessment of Anti-inflammatory activity.

FOURTH YEAR SECOND SEMESTER

Pharm / T / 421 Pharceutics - VIII 4 pds / week
Regulations of clinical trials: Ethical guidelines, regulatory guidelines & legislation, clinical trial directives, GMP.

Intellectual property rights (IPRs) with reference to the Patents Act: What is a patent? Criteria adopted for grant of a patent, when should an application for patent to be filed, essential documents needed to be submitted by a potential patentee. An opposition under the Indian Patent Act, 1970, cost of filling a patent, where to apply?

Pharmacokinetics

Principles of Pharmacokinetics: first order, zero order, Biological half life, Pharmacokinetics of Multiple Dosing, Dosage regimen design based on mean average, minimum and maximum plasma concentrations, Concept of Steady state plasma concentration and Renal clearance, One compartmental open model and calculation, Basic idea of two compartmental model and its use, concept of AUC, $C_{max}$, $T_{max}$, Absorption and Elimination rate constants, lag time, onset of action, duration of action, termination of action, Flip-flop phenomena.

Non-Linear Kinetics: Special reference to Michaelis-Menten equation.

Hospital pharmacy practice: Professional aspects of hospital pharmacy organizations and administration, functions, standards, planning, legal aspects, formulary.

Pharm / T / 422 Medicinal Chemistry - IV 4 pds / week
1. Theoretical aspect of rational drug design
   a) Influence of structural variations and physicochemical properties on drug action.
   b) The drug development process.
   c) An introduction to Classical QSAR
   d) Computers in Medicinal Chemistry
2. Hormones
3. Vitamins
4. Immunosuppressants.

**Pharm / T / 423 Pharmacology - IV**

1. Bioassay and biological standardization of drugs.
2. General and Local Anaesthetics.
3. Drugs that act on haemopoietic system.
4. Drugs acting on cardiovascular system: Anti arrhythmic drugs, Cardiotonic drugs, Anti anginal drugs, Anti hypertensives and Hypolipidemias.
5. The drugs acting on Gastro Intestinal Tract and Antiemetics.
6. Respiratory pharmacology: Drugs used in treatment of various disorders of the respiratory tract.

**Pharm / T / 424 Pharm. Engineering - II**

1. Interphase mass transfer and gas absorption: Diffusion in gas and liquid systems, and related theory; packed tower operations and related problems.
2. Distillation: Raoult's law and Henry's law; Boiling point diagram, relative volatility. Different types of distillations for example: batch distillation (Raleigh’s equation), and distillation in different rectification columns etc; theory on rectification, McCabe Thiele design method, plate efficiencies. Problems on distillation.
6. Basic idea on Unit process.

**Pharm / T / 425 Elective - II**

a) Industrial Pharmacy—II

Stability studies of Pharmaceuticals: Stability program at preformulation and formulation stages of Pharmaceuticals, Stability prognosis for marketed batches of products.
Physics of tablet compression: Physicochemical and physicomechanical properties of granules affecting the degree of compression, Static and dynamic factors involved in compression, Binding mechanisms in compression, Illustrative examples.
Bioprocess: Fermentation technology, Fermenter design; basic knowledge on batch microbial production; continuous and fed batch fermentation; fermenter design; media formulation; batch and continuous types in sterilization of media, and recovery of products of fermentation.

Chemical process: Reactors used in the production of synthetic chemicals of pharmaceutical uses by nitration, amination, halogenation, oxidation, hydrolysis, esterification, alkylation etc.

Principles and equipment involved for processing any categories under “A” and for the following topics: Size reduction of tissues, dehydration or drying, solvent and solubility, filtration, Preservation of Extractives or Isolates, Packaging or Labeling.

Ecology of Microorganisms affecting Pharmaceutical is processing: Aspect of microbiological technique in Pharmaceutical Industry.

Microbiological Aspects of fermentation for drugs of microbial origins.

Production of therapeutically useful substance by recombinant DNA technology.

b) Newer Drugs and Biotechnological Application—II
Modern Concept relating to design and analysis of drugs including GMP.

Mechanism at the cellular, enzymatic and molecular level, development of diagnostic kits, future perspectives.

Screening of Newer drugs

Target sites of drug action. Different aspects of drug metabolism, clinical trial.

**Pharm / S / 421** Project / Seminar 6 pds / week
Syllabus: pertaining to the syllabus covered under theory for final year

**Pharm / S / 422** Pharmaceutics Lab - VI 4 pds / week
Cosmetic preparations, Creams and gels, Shampoo, After-shave lotion, Body powder, Face powder, Face compacts, Nail polish, Nail polish remover, Lipsticks, Perfumes.

**Pharm / S / 423** Pharm. Chemistry Lab – VIII (Med Chem Lab III) 4 pds / week
Assay of various classes of drugs using modern techniques.